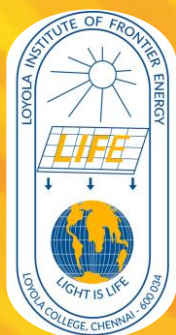


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# CONVERGENCE

**A quarterly multidisciplinary journal devoted to physical  
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## EDITORIAL

The latest IPCC report shows that with every increment of warming the world will become more and more dangerous. Beyond 1.5°C warming, we will see new risks will emerge associated with sea level rise, permafrost degradation, biodiversity loss, water scarcity, more extreme weather, food insecurity etc. The world metrological organization's 2023 "State of the Climate in Asia" report indicated that 2023 was the warmest on record around the world. The global mean near-surface temperature in 2023 was  $1.45 \pm 0.12^{\circ}\text{C}$  above the pre-industrial 1850-1900 average. 2023 was the warmest year in the 174-year observational record.



This shattered the record of the previous warmest year, 2016 at  $1.29 \pm 0.12^{\circ}\text{C}$  above the 1850-1900 average and 2020 at  $1.27 \pm 0.13^{\circ}\text{C}$ . According to Priyali Prakash, more than 2000 people died and more than nine million were affected by extreme climate change across Asia in 2023 alone. According to Celeste Saulo, Director General of World Meteorological Organisations, "The climate crisis is the defining challenge that humanity faces and is closely intertwined with the inequality crisis - as witnessed by growing food insecurity and population displacement and biodiversity loss". Climate change is affecting the frequency, intensity and geographical distribution of extreme weather events such as storms, floods, heat-waves and slow-onset events such as sea level rise, ocean acidification, loss of biodiversity and desertification. All of these result in loss and damage, both economic and non-economic. Economic loss and damage may include damage to crops, homes or infrastructure. Non-economic loss and damage may include harm to human health and mobility; loss of access to territory, of cultural heritage and of indigenous and local knowledge; and loss of and damage to biodiversity and habitats.

The scale and pace of climate change poses unprecedented challenges to humanity mitigation and adaptations are the two side of the coin of climate change. In order to act effectively against the impacts of climate change we all have to work unitedly to reduce the adverse effects of climate change - it involves reducing the flow of heat-trapping greenhouse gases into the atmosphere, either by reducing sources of these gases (for example, the burning of fossil fuels for electricity, heat or transport) or enhancing the "sinks" that accumulate and store these gases (such as the oceans, forests and soil). The goal of mitigation is to avoid significant human interference with earth's climate, "stabilize greenhouse gas levels in a timeframe sufficient to allow ecosystems to adapt naturally to climate change, ensure that food production is not threatened and to enable economic development to proceed in a sustainable manner. This mitigation has to be supplemented by effective adaptation strategies. The main goal is to reduce our risks from the harmful effects of climate change (like sea-level rise, more intense extreme weather events or food insecurity).

In order to reduce the impact of climate change both on human and on the environment we need to fight against ever increasing climate change with concerted effort by the government with effective policies and strengthening the infrastructure and empowering our communities against the climatic adversities. We need to work with diligence and our concerted efforts have to be effective. Otherwise we would be the losers on the face of climate change.

**Dr. M. Selvanayagam**

Editor-in-Chief & Director

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## CLIMATE CHANGES AND IMPACTS ON HEALTH

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### Abstract

Climate change is caused by the over-ambition and greediness of human beings. It has deteriorated with human exploiting civilization due to rapid progress in all walks of life. Today the climate change presents a-fundamental and tremendous threat to human survival. Health is one of the areas of our concerns today, as the climate change affects both our physical environment as well as all aspects of natural and human systems including social and economic conditions and the functioning of health systems. As an outcome of the climatic change, the entire environmental condition changes resulting in more frequent and intensifying weather conditions namely storms, extreme heat, floods, drought and wild fires. The above changes directly or indirectly increases the threat of premature death, non-communicable diseases, spread of infectious diseases, etc.

Climate change is also impacting human work forces and infrastructures. The climate crisis results in climate shocks and increasing the stress such as sudden variation in environmental temperature and the precipitation pattern which in turn results in drought, floods and rising sea levels and degrades the environmental and social determinants of physical and mental health. All our environmental factors have deteriorated in quality atmospheric air, water, soil to food systems and livelihoods.

According to IPCC sixth assessment report [1] the climate risks are appearing faster and will become more severe sooner than previously expected, and it will be harder to adapt with increased global heating. More than 3.6 billion people are already living in areas that are highly susceptible to climate change. Climate change is impacting health in a myriad of ways, that includes leading to death and illness from increasingly frequent extreme weather events, such as heat-waves, storms and floods, the disruption of food systems, increase in zoonosis and food-, water- and vector-borne diseases, and mental health issues. Furthermore, climate change is undermining many of the social determinants for good health, such as livelihoods, equality and access to health care and social support structures. These climate-sensitive health risks are disproportionately felt by the most vulnerable and disadvantaged, including women, children, ethnic minorities, poor communities, migrants or displaced persons, older populations, and those with underlying health conditions.

## Climate Changes and Impacts on Health

Recently, the COP28 Presidency joined with the World Health Organization and announced a new 'COP28 UAE Declaration on Climate and Health' (the Declaration) to accelerate actions to protect people's health from growing climate impacts. Declaration is announced one day ahead of the first ever Health Day at a COP and marks a world first in acknowledging the need for governments to protect communities and prepare healthcare systems to cope with climate-related health impacts such as extreme heat, air pollution and infectious diseases.

**Keywords:** Climate change, Environmental conditions, Zoonosis, Climate sensitive health risks, Livelihood, COP28

### Introduction

Climate change is a change in the world's weather systems that occurs over decades. Most of the recent changes in our climate have been brought about by human activity. Without intervention, the changing climate will have far-reaching and catastrophic consequences for the entire world. Climate change is caused by increase in the amount of greenhouse gases (such as carbon dioxide, methane and nitrous oxide) in the atmosphere, which cause the earth's average temperature to rise. Greenhouse gases trap heat in the atmosphere, raising air and sea temperatures. They are primarily produced through the burning of fossil fuels (like coal) for electricity generation, as well as through agricultural, mining, land management and transport practices.

Intergovernmental Panel on Climate Change (IPCC) [1], report shows that climate change is a grave and mounting threat to our wellbeing and a healthy planet. Our actions today will shape how people adapt and nature responds to

increasing climate risks. The world faces unavoidable multiple climate hazards over the next two decades with global warming of 1.5°C (2.7°F). Even temporarily exceeding this warming level will result in additional severe impacts, some of which will be irreversible. Risks for society will increase, including to infrastructure and low-lying coastal settlements.

To avoid mounting loss of life, biodiversity and infrastructure, ambitious, accelerated action is required to adapt to climate change, at the same time as making rapid, deep cuts in greenhouse gas emissions would be needed. Therefore the progress on adaptation is uneven and there are increasing gaps between increasing risk and action to be taken. These gaps are largest among lower-income populations.

### What is Health? / Understanding of Health

Health is a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity. According to World Health Organization [2], health is defined as a state of complete

physical, mental and social well-being. The enjoyment of the highest attainable standard of health is one of the fundamental rights of every human being without distinction of race, religion and political belief, economic or social condition. In the 5th century BC, Pindar defined health as “harmonious functioning of the organs”, emphasizing the physical dimension of health, the physical body and the overall functionality, accompanied by the feeling of comfort and absence of pain [3]. All modern concepts of health recognize health as more than the absence of disease, implying a maximum capacity of the individual for self-realization and self-fulfilment. This should equilibrate the human inner forces and possibilities with the feeling of pleasure or dissatisfaction in their relations with the environment [4]. The holistic concept of health is contained in the expression of wholeness. Health is a relative state in which one is able to function well physically, mentally, socially, and spiritually to express the full range of one’s unique potentialities within the environment in which one lives.

### **How Health is Affected**

The human health is affected due to the deterioration in the quality of various Environmental factors such as air, water, soil pollution, radiation and noise; social factors such as income, education, political and economic systems in the society,

social and cultural systems and health care services. Even though the individual health is dependent on the physical, mental, and social well-being of an individual, the external factors play very important role which include the various parameters that are independent of an individual's will and control. The state of the environment, pollutants, contaminants, and toxicants are responsible for the air we breathe, the water we drink, and the soil we come into contact with. While a clean environment like a forest area helps maintain good health, unhealthy, polluted and contaminated environment area worsens health conditions.

Vulnerability is another factor which affect one’s health condition. Some people are more vulnerable to the effects of climate change and health. The following are some examples:

- Children are more vulnerable and more susceptible to heat stress and dehydration and are more sensitive to exposure to air pollution and smoke from fires. Their immune systems are not fully developed, putting them at increased risk of infections.
- Pregnant women are at increased risk of heat stress during heatwaves due to the physiological demands of pregnancy. They and their unborn babies are particularly

sensitive to exposure to air pollution and smoke from fires.

- Senior citizens and people with pre-existing medical conditions are more prone to dehydration, heat stress, infections and exacerbation of heart and lung disease.
- People from low income group are also at increased risk, in part due to inequalities in underlying health outcomes and limited accessibility of healthcare and other services. People living in rural or remote communities or along the coast are also at risk from extreme events such as droughts, storms, floods, cyclones and sea level rises.

The health effects of climate change include respiratory and heart diseases, pest-related diseases like Lyme disease and West Nile Virus, water- and food-related illnesses, and injuries and deaths.

The Most Common Types of Respiratory Diseases include, asthma, chronic obstructive pulmonary disease (COPD), cystic fibrosis, lung cancer, tuberculosis, bronchitis and pneumonia. Climate changes poses a significant risk to cardiovascular health. Exposure to poor air quality due to particle pollution or extreme heat can increase the risk of cardiovascular events like heart attack and stroke, particularly in people already at risk for these conditions.

### **Climatic Influences on Infectious Diseases**

Changes in baseline climatic conditions, such as average daily temperatures or seasonal precipitation, can affect the developmental biology of pathogens and vectors. Increased temperatures often shorten the duration of the life cycle of parasites such as the malarial *Plasmodium* species (5, 6). On the other hand, more amounts of precipitation can create flooding and water stagnation which facilitate the formation of breeding sites for insect vectors, such as mosquitoes and other flies. Modifications in the baseline conditions of the physical and biological environment, as a consequence of climate change, can alter the so called "ecological niches" of vectors of diseases (7). This creates an ideal conditions for the build up of arthropod populations, thereby resulting in the expansion of the geographical area of distribution of the vectors, with the potential increase in the incidence and distribution of the infections they transmit .The other climatic phenomena such as the extreme hydro-meteorological events (storms, floods, droughts) can alter the dynamics of vector and pathogen populations and, also water related infectious diseases namely diarrhea, giardiasis, dysentery, typhoid fever, E. Coli infection, salmonellosis and leptospirosis, etc [8]. Droughts is another

climatic condition, which may have severe and lasting effects in poverty-stricken areas, often facilitate an increase in the incidence of infections due to poor hygiene standards resulting from water scarcity. This is often the mechanism involved in outbreaks of childhood diarrhoea and skin infections, often seen in less developed areas.

The climate change causes a number of infectious disease through three important components namely pathogens, host and transmission environment. Kovats [9], illustrate, as indicated in Fig.1, the relationships between climate change, human infectious diseases and human society.

In order to overcome the ever increasing climate change crisis, it is important to implement the two strategies namely mitigation and adaptation against increasing climate change.

### **Mitigation**

Mitigating climate change means reducing the flow of heat-trapping greenhouse gases into the atmosphere. This involves cutting greenhouse gases from main sources such as power plants, factories, cars, and farms. Forests, oceans, and soil also absorb and store these gases, and are an important part of the solution. Reducing and avoiding our emissions requires us to reshape everything we do in day to day life. The reshaping is possible only by using the

alternative sources of energy /nonconventional energy sources namely, hydroelectric energy, solar energy, geothermal energy, wind energy, nuclear energy, and biomass energy. At the same time energy should be utilized judiciously using energy at home, using less energy by reducing our heating and cooling use, switching to LED light bulbs and energy-efficient electric appliances, washing our laundry with cold water, or hanging things to dry instead of using a dryer and improving our home's energy efficiency, through better insulation. Using public transport system wherever possible and following the principles of reduce, reuse, refuse, repair and recycle. Preferring vegetarian food by consuming in terms of vegetable, fruits, grains, legumes, nuts and seeds would also reduce the carbon footprint considerably. Above all throwing away much less food, if necessary, will also enhance the reduction of carbon footprint.

### **Climate Change and Adaptations**

Climate change adaptation means critical interventions identified for enhancing the effectiveness to managing climate related health risk is to enhance the surveillance mechanism, increase public awareness on health related issues and altering our behavior, systems, and—in some cases—ways of life to protect our families, our economies, and the environment in which



we live from the impacts of climate change. A central goal of adaptation is the development of adaptive capacity without which adaptation is likely to occur. Adaptation strategies must be flexible and able to incorporate new hazard information as well as information on socio economic and environmental systems [10, 11]

### **Climate Change and Adaptation in the Health Sector**

The steady process of change in the frequency and variability of climatic events require the development of strategies to reduce the impacts of climate change upon human population health.

Although most countries have well established public policies to promote human health, many are not prepared to deal with the range of problems associated to the consequences of climate change [12]. Many countries still need to improve their capacities to formulate and implement adaptive strategies for health protection. This would imply the reduction in many determinants of vulnerability to the impacts of climate, especially in low and middle income countries. Among these are the reduction in poverty and the improvement in the quality of education, the effective control of climate-sensitive diseases and improved access to health care and sanitation services.

One general strategy for adaptation in the health sector is epidemiological

surveillance which can provide an early detection of changes in incidence, mortality and geographic range of health outcomes associated with climatic change. This would be achieved through regular reporting of specific health outcomes and routine statistical analysis of the data.

### **Adaptation for Infectious Diseases**

In order to have an effective strategy for infectious diseases, we have to prepare individuals and societies for the expected changes in the behaviour, distribution and incidence of these diseases and to reduce their vulnerability to infection.

For this, the different determinants includes, individual (behaviour); social (economics; health care) and environmental, including the climatic conditions. Therefore, adaptation measures should include actions in the health sector and also in other sectors such as meteorology (weather forecast and early warning systems), sanitation and civil defence. Strategies undertaken in these non-health sectors would both reduce the environmental risks of infection and improve the efficacy of public services for the protection of the population.

An adaptation strategy within the health sector should be focused both on primary prevention (reduction of exposure to infection) and secondary prevention (health care).

Important health adaptation actions include:

- a. Enhancement of epidemiological surveillance actions, targeted to specific territories, due to the expected expansion of the distribution of endemic infections is the emergence of diseases in new areas. This would be guided by information from climatic scenarios downscaled to specific regions and their implications in relation to disease cycles.
- b. Development of early warning systems for epidemics, especially after extreme hydro-meteorological events, such as storms and floods. Outbreaks of water-associated, water-borne and mosquito born infections are commonly reported after these events.
- c. Within the field of health systems, strategies to facilitate access to health care services would assist in early detection and treatment of infections and, thereby, potentially outbreaks. This should preferably be directed to the more vulnerable populations and territories.
- d. Important adaptation actions are also those focused on specific disease and vector control programs, including entomological surveillance. The goal of these

actions would be a reduction of the risk of infection, through the reduction of the populations of pathogens, vectors and animal reservoirs of infection [13].

The strategies mentioned above are based on the assumption that the epidemiological changes resulting from climatic change are – and will be - an exacerbation of already known infectious diseases, as well as of other health outcomes [14]. The intensification of disease transmission and/or their expansion to new areas due to climate shifts are expected, but not the emergence of unknown diseases, since disease emergence is usually linked to a host of factors other than climatic events. Adaptation strategies will be successful only when there is a willingness to adapt among those affected, as well as a degree of consensus regarding what types of actions are appropriate.

Adaptive capacity, therefore, depends on the ability of a society to act collectively, and to resolve conflicts between its members -factors that are heavily influenced by governance [15]

In relation to adaptation strategies in non-health sectors that will have an impact in the reduction of infectious disease incidence, those linked to improved sanitation (clean water supplies, garbage collection, sewage treatment and disposal) are important measures for the reduction of

environmental contamination by microbial pathogens. On the other hand, the sanitation infrastructure under climatic change run the risk of damage due extreme weather (eg. storms followed by floods) and also due to impacts in coastal cities caused by sea level rise.

Meteorological services are highly relevant for the development of early warning systems to protect the population from the impacts of extreme weather events and their health impacts. These systems would guide interventions by civil defence agents help to increase the resilience of communities affected by disasters and reduce their exposure to infection.

### **Safeguarding and Strengthening Nature is Key to Securing a Liveable Future**

There are options to adapt to a changing climate. The IPCC report provides new insights into nature's potential not only to reduce climate risks but also to improve people's lives.

What we know based on the IPCC reports 2023:[1]

- It is unequivocal that human influence has warmed the atmosphere, ocean and land. Widespread and rapid changes in the atmosphere, ocean, cryosphere and biosphere have occurred.
- The scale of recent changes across the climate system as a whole – and the present state of many

aspects of the climate system – are unprecedented over many centuries to many thousands of years.

- Approximately 3.3 to 3.6 billion people live in contexts that are highly vulnerable to climate change.
- Vulnerability of ecosystems and people to climate change differs substantially among and within regions.
- If global warming transiently exceeds 1.5°C in the coming decades or later, then many human and natural systems will face additional severe risks, compared to remaining below 1.5°C.

According to Hans-Otto Pörtner. IPCC Working Group II Co-Chair “By restoring degraded ecosystems and effectively and equitably conserving 30 to 50 per cent of Earth's land, freshwater and ocean habitats, society can benefit from nature's capacity to absorb and store carbon, and we can accelerate progress towards sustainable development, but adequate finance and political support are essential”[16].

Scientists point out that climate change interacts with global trends such as unsustainable use of natural resources, growing urbanization, social inequalities, losses and damages from extreme events and a pandemic, jeopardizing future

development. **“Our assessment clearly shows that tackling all these different challenges involves everyone”**- governments, the private sector, civil society - working together to prioritize risk reduction, as well as equity and justice, in decision-making and investments.

### **IPCC Sixth Assessment Report**

According to the Synthesis Report of the IPCC’s Sixth Assessment Report (1), there are multiple, feasible, and effective options to reduce greenhouse gas emissions and adapt to human-caused climate change, and they are available now. The IPCC proposes adopting a “climate-resilient development” that involves integrating measures to adapt to climate change with actions to reduce or avoid greenhouse gas emissions in ways that provide wider benefits.

For instance, access to clean energy and technologies can improve health, especially for women and children. Low-carbon electrification, walking, cycling, and public transport can enhance air quality, improve health, employment opportunities, and deliver equity. Economic benefits for people’s health from air quality improvements alone would be roughly the same, or possibly even larger than the costs of reducing or avoiding emissions.

To be effective, these choices need to be rooted in our diverse values, worldviews,

and knowledges, including scientific knowledge, indigenous knowledge, and local knowledge. This approach will facilitate climate-resilient development and allow locally appropriate, socially acceptable solutions.

### **What is Resilience?**

The term gained importance among national governments in 2005 with the adoption of The Hyogo Framework for Action by 168 members of the United Nations to ensure that reducing risks to disasters and building resilience to disasters become priorities for governments and local communities[17]. Otherwise, it is the ability to prepare and plan for, absorb, recover from, or more successfully adapt to actual or potential adverse events.

### **Climate Resilience**

The National Academy of Sciences defines resilience as, “the ability to prepare and plan for, absorb, recover from, and more successfully adapt to adverse events [18]. The current U.S. government definition states, the climate Resilience is the capacity to cope or how well people or ecosystems are prepared to bounce back from certain climate hazards like floods, droughts, epidemics. The building of climate resilience is a highly comprehensive undertaking that involves individuals, community, organisations and the government agencies both National

and International level. Otherwise it is enhancing the adaptive capacity of social, industrial and environmental infrastructure that can mitigate the effect of climate change[19]. The IPCC Sixth Assessment Report defines climate resilience as follows: "Resilience is defined as the capacity of social, economic and ecosystems to cope with a hazardous event or trend or disturbance, responding or reorganising in ways that maintain their essential function, identity and structure as well as biodiversity in case of ecosystems while also maintaining the capacity for adaptation, learning and transformation"[1].

### **To Increase the Climate Resilience**

The following specific objectives are envisioned to reduce the impacts of climate change on human health, in order to minimise risks and to enhance adaptation measures:

1. To raise public awareness about climate change and its effect on health;
2. To generate evidences on the health effects of climate change at national and Regional level through continuous research and studies;
3. To reduce morbidity and mortality of infectious diseases (vector, water, air and food-borne diseases) and malnutrition attributed to climate change;
4. Introduce and deliver courses on climate change and its effects on health in school

and University curriculum.

5. Conduct National/International level researches on climate change and health related subjects and disseminate the same through publication and advertisement as research reports and articles.
6. Develop online database of climate change and health related data and findings of the research.
7. Expand surveillance of vector, water, food-borne and air borne diseases throughout the country and scale up programmes as per the need to control these diseases.
8. Development of early warning system at least in each district level to protect human health from climate induced diseases and risks.

### **Conclusion**

The need of the hour is to create the climate resilient communities. Climate resilience is about successfully coping with and managing the impacts of climate change while preventing those impacts from growing worse. A climate resilient society would be low-carbon and equipped to deal with the realities of a warmer world. The only one real way to achieve the climate resilience is to cut the heat-trapping emissions that drive climate change while adapting to the changes that are unavoidable. Only by pursuing

mitigation and adaptation in tandem, we can achieve and sustain climate resilience. If we work hard on both these fronts, keeping climate justice front and centre, we can build a climate resilient society that is low carbon, equipped to deal with the realities of a warmer world, and works to safeguard the well-being of all. Building climate resilience should be a core ambition of climate activists and policymakers.

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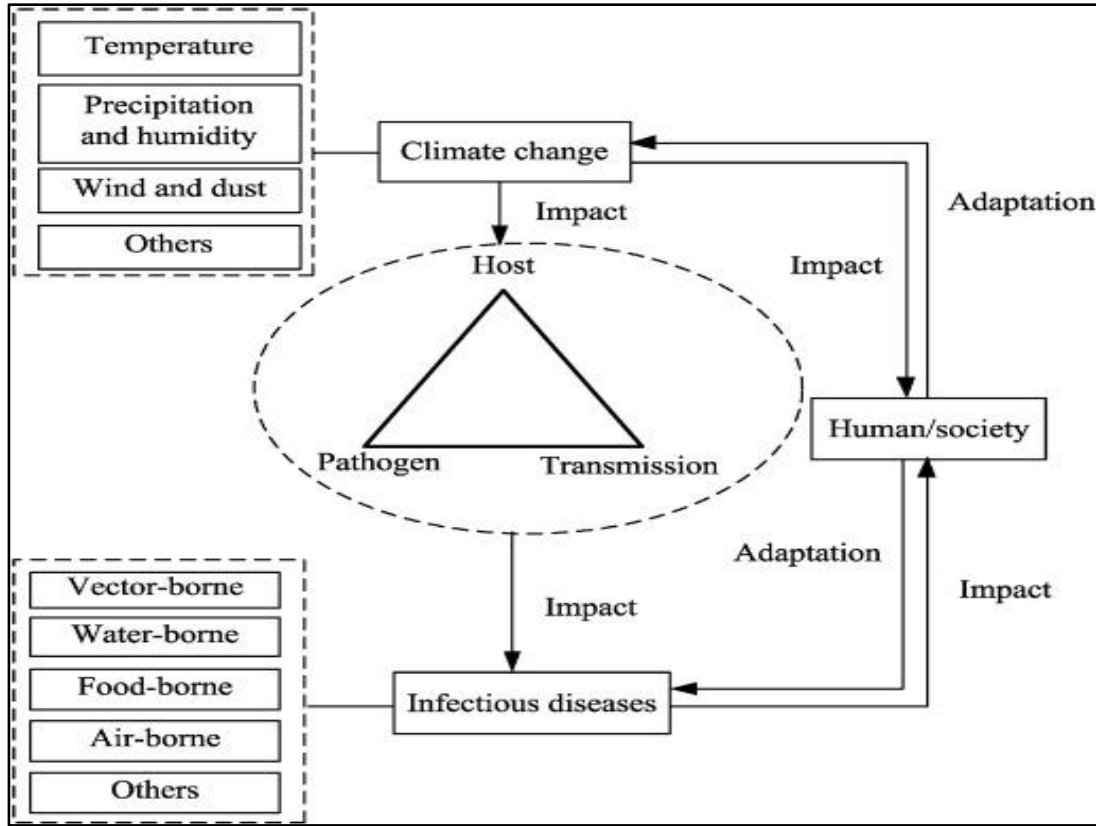


Figure 1. Climate change, human infectious disease and human society

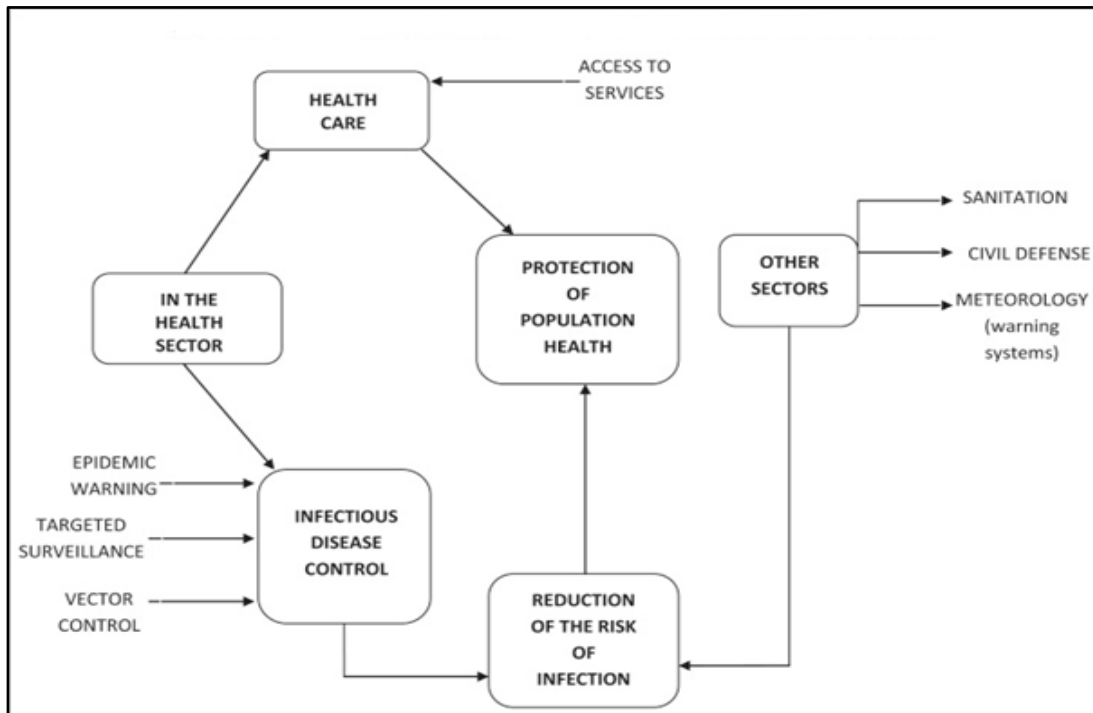


Figure 2. Adaptation strategies for Infectious Diseases in relation to Climate Change



**CORROSION AND ITS ERADICATION: WHAT WE LEARN FROM THE NATURE****Francis P Xavier SJ<sup>1\*</sup> and S. John Mary<sup>2</sup>**<sup>1</sup>Program Director, Dr. Ambedkar Cultural Academy (DACA), Madurai - 22.<sup>2</sup>Assistant Professor of Chemistry, Corrosion Science and Nanotechnology Research Centre, Loyola Institute of Frontier Energy (LIFE), Loyola College (Autonomous) Chennai - 34.**\*Corresponding Author Email:** *francisx@gmail.com***Abstract**

Corrosion is a threat that faces our life through materials we use and environment we live in and that are much affected by our industrial and technological advancement. While searching for various methods and techniques to minimize or eliminate corrosion, we could look up to our mother nature that has been tolerant, self-sustaining, and self-healing. We could also think of new sophisticated and cost-effective materials and methods in our research, with effective collaboration with industries, to address the growing and ever threatening phenomenon of corrosion especially affecting our health. This could begin from designing of equipment and materials used for technological applications. And finally, we also feel our responsibility to address the social responsibility and the way of mending the social ailment would be ethical values in all walks of life.

**Keywords:** Corrosion, Corrosion-free Materials, Designing of Equipment, Medical Application.

**Introduction**

Nature is self-sustaining or self-healing and self-balancing. There is no greediness in nature. But human limitless greediness and hasty tendency for quick-results or instant-successes have corroded our life and nature. As a consequence nature, unable to counter-balance the destructive activities of humans, has been deteriorating. Corrosion, we observe, is just an indication of this down the hill death knell of nature. Human beings have been created or evolved as the apex of all creation; and human beings have been

entrusted with the sacred duty of steward or care taker of the created beings. But human beings, instead, have today over-exploited nature and we seem to be on the path of no-return with regard to the survival of life on this planet. All the same, we could still learn a few lessons from nature how to survive and if possible, to recover at least a part of destruction already caused to nature and living beings. In addition to deterioration of natural resources we are also facing catastrophic equipment failures. Air pollution, caused by sulfur dioxide generated by power plant

and vehicle emissions (500 to 600 ppm in the exhaust), threatens quality life and prolonged survival as well. In addition, carbon dioxide, dust, humidity adds to pollution causing corrosion to ecology. Corrosion can cause damages to communication or data transfer process and facilities. Sulfur dioxide is particularly aggressive towards copper contacts used in electronic equipment. Additional contaminants would include hydrogen sulfide generated by waste materials, dioxide from combustion processes, hydrochloric acid, chlorine, acetic acid etc add to the pollutants that corrodes the environment [1].

### **Taking Clues from Nature**

Through the process of evolution, nature has developed fascinating adaptability to inimical and adverse external environments. We can look up to nature to learn how she manages to heal herself from the onslaught of corrosion attacks. Rough surfaces at the micro, nano and even atomic scales effectively block corrosive substances from sticking to the plants. M. Cui *et al* observe three distinct processes, namely, liquid repellent passive surface, coatings to control ion transport control of [2] corrosive substance, and interfacial adhesion:

i. Lotus leaf, for example, develops super-hydrophobicity through air-pockets trapped in the rough substance of the

surface. This surface barrier blocks and removes unwanted salts; ii. the control of ions and liquid transport within natural organism is more spectacular: Cactus, for example, is capable of harvesting and storing liquid, then, through guard cells, has the ability to opening up under high humidity whereas closing under low humidity; and iii. creating anticorrosion coatings, as natural adhesive surfaces, helps certain species such the frog to move around both in dry as well as wet surroundings.

Nature resorts to physical changes which is temporary modification. In contrast, our so called advancement or development has created chemical changes which is permanent deformation.

### **Corrosion Prevention Methods**

Most of the corrosion problems arise from corroding metals. As rust, as the main form of corrosion, could ruin the accuracy and functioning of instruments, the following methods could be contemplated as methods on cost and effectiveness in preventing [3] corrosion:

i. Multiple Barrier Coating: This is very economic. Surface painting using epoxy, nylon, and urethane, adhere well when used as thin films over the metal surface. In addition, plastic and waxes could be sprayed onto the metal surface. This paint coating protects the metal from electrochemical charges originating from

corrosive compounds. Multiple layers of painting is lasting much longer: the primary coating acts as inhibitor, the intermediate coating adds strengths to the thin film's thickness, and the finish coating provides resistance to environmental corroding factors.

ii. Hot-Dip Galvanization: Dipping the steel in molten zinc creates a tightly bonding alloy which serves as corrosion-protection. This method is much recommended especially to preserve artistic sculptures.

iii. Stainless/Alloyed Steel: Use of stainless steel could be most effective corrosion prevention agent, adding strength as well as resistance. For example, corrosion-resistant nickel combined with oxidation-resistant chromium becomes an alloy that can be used in oxidized and reduced chemical environments. Various alloy-combination that provide resistance to varying conditions could further be studied.

iv. Cathodic Protection: This is an electrochemical method. The active space on the metal surface could be converted into passive sites by providing electrons from another source, with galvanic anodes attached on or near the surface. Metals such as aluminium, magnesium or zinc could be used for anodes.

v. Econ Coat: This is an economic and relatively innovative as well as cost-

effective way to protect equipment from corrosion. A thick layer of inhibitors coated over the surface of the alloys prevents toxic chemicals. This is very environmentally friendly and much effective and long-lasting to protect equipment.

As corrosion, in general, is due to oxidation, choice could be made of rust-proof or corrosion-proof materials, such as stainless steel (with relatively high content of chromium), aluminum metal, copper, bronze, or brass, and galvanized steel (Eg. Carbon steel coated with a thin layer of zinc) [4]. Corrosion-resistant metals could be widely used for culinary to aerospace applications as these materials provide not only structural strength as well as are heat resistant, but also they resist corrosion better than other metals. The degree of corrosion resistance much depends on the elemental makeup of the alloy. And the specific chemical resistance varies with the metals chemistry as well. The key mechanism with regard to corrosion resistance in stainless steel is the formation of a chromium oxide layer. Stainless steel comes in three main categories based on its microstructure as austenitic stainless steel (with 18% chromium and 8% of nickel with a small amount of nitrogen and manganese), martensitic stainless steel (with no nickel but a higher concentration of carbon making it tougher than other

corrosion-resistant metals), and ferritic stainless steel (with higher concentration of chromium, up to 27%, to boost the resilience but with a lower concentration of carbon to make it more ductile). The super-alloy category, such as nickel super-alloy, cobalt super-alloy, iron super-alloy are economic. Copper alloys (bronze and brass) could be also good players to resist corrosion [5].

Each method has minor practical disadvantages but further research could explore the possibility of reducing these limitations. This is a potential area where research institutions could work in close collaboration with industries on application oriented and cost-effective projects.

### **Hybrid Method**

Material we choose for corrosion protection should be strong on corrosion, but gentle on nature, that is, it should be environmental friendly. Bio-based coatings, which are biodegradable, provide more economic solutions. Biocorr HP and University of Zagreb have come up with emulsion of stability with no chemicals. This has added advantage as it uses various polarization techniques such as displacement of water and oil from metal surface, cost effective, odour free and forms an invisible dry-to-touch film thereby creating a clean workplace as well as preventing material waste. Titanium is

widely used in the aerospace industry due to its strength to weight ratio. It has the unique resistance to chlorine solutions and hence it is widely used especially in chloralkali industry [6]. This might be a boon with regard to acid rain.

### **Corrosion and Medical Applications**

Corrosion in medical application needs much study and research. *In vitro* medical devices and implants such as stents, clips, valves, dental implants, and joint replacement components might face degradation in course of time. Biologic interaction with metallic implants needs attention and study [7]. Recent research focuses on development of composite materials for implant applications which will mimic the nature at the atomic level. Though ceramics, alumina, zirconia, bioactive glass, fused quartz etc are tempting corrosion-resistant candidates, they have their own drawbacks and minor risks. We know only little about human physiology and its interactions with the foreign body, which is complex and complicated, there is need for in-depth study and extensive research. One possibility is developing a simulator to measure corrosion in the simulated body condition to study and understand the interaction taking place at the atomic level between the surface of the implant, the host and the biological environment to

obtain insight for longer period of sustaining corrosion-resistance [8].

Another area of corrosion resistance in medical application is sterilization of medical equipment. Among the usual methods of sterilization, ethylene oxide sterilization and gamma sterilization are coming up with better promise. Though ethylene oxide is an effective sterilizing agent, at certain levels, it might induce cancer. Also it is found that ethylene oxide kills microorganisms through prolonged exposure. Similarly, gamma sterilization is very popular but it might destroy the DNA of any live microbes [9].

This is another area where the science-researcher could work with medical industry to optimize corrosion-resistance with minimal disadvantage or risk.

#### **Equipment Design to Reduce Corrosion**

In order to minimize or avoid harsh corrosive parameters due to dust, wind, rain, salt and snow, the design of equipment could be contemplated to reduce corrosion especially when an equipment requires continuous operation. After choosing a suitable material, using the same or similar material throughout an equipment would avoid galvanic corrosion. Other recommendations are: minimizing surface temperature difference in an equipment exposed to extremely high/low temperatures; avoiding the concentration of stress on certain parts of

the equipment; and avoiding contact with other corrosive parts or equipment would minimize metal corrosion. In addition, protection mechanism could be considered: Cathodic protection of applying a stable direct current through a protective metal compensates the delocalized electrons and pushes the corrosive electronic potential to the negative polarity where the oxidizing rate is relatively slower. On the other hand, the anodic protection method makes occurrence of corrosion at the positive polarity, while protecting the component at the negative counterpart [10].

#### **More Research**

Researchers need to have a wider horizon of concept for practical application, through collaborative and interdisciplinary research in the areas of causes of corrosion, environment, types of corrosion, materials used, design details, cost-effectiveness, and betterment of health. Study should include water, oxygen, carbon dioxide, hydrogen sulfide, acids, bacteria in a given context in order to come up with effective solution to corrosion. And research should take into account factors that increase the rate of corrosion such as temperature, pH, humidity, chlorides (*eg.* Saltwater), dirt, debris, abrasion etc. Understanding the factors that contribute to corrosion, careful selection of material that are corrosion

resistant, designing equipment with effective corrosion protection etc would pay the desired dividend of optimum and reliable solution [11].

### Conclusion

Corrosion is a phenomenon that degenerates the state of goodness or usefulness. It is normally physical and environmental; but we should also think of social, religious, and political values that get corroded. As research institutes we work to address corrosion to minimize and if possible to eliminate. At the same time, as institutions we need to look into enriching society we live in, especially eliminating degrading ethical values through fundamentalism and divisive forces. In a world of demand for liberty and freedom, as people in formative education we should bring in social responsibility, because we are all interconnected. As H. Sumin says: "The air I inhale enters my body and becomes part of me. The air that I exhale moves into someone else and becomes part of (him)/her. Just by looking at how the air moves, we realize we are all connected to one another, not just figuratively but also literally [12].

In the world arena, in many countries, democracy is falling a prey to or degraded by, as M. Naim says in *The Revenge of Power* (2022), *Populism, Polarization, and Post-Truth* we need to find anti-dote to

this rising phenomenon [13]. E. Filer says we need to work with another triad, ABC of meaning, in research and life, namely, *Agency - Belonging - Cause*. Every lab or institution is the *Agency* that promotes on the one hand autonomy, freedom, creativity, mastery; but at the same time it demands one's responsibility for the betterment of the world to be healed of social, religious, and political corruptions. This is because we are built-in with the sense of *Belonging* to the society we live in through relationships, friends, family and environment that surround and nurture us. So we have the *Cause* as researchers and educators which is our call, mission, direction that transcend our individual commitment converging as collective dedication [14]. What J. Collins admonishes to the Corporate Companies could be applied to our study and research. Our research projects should grow from Good-to-Great, instead getting entangled with the race of comparison with other research institutes or projects [15]. More than the success in our research, we should be clear about the purpose of our research and the meaning that would give to the society we live with and live in and live for.

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## CORROSION AND COLLECTIVE JOURNEY OF THE GLOBE: PROACTIVE PROTECTION

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### Abstract

New technologies assessment for surface preparation before coating should include methods on the feasibility of using microwave technology for surface preparation, hand-held x-ray fluorescence system to detect salts on the surface, and a project to improve the dissemination and clarity of information on allowable surface chlorides. Improvement of application equipment to facilitate applying high solid coatings in the field to inaccessible areas. A project investigating the effects of minor variations in surface preparation and effects of variation in composition of surface contamination, including mill scale, on long-term coatings performance is necessary. A project on secondary surface preparation criteria/ Standards needs to be established. The cost of surface preparation and coating application for underwater hull areas is going up and the designs of coating technology for this area has not kept pace.

**Keywords:** Exploitation, Climate Change, Environment, Species, Deforestation, Pollution.

### Where are We?

### Status of Our Environment:

Environment might be one of the most important treasures entrusted to us, but human beings do end up treating it recklessly. We have exploited it to the maximum and now the environment is reacting through natural disasters, water shortage, air pollution etc. Other outcomes of environment exploitation are complex diseases, ever increasing child-mortality, hunger, and poverty. In order to raise awareness about protecting our environment, which is our Mother Nature, every year June 5 is celebrated as World Environment Day

designated by the United Nations. The day also reminds and enables us to be more responsible in the way we conduct ourselves and treat the environment with respect and reverence [1].

India is the global host in 2018 and the theme is 'Beat Plastic Pollution'. It started in 1974 and since then the day has provided a global platform for like-minded people to reach out to each other. One million plastic bottles are purchased every minute. In Kenya, Africa plastic bags are banned – Before alighting the flight, announcement is made not to take any plastic bags with you. And you do not see plastic bags scattered around in Kenya [2].



Each year 1.7 million deaths of children under 5 years old are linked to the present environmental situation. According to the Intergovernmental Panel on Climate Change, "*warming in the Arctic, as indicated by daily maximum and minimum temperatures, has been as great as in any other part of the world.*" The period of 1995–2005 was the warmest decade in the Arctic since at least the 17th century, with temperatures 2°C (3.6°F) above the 1951–1990 average. Some regions within the Arctic have warmed up even more rapidly, with Alaska and western Canada's temperature rising by 3 to 4°C (5.40 to 7.20°F). This warming has been caused not only by the rise in greenhouse gas concentration, but also the deposition of carbon soot on Arctic ice [3]. Mount Kilimanjaro, the highest free standing mountain in Tanzania (5,895 meter-altitude), has lost over 85% of its glacial ice since 1912. 26% of the ice that remained in 2000 was gone by 2007. UN experts predict that the glaciers of Kilimanjaro would melt by 2050 due to climate change.

In addition, environment encounters with degradation caused by corrosion that would result in plant shutdowns, waste of valuable resources, loss or contamination of products as well as their efficiency making maintenance costly. Corrosion can also jeopardize safety and inhibit technological progress.

### **Indian Context**

The environment of India comprises some of the world's most bio-diverse eco-zones. The Deccan Traps, Western Ghats, Gangetic Plains, and the Himalayas are the major geographical features. The country faces different forms of pollution as its major environmental issue and is more vulnerable to the effects of climate change being a developing nation.

There are 350 species of mammals, 375 reptiles, 130 amphibians, 20,000 insects, 19,000 fishes and 1,200 species of birds in India. The Asiatic lion, Bengal tiger and leopard are the main predators; our country has the most species of cats than any other. Elephants, the Indian Rhinoceros and eight species of deer are also found.

Further, there are over 17,000 species of flowering plants in India, which account for six percent of the total plant species in the world. India comprises seven percent of world's flora. Wide range of climatic conditions in India gave rise to rich variety of flora. India covers more than 45,000 species of flora, out of which several are endemic to the region [4].

Although India still has low average income per person, the country is now the third largest emitter of greenhouse gases, after China and the USA. Greenhouse gas emissions, for example, produced by the steel industry could rise up to about 27.5 percent of the world's total carbon emissions by

2020, resulting in corroded steel of about 4 to 9 percent. At this rate, extinction is final and irreversible - We are killing off the species on which we completely depend for our own existence. Pope Francis urgently asks us to attend to an Integral Ecology in his encyclical *Laudato Si'* (2015). He says that “*the exploitation of the planet has already exceeded acceptable limits*”.

- He points out: “*Consumerism has led us to become accustomed to the superfluous and the daily waste of food, which we are sometimes no longer able to value correctly, as its value goes far beyond mere economic parameters*”.
- He challenges every human being: “*What kind of world do we want to leave to those who come after us, to children who are growing up? The question not only concerns the environment in isolation; the issue cannot be approached piecemeal*”.

### **What Needs to Be Done?**

Today we have 7.5 billion people on the planet and we are growing at an unprecedented and unsustainable rate of 225,000 new people per day, heading for 9 to 10 billion by 2050. We have experienced this alarming population explosion in just the last 100 years of the entire 2.8 million year history of humans on earth [5].

This, compounded with our increasing ability to use energy and other resources through technological developments, and our

unstoppable desire for material riches, has driven us to exceed nature’s natural checks and balances by a long shot, and the biosphere, which supports us, is greatly suffering as a result. We humans are clearly overwhelming the earth; our deforestation, relentless development of wetlands and grasslands, and extensive and unsustainable agricultural practices are crowding our whole ecosystems and driving species to extinction at an unprecedented rate.

Our use of fossil fuels is changing the climate. Consumerism is flooding the planet with accumulated waste, and also with new, potentially harmful materials. All this is transforming the Earth into an unlivable habitat for all of the species in the biosphere, including ourselves. Our domination of Creation and modification of earth and its atmosphere have defined a new epoch; since WWII we have single handedly modified the earth and its systems to such a degree that we are now in a new geologic period [6].

We cannot continue to pollute our air, water and soil causing corrosion, and exterminate the biosphere and at the same time expect to be able to survive on this planet. We are completely and utterly dependent on the goods and services that are bequeathed to us by the biological diversity on this planet. In addition to providing 100 percent of our food and over 80 percent of the world’s medicines, the forests, grasslands and oceans grace us with the oxygen we breathe,

consume our bodily wastes, regulate the water cycle and stabilize the climate.

Entire ecosystems continue to be plowed down, species are driven to extinction to make way for our kind, and our common atmospheric, geologic and oceanic resources have become open dumping ground for our toxic industrial waste [7]. The poor and the indigenous continue to be exploited and left behind with smaller pieces of the pie.

### **Think Globally and Act Locally**

Our indigenous peoples are demonstrating varieties of adaptation and mitigation strategies across Asia. These successful cases are often based on the use of their traditional knowledge, innovations and practices with minimal support from outside. The success in their adaptation and mitigation strategies is contributing to the survival of their cultural identities, sustainable use and management of natural resources and ecosystem restoration.

To counter the disappearance of medicinal plants that is found in the forest areas, some communities have started ex-situ conservation in their backyards or in community gardens guided by indigenous healers in countries like Nepal, Malaysia and Vietnam. Some of this knowledge are documented and taught in community schools for knowledge transmission. Many indigenous communities in Asia have enhanced their food preservation and storage methods such as drying or smoking the food items [8]. The indigenous knowledge offers

new models for development that are both ecologically and socially sound.

### **Action Plan**

We need to act and act here and now. Here are a few suggestions from the Task Force on ‘Environment and Economic Justice’ of International Association of Jesuit Universities:

- Teaching environmental and economic justice across the curriculum is needed. Not a single student should be graduating from our universities without a high degree of ethical, environmental and economic literacy.
- Conducting community-based research and action, with a global perspective should be carried out. Students could be engaged in this plan so that they can put to work what they learned, and practice what they should do in their professional lives. There is need to create in them a global mindset and a desire to address large-scale challenges.
- Collaborating with our Social Centers in service and advocacy is highly recommended. Our Universities could provide answers to the social and environmental issues posed by our social centers, and work together with them in implementing them. Working together we can empower and educate women and impoverished communities, enabling the stabilization of the human population

with this education, collaboration and outreach.

- Building a Campus Sustainability Ethic through living out Laudato Si' is the need of the hour. Demonstrating love of each other and care for our common home is needed. We must embrace the practice of reduce, reuse, recycle, and share the wealth while also sharing the pain, poverty and pollution.
- Developing networks of faculty research and curricular resources toward strengthening those impactful areas of learning and action is a must. For example, some universities/colleges might have expertise in sustainable agriculture, while another might have a center on water conservation, or excel at community organizing, international law, or environmental science.
- In concrete, the Enviro-Club could practice a couple of concrete proposals:
  1. You could promote the use of cloth bags over plastics. If we do not change, nobody or nothing will change;
  2. You could use the rainwater as well as waste-water from RO plants or from water-purifiers for watering the plants in your kitchen gardens;
  3. You could be careful not to waste food. If no food is wasted, no one needs to go hungry; and

4. You could plant trees in the campus, in the neighbourhood, and in the city for a better environment.

Finally, everything is inter-connected. Every action, decision, and purchase we make has a ripple effect both upstream in the supply chain, and downstream in the consumer or waste stream. The overall goal of Laudato Si' is to help all of us recognize the urgent need to become integral ecologists; to live as people who dare to imagine a healed Earth; and to be people who are ready to put their hands, hearts, and minds to the task of taking care of our environment as we are making a collective journey in this globe, which is our home [9].

#### **Proactive Protection of Environment from Corrosion**

Corrosion plays a major role in the degradation of environment. By regulating the environment, we could prevent or reduce the rate of corrosion. By reducing intense and prolonged exposure of environment to moisture and normalizing oxygen, sulfur, or chlorine levels in the environment around metal surfaces could delay environment degradation.

Cf. Updated from Enviro-Club Inaugural Address at Loyola College (Chennai)-06Aug2018.

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## SUSTAINABLE BETRAYAL: MNCS' EXPLOITATION OF INDIGENOUS LANDS AS A THREAT TO BIODIVERSITY AND ECOLOGICAL HARMONY

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### Background

Dalit rage brought down the Gujarat model and exposed it for what it is – a sickening upper caste pro-corporate policy framework. Discontent is simmering in tribal villages. Sometimes, it bursts out in sporadic protest. The power of their anger may not be as visible as those of comparatively more organized communities of the oppressed. Nevertheless, do not be surprised if the next significant upsurge comes from within Adivasi communities. The government is playing with fire [1].

- Brinda Karat

**Keywords:** Harmony, Exploitation, Lands, Threat, Biodiversity, Ecological.

### Introduction

The land has been an integral part of human life since ancient times. Every being on earth depends on land, but the importance one attaches to it varies from person-to-person community to community and culture to culture. As we have seen, land has social, political, economic, and religious significance for the Indigenous peoples of central and northern India. The land is a gift from God and the foundation of life itself. Therefore, the inheritance of land ensures the survival, continuity, and flourishing of the Adivasi community. They believe that

land does not belong to them; instead, they belong to the land. They have learned how to use the land sustainably without causing any permanent damage to it. They have always known the difference between their “needs” and “wants,” a distinction that often eludes people of more “advanced” cultures. This raises a conflict between “us,” the urbanized mass, and “them,” the deprived and marginalized segments of society. The possession of land also manifests the community's life with God. Therefore, uprooting Indigenous peoples from their

land on the part of the extraction industries in the name of “*development*” is an unethical and sinful practice [2]. Such dislocation causes unemployment, poverty, homelessness, and psychological stress and violates the human rights of the indigenous peoples at multiple levels. In addition, people are uprooted from their faith, culture, and the traditions of their ancestors. Such uprooting also breeds violence, religious intolerance, and societal unrest as the oppressed turn against society's powerful and dominant elite business class seeking justice. This clash has taken a new and dangerous turn in recent years with the unprecedented rise in the number of Multi-National Corporations (MNCs) operating in tribal areas [3]. In this article, we analyze the issue of displacement induced by the MNCs through the lens of rights-based ethics, which advocates for the protection of the rights of Indigenous peoples and other vulnerable people, all of whom cry out for the most basic of all human needs—a place to be at home—to flourish in the land.

### **The Cosmic Vision of Liberation**

The struggle of the Indigenous peoples to protect their lands against the MNCs is an old story, but it has sought renewed attention in the last two decades. It has unmasked multiple problems, such as the political

strategy of cultural, social, and religious genocide of Indigenous peoples. The displacement of the Indigenous peoples from their land also appears to be a political game of the Modi government, which plans to uproot the indigenous peoples from Indian soil to establish *Ram Rajya* (the kingdom of Lord Rama). The pragmatic approach to globalized development is a dangerous churning pathway because it destroys ecological biodiversity, harms the earth, and creates a tremendous political, economic, and ecological chasm. It brings about social and cultural exclusion and increases inequalities and environmental crises. The flavour of the churning pathway of development will be bitter. Undoubtedly, India is one of the fastest-growing economies in the world but is on a pathway that will lead it to the genocide of a rich Adivasi culture and the trampling of their fundamental human rights. The cry of Indigenous peoples for rootedness is the cry of the earth. This article analyzes how the tribal unrest in central India has taken on violent means (Maoist insurgency) of protest against globalized development.

This article draws primarily on the socio-political and anthropological studies of others to analyze the Indigenous people's historical reality rather than on our empirical

observations or experiences among the Indigenous peoples. At the same time, we write knowing the government of India's war against ecology and its indigenous population, spurred on by MNCs and their false economic development promises.

Indian politicians repeatedly say we must grow more to reduce or eradicate poverty. The metaphor is that the cake must get bigger for people to have a larger share, especially the poorest. However, the beneficiaries are not the poorest but the rich and the Elite business class. Recently, the Indian media did a complete analysis of the benefits of 25 years of economic liberalization. Sadly, Tribals, Dalits, and an ever-increasing number of the working poor were just footnotes in the entire discourse. However, their plight is becoming more desperate and more visible. India's present growth model is driving not only its economic paradigm but also the paradigm of how society should approach sustainable forms of eco-economics. It is generating non-sustainability, inequality, and profound violence within society. Our remarkable pluralism of cultures is being reduced to uniformity. The dominant culture is fast swallowing up a wide variety of other traditions. Vandana Shiva shines a light on the advent of an industrial uprising, showing

how the "shadowboxing" of the political agenda poses a severe threat to a sustainable culture [4].

Shiva presents two metaphors, the "Sacred Cow" and the "Sacred Car," to represent two competing cultures. The "Sacred Cow" represents biodiversity and sustainable culture, and the "Sacred Car" is a non-sustainable, fossil-fuel industrial culture. Shiva also shows how the Sacred Car triumphs over the Sacred Cow culture, uprooting local communities from their land and depriving them of their right to life and sustenance. Land acquisition also leads to human rights violations at multiple levels, such as the right to education, health care, job opportunities, and other basic needs such as food, clothing, and shelter. This exploration begins by recognizing a profound existential crisis in the tribal belt despite the empowerment policies of the government. Considering anthropological, cultural, and existential consequences on the displaced Indigenous peoples, this article underscores reasons for tribal resistance. It illustrates radical ecological democracy as an alternative path to inclusive and sustainable development that protects indigenous rights and their land.

**Indigenous Land Alienation and Displacement**



## Exploitation of Indigenous Lands

India is the largest country in South Asia, covering an area of 3,288 thousand square kilometres, with a population of 1.23 billion (World *et al.*, 2002). India accounts for 2.42% of the total world area. Nearly 35% of Indian households live below the poverty line (BPL) and are deprived of basic amenities [5]. Due to inadequate irrigation facilities, inefficient cropping patterns, lack of an appropriate distribution system of seeds and fertilizers, low levels of mechanization, natural calamities, and outdated agrarian policies, agriculture contributes only 27.4% of the GDP. The marked disparities of landholding in a society not only yield economic, social, political, and cultural disabilities but also result in poor access to health care services, education, and the rural power structure.

In land grabbing, the poor indigenous have been most affected by their acute poverty, supernatural beliefs, and limited development opportunities. However, conversely, indigenous peoples have always been easy prey to moneylenders, traders, and exploiters due to their innocence and honesty [6]. N. K. Behura and Nilakantha Panigrahi think that opening the indigenous area to the non-tribals, industrialists, mining corporations, and the state to develop a tribal economy has resulted in large-scale land

alienation from tribal land to non-tribals. The Indigenous peoples are uprooted from their ancient land due to their inability to discharge the loan liabilities incurred or due to policy inadequacies, which failed to protect Indigenous land rights [7]. However, according to John Mundu, who belongs to one of the indigenous communities, we see a different rhetoric of land alienation. According to Mundu, the Adivasi reality has been a saga of land alienation, exploitation, displacement, and migration [8]. Although Adivasi land alienation began during the medieval period and intensified during the British regime, it has accelerated since the year of independence. With the economic liberalization of the 1990s, vast industrial estates and Special Economic Zones are rising, and with them, land sharks gobble up land.

The British introduced the Zamindari System to collect revenue, worsening the oppression of the Indigenous peoples. The long exploitation and oppression of the indigenous and poor resulted in rebellions, one after the other. There have been a few notable movements, such as the Chota Nagpur Tribal Revolt (1807-08), Munda Rebellion (1832, 1867-80), Santal Rebellion (1885-86), Rampha Rebellion (1879-90) and Madri Kalo Revolt (1898) to challenge the

British Rule in India. All these movements pressured the state to protect and promote the land rights of the poor indigenous people and lower-caste peasants. In response to these and other Adivasi uprisings, there have been several legislative attempts to check the land alienation of the Indigenous peoples: the Chotanagpur Tenancy Act (1908), the Central Provinces Land Alienation Act (1916), the Bihar Tenancy Act (1885), Bombay Land Revenue Code (section 73A), and the Santal Pargana Tenancy Act (1949). These protective laws gave the lower castes a distinct identity and awakened the government to recognize these disadvantaged groups' rights and undertake measures to remove social injustice and exploitation. According to these laws, the Adivasi ancestral land cannot be sold or transferred to a non-Adivasi.

Similarly, specific articles of the Indian Constitution are devoted exclusively to the cause of the tribal people: Articles 244, 244A, 275(1), 342, 338(A), and 339. These provisions aim at ensuring social, economic, and political equity for tribal people. The provision of the Fifth Schedule enshrined under Article 244 of the Indian Constitution, for example, protects the interest of the Indigenous peoples regarding land alienation. Moreover, under this article, the

Governor is empowered to repeal any Act enforced by the Parliament or the Legislative Assemblies merely through the public notice that the law is unsuitable for the Scheduled Area to have a retrospective effect hundred and twelve blocks of Jharkhand in 14 districts identified as Scheduled Areas [9]. These have been the original home of the Indigenous peoples through the centuries.

More recently, two more laws have been promulgated to protect the interests of the tribal people: the Panchayat Raj Extension to Scheduled Areas (PESA) Act 1996 and the Forest Right Act 2006 [10]. PESA makes the community, the collective, a legal entity and confers the right to self-governance on tribal societies who live in Scheduled Areas. The prime objectives of these legislations are the protection of Adivasi land, traditional self-governance, and culture.

However, the government adopted the Western industrialization model since independence, and displacement escalated in central India. The Chotanagpur Tenancy Act was amended in 1947 for urbanization, industrialization, and development projects. The country's first Prime Minister, Jawaharlal Nehru's policy of setting up mega projects relating to industry, dams,

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etc., as the temples of modern India have left tens of thousands of Indigenous peoples displaced. Human rights activist Gladson Dungdung contends that Nehru is not only the architect of modern India but also the architect of the Adivasi misery [11]. The Adivasi land alienation and displacement are spoken of as “sacrifice” for “national interest” and “the greater common goods” [12]. Several government-owned projects like Damodar Valley Corporation, Bokaro Steel (1950), the Heavy Engineering Corporation, Uranium Corporation of India Ltd. Mines, the Koel Karo Project (1955), the Patratu Thermal Plant (1960), and several coal mining projects began in Chotanagpur. All these projects were launched with the aim of proper rehabilitation and compensation, but the story is different. According to one study, the total land acquired in the name of development projects between 1951 and 1995 is 6,258.895 sq. km. of land out of the total area of Jharkhand of 79,714,000 sq. km [13]. Although an official database for persons displaced or affected by projects is not available, Alex Ekka estimates the number of people displaced during this period to be as much as 15,503,017, of which 41% belong to the Adivasi community. Moreover, only a third of the

displaced persons of planned development have been resettled. As a result, the entire Adivasi population is threatened by land alienation and displacement today.

Within a decade of its creation in 2000, the Jharkhand government signed 104 Memoranda of Understanding (MoUs) with different corporate houses [14]. Similarly, Chhattisgarh, Odisha, and West Bengal signed a series of MoUs with corporate houses. For the MoUs to translate into real money, tribal people must be moved. Nevertheless, as we saw, to forcefully acquire tribal land and turn it over to private mining corporations is illegal and unconstitutional under the PESA. Hence, the state had to find a pretext to acquire the lands legally [15]. This land acquisition violates the fundamental right to life with dignity inscribed in Article 21 of the Indian Constitution [16].

Consequently, in 2009, the government of India announced what it called Operation Green Hunt, deploying 200,000 paramilitary troops across central Indian states—the homeland to millions of India’s tribal people and dreamland to the corporate world—against the poorest, hungriest, and most malnourished people in the world [17]. It was euphemistically called “creating a good investment climate.” The government

argued that development activities could not occur in areas infested by Maoist Naxalites until they were cleansed. The Maoists (most of them tribals) were considered “India’s gravest internal security threat.” Slain Maoists were displayed like hunters’ trophies, with their wrists and ankles lashed to bamboo poles.

This paramilitary campaign throughout the tribal region is touted as a “war against terrorism” against the Communist Party of India (CPI). However, Dungdung has argued that the war is not against terrorism but against the Indigenous peoples. He writes:

[T]his is not a war against terrorism, the so-called Naxalite insurgency by the CPI-Maoists, but a war against the Indigenous peoples. The hidden goal is to snatch their resources, i.e., lands, forests, water, and hills. The war is fundamental, a war for control over the mineral resources. It threatens the security of all the ordinary people in the Red Corridor and is wrecking their peaceful existence, good governance, development, and prosperity [18].

In the process, Dungdung concludes, innocent Indigenous peoples are killed, women are sexually exploited, villagers are tortured, youth are forced to migrate from their villages, children are denied their right to education, development activities are

blocked, and the entire region is terrorized by both state and non-State actors [19]. Branding all the democratic movements as Naxal movements, the state suppresses them. The government and MNCs suppress dissenting voices. Consequently, the Indigenous peoples continue to lose their land, territory, lives, and livelihood. The Indigenous peoples’ recent history is an *Unbroken History of Broken Promises* [20]. The Expert Committee Report 2008, commissioned by the Planning Commission, concluded that the development paradigm in the region had benefitted the dominant segments of society at the expense of people with low incomes, causing displacement and reducing them to a sub-human existence. The report also affirmed that this development model destroyed tribal social organization, cultural identity, and resource base and generated multiple conflicts, undermining their communal solidarity and cumulatively making them increasingly vulnerable to exploitation [21]. The 2008 Expert Committee Report also talked of “increased corrupt practices of a rent-seeking bureaucracy and rapacious exploitation by the contractors, middlemen, traders and the greedy sections of the larger society intent on grabbing their resources and violating their dignity” [22].

The Indian State has been promoting crony capitalism in tribal areas rather than enforcing the people's rights and entitlements. Scholars have, therefore, argued that the Jharkhand state was created based on political bargains between India's political elite business class business class, based on opportunism and expediency, rather than a long history of struggles from within the state [23]. The Jharkhand government of the day is trying to amend the Chotanagpur Tenancy Act and the Santhal Pargana Tenancy Act to facilitate the acquisition of agricultural lands for non-agricultural purposes like building roads and setting up power projects [24]. Jharkhand tribals are fighting against these amendments for their survival.

### **Shadowboxing the Climate Crisis**

Every politician in India repeatedly tells Indians that they must have more growth to reduce or eradicate poverty. The metaphor is that the cake must get bigger for people to have a larger share, especially the poorest. However, the actual beneficiaries are not the poorest; they are the wealthy and the elite business class. Recently, the Indian media analyzed the benefits of 25 years of economic liberalization [25]. Sadly, tribals, Dalits, and an ever-increasing number of the working poor were mere footnotes in the

entire discourse. Unsurprisingly, their reactions to such injustice are also becoming increasingly defiant. The present growth model is driving not only our economic paradigm but also the paradigm of how society should approach sustainable forms of eco-economics. It is generating non-sustainability, inequality, and profound violence within society. India's fantastic pluralism of cultures is being reduced to uniformity.

The dominant culture seems to fast swallow the little traditions [26]. Shiva elucidates the mushrooming number of MNCs, showing how the shadowboxing of the political agenda poses a severe threat to a sustainable culture. Shiva presents two metaphors, the "Sacred Cow" and the "Sacred Car," to represent two competing cultures. The "Sacred Cow" represents poly-culture—biodiversity and a sustainable culture; and the "Sacred Car" monoculture—a non-sustainable, fossil-fuel, industrial culture. Shiva also shows how the Sacred Car triumphs over the Sacred Cow culture, uprooting local communities from their land and depriving them of their right to life and sustenance. Land acquisition has violated human rights at multiple levels, including the right to education, health care, job opportunities, and other basic food, clothing,

and shelter needs. Metaphorically, they protect and worship the "Sacred Car" over the "Sacred Cow." Moreover, it is intriguing to see how the elite business class worships the "Sacred Cow" in literal terms and has resorted to slaughtering them when money and wealth are involved [27].

### **The Protection of the “Sacred Car” over the “Sacred Cow”**

It is deeply troubling that the present governing party—the *Bharatiya Janata Party* (BJP) in the Democratic Republic of India—consists principally of Elite businesses, who are influenced by fundamentalist Hindutva ideology, which claims that Elite business class belongs to the governing class (though at one time they styled themselves as *Bhudevas* (Gods of Earth)) [28]. They claim that their sacred law of humanity is not only to serve the interests of their class but also to safeguard the interests of all, including the earth, and never to pollute the environment. They pretend to protect the Sacred Cow over the Sacred Car [29]. From ancient times, there was an attitude that the person of the Brahmin was sacred and could not be hanged regardless of the offense. As a sacred person, the Brahmin had immunities and privileges that were denied the servile classes (untouchables). The elite business class was entitled to the first fruits of the

earth [30]. History also shows that the Elite business had other classes as their allies who worked for them in subordinate cooperation. The servile classes were (and continue to be) treated as contemptible people who must never aspire to rule. Generally, the elite business class had alliances with the *Kshatriyas* or the warrior class. These two classes ruled and ground people down—the elite business class with their pens and the *Kshatriyas* with their swords.

### **The Reign of the Free Riders**

At present, the elite business class has allied with the *Vaishyas*. The *Vaishyas* are commonly known as *Banias*. They deal with money transactions and many different commercial enterprises nationally and globally. It is not an exaggeration to say that in commerce, money is more important than the sword and can buy anything. At present, the *Banias*, also termed “free-riders” [31], are the industrialists, the multinational corporations, Monsanto India Limited (MIL) and other agribusinesses, the mining companies, such as Adani, Ratan, TATA, Mittal, Jindal, Ambani brothers, and other private local companies, all of whom who raise funds for the political campaigns of the Modi government. Brahmin ideology and the Modi government have developed cordial alliances with the *Banias* to reap

enormous profits for themselves. Earlier, the elite business relationship was strong with the *Kshatriyas*, but now, there is an exciting shift in relational dynamics [32]. The paradigm has shifted to a *Brahmin-Bania* alliance rather than a *Brahmin-Kshatriya* alliance [33].

We know from our experience that the outlook, traditions, and social philosophy of Brahmin ideologies breed social exclusion and inequality among different classes, disarm the lower classes, prohibit their education, prevent them from occupying places of power and authority, and prevent them from acquiring property. The Brahmin ideology also subjugates and oppresses women and children. The tendency and ideology of Brahmin dominion extend to nature, as they treat land as a marginal entity. Stephen M. Gardiner calls this ideology "dangerous anthropogenic interference with the climate system" [34]. Cynthia Moe-Lobeda, climate justice, and political ethicist, sees these problems as structural evils that violate Indian society. She raises deep theological, anthropological, and sociological questions regarding how these ideologies blindfold the moral agent from seeing the moral vision. She would unmask the Brahmin ideology of an anthropocentric and non-egalitarian

approach of treating natural resources as marginal entities. She argues that economic inequality devalues the human person and impedes life-furthering developments. Anthropocentrism and dominion become evil practices that cause structural violence and keep the community from a deeper understanding of how economic injustice relates to ecological injustice [35]. This structural violence caused by the elite business class and upper castes has given rise to many forms of resistance, notably Maoist insurgency in the tribal areas.

### **A Violent Cultural Resistance of the Comrades-indigenous**

The rise of the Maoist insurgency, fomented by the tribals of central India—particularly those of Baster in Chhattisgarh against the present government—has been perceived by the upper castes as an anti-nationalist movement. However, it is a resistance movement to save lives and ecology [35]. This resistance is against the pernicious growth projects proposed by the industrialists, corporations, and mining companies on behalf of the Indian government, which are destructive of life on all levels and do not adhere to the UN index of growth [36]. The government does not yet have creative answers except for the militarization of the state. Consequently, in

2009, the government of India announced what it called *Operation Green Hunt*, deploying twenty million paramilitary troops across central Indian states—homeland to millions of India’s tribal people and dreamland of the corporate world—against the poorest, hungriest, and most malnourished people in the world [37]. It was called “creating a good investment climate.” The government argued that development activities cannot take place in Naxal-infested areas without cleansing the Maoists. The Maoists (most of them tribals) were "India's gravest internal security threat." Slain Maoists (and other non-political Adivasis) were displayed like hunters' trophies, with their wrists and ankles lashed to bamboo poles. It was declared a "war against terrorism [38].”

### **Vitiating the Imago Dei**

Through these death-dealing activities, the Brahman culture vitiates the reality of the image of God within the human person (*imago dei*). It denies the presence of the divine in creation, which spawns and supports life with complexity and generosity. The fundamental claim of the Christian faith is that creation is “good” and is “life-furthering” [39]. Even recent scientific inquiry proves that the earth is the only body in our solar system and the only

body we know in the universe that generates the capacity to produce and further life. Hinduism and Buddhism share a common vision of life lived within the great cosmic wheel of *samsara*, and both agree that the fundamental problem of life is an illusion rooted in selfish desire. Therefore, selfish desire becomes the quintessential root cause of inequality and the destruction of life [40]. Inequality is the official doctrine of Brahmin ideology and the free riders on which both operate to subject and suppress the lower classes. Brahmin ideologies monopolize education and declare that the acquisition of education by the lower classes is a crime punishable by cutting off the tongue or by the pouring of molten lead in the ear of the offender [41]. These many forms of abject inhumanity have become part and parcel of the Brahmin culture. Their greed and exploitive political motives have reflected their agenda of profit and development solely of the urban and metropolitan cities such as Delhi, Mumbai, Calcutta, and Chennai.

The adherence to Brahmin ideology plunders the natural resources from the indigenous states of central and north India and exports them to places overseas. Thus, the indigenous land becomes barren and unproductive. Over a while, the government



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declared such barren land as "Special Economic Zones" (SEZs) and launched a mega project, for example, of manufacturing cheap cars that worsen carbon emissions [42]. This example demonstrates how land is objectified as a fungible commodity that produces not food but cars for the middle and upper classes. They exploit land as they would have exploited a woman of the lower classes of Indian society for their self-gratification. In general, the land is treated in the same way by such elite business classes as the *Kshatriyas* (who are now primarily disenfranchised), the *Sudhras*, the untouchables, and indigenous peoples are treated. They are often treated as parasites, which are thought to prosper during an epidemic [43]. The undertakers of the earth, such as farmers and indigenous peoples living in villages near forests, are viewed as evil. The caretakers of the land become as foreign as Germans are to the French, as the Jews are to the Gentiles, or as Blacks are to Whites. There is a chasm between ecological stewardship and Brahmin ideology. The ideals of justice, solidarity, and freedom have vanished. Therefore, enslavement remains the only option: the Brahmin enslaves the mind, and the *Bania* enslaves the earth.

However, the essentials of Hinduism, according to Vinayak Damodar Savarkar, who was a "born Socialist" and a "born Warrior," are "a common nation (*rashtra*), a common race (*jati*), and a common civilization (*culture*)" [44]. Ideally, Hinduism (*Hindutwa*) can thus be a binding force for all Indians irrespective of their religion, caste, or creed. The holistic worldview of Hinduism is organic, with the potential to generate cosmic visions of charity, hospitality, love of neighbor, and an ecological conversion in which humans become protectors and tillers of the earth [45]. Raimon Panikkar called this spiritual energy the "Cosmo theandric intuition" [46]. The eminent leftist Indian historian Dr. K.N. Panikkar asserted that Savarkar's *six glorious epochs of Indian history* are essential in awakening the spirit of unity and nationalism among Indians. He further elucidated that the Hindus led a liberation war to free their nation from the shackles of foreign domination [46]. The six epochs are *Chanakya-Chandragupta*, *Pushyamitra*, *Vikramaditya*, *Yashodharma*, the *Marathas*, and the period when Hindus freed India from British dominion. Today, however, Hindu fundamentalism has misappropriated Hindu unity and its spirit of nationalism for its political agenda, spreading its deficient

form of nationalism everywhere in India. The various frontal organizations that form part of the Hindutva forces are known as *Sangh Parivar*, which comprises the VHP (*Vishwa et al.*), BJP (*Bhartiya Janta Party*), BD (*Bajrang Dal*), and ABVP (*Akhil et al.*) factions. India needs a cultural transition and ecological conversion to what Joanna Macy calls "mindfulness and interdependence" so that the "Sacred" or "Holy" is encountered both within and outside of one's ethnicity, political party, community, and religion [47]. Since human beings flourish in unity, they must strive to integrate their minds and hearts to seek common ground.

### **Radical Ecological Democracy**

The pervasive nature of the "development" ideology makes any alternative vision rather tricky. Radical Ecological Democracy (RED) necessitates a considerable paradigm shift in governance, in which all citizens have the right and full opportunity to participate in decisions impacting their lives, and where such decision-making is based on the twin principle of ecological sustainability and human equity [48]. RED encounters considerable resistance from current political and corporate power centers.

The dominant economic development model is thus perilous. A business-as-usual

approach resonates with the behavior of the proverbial fool, "cutting the very branch on which he sits." We may recall the words of Rabindranath Tagore in his long-neglected essay written in 1922, "The Robbery of the Soil":

Most of us who try to deal with the problem of poverty think only of a more intensive production effort. We forget that it brings about a greater exhaustion of material and humanity. It gives a few excessive opportunities for profit at the cost of many. Food nourishes, not money; the fullness of life makes one happy, not the fullness of a purse. Multiplying material wealth alone intensifies the inequality between those who have and those who have not. It inflicts a deep wound on the social system, and the whole body dies [49].

Therefore, Aseem Shrivastava and Ashish Kothari argue for a radical transformation in development policies, priorities, and attitudes. They advocate "radical ecological democracy" as a sustainable and equitable alternative [50]. This framework arises from the numerous grassroots initiatives that have sprung up in India. This new paradigm affirms direct democracy, local and regional economies, cultural diversity, human well-being, and ecological resilience. Critiquing "the dominant values of competitiveness and

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aggression, greed and covetousness,” which are typical of a prosperous industrial economy, this framework upholds values of “cooperation, compassion, integrity, simplicity, responsibility, equity and loyalty” [51]. Thus, Shrivastava and Kothari offer RED, a fundamental transformation of development policies, priorities, and attitudes for the Indian context, to re-structure the caste system. This framework arises from the numerous grassroots initiatives that have sprung up in India. This new paradigm affirms direct democracy, local and regional economies, cultural diversity, human well-being, and ecological resilience.

Consumerism has struck deep into the heart of middle-class India. Money is the new deity worshipped by the rich. Advocacy of a RED paradigm will face the enormous challenge of overcoming the resistance of entrenched institutions and mindsets. Acceptance of this paradigm entails the spread of the core values underlying the framework. They are tribal values. Adivasi society, as we argued above, is based on collectivism, equality, autonomy, and indigenous democracy, not a profit ethos [52]. Traditionally, they have practiced radical ecological democracy by resisting destructive projects that have caused

impoverishment, landlessness, homelessness, joblessness, food insecurity, increased morbidity, and mortality. In addition, they have shown that even small communities, if united, can match the influence of some of the world's most powerful corporations [53]. Their values thus stand in sharp contrast to the “pride” of the caste and the “greed” of consumerism, which largely determine the social oppression and economic exploitation that define the brutal reality of Indian society today. Cultivating these values is essential if Indian society is to be renewed. Values that are essential for our survival of life are those of caring and sharing, not domination and manipulation. The pattern of domination and exploitation can lead to the silencing of nature and the ecological death of both nature and humans. The new perspective affirms our interrelatedness to one another and nature. The scale of values essential for sustaining the interrelatedness and wholeness of creation differs from the dominant value system of modern society. These values are conservation, not consumerism; need, not greed; enabling power, not dominating power; integrity of creation, not exploitation of nature. Through the centuries, the Indigenous peoples have developed a traditional culture that has

helped them view their life support system as a community resource inherited from their ancestors to be judiciously used and preserved for posterity. Their traditional culture is community-based. Its basic principles are equity, conservation, and proper use of natural resources, which we now term “sustainable development” [54].

### **Conclusion**

Seventy years of the planned economy have not benefitted all the citizens of India at the same level. Instead, it has elevated some to the peak of riches and sunk others, namely, the Indigenous peoples, into the pool of poverty and misery. Industrialization is promoted as the only way to develop. The Indian State sees development and military action as the solution to the violence. In truth, injustice, denial, dispossession, displacement, and violation of indigenous rights are some foundations of tribal unrest in central India.

Authentic development is about enhancing human freedoms and quality of life and furthering sustainable growth. Indeed, essential components of human freedom and crucial aspects of our quality of life depend on the integrity of the environment, involving the air we breathe, the water we drink, the food we consume, and the epidemiological surroundings in which we

live. The capacity to live the kinds of lives we value and have reason to value depends, at the most primal level, on the nature and robustness of the environment. Hence, the Indigenous peoples are battling daily to protect forests, mountains, and rivers because they know that these natural resources protect the Indigenous peoples. Maintaining rapid and environmentally sustainable growth remains an important and achievable goal for India. At the heart of this vision lies a profound reverence for nature that sustains life and connects us all as living beings.

Now, at the dawn of the twenty-first century, Indians are becoming conscious that human activity, whether economic, political, or social, also has ecological consequences. It is not just a matter of sharing the natural resources of Mother Earth. It is also a matter of preserving the environment, making it possible to survive on this planet. If we continue to destroy the planet’s atmosphere at the present rate, it will not be long before we destroy humankind itself. We are facing a national and global crisis. The solution lies not just in economic, political, or technological instruments but, above all, in the moral and spiritual rejuvenation of Indian society, which should acknowledge its corporate

responsibility for the state where we find ourselves and seek a resolution to pull back from the brink of disaster.

This will involve adopting RED, which nurtures tribal values. Renunciation is the key. Greed is identified as the source of ecological problems, and adopting a simple lifestyle is the way to suppress it. Hinduism and Buddhism share a vision of life as lived within the great cosmic wheel of *samsara*, and both proclaim that the fundamental problem of life is an illusion rooted in selfish desire. Indeed, there is truth in the statement that selfish desire divides and separates one being from another. In modern India, the fundamental human problems of old age, sickness, and death are compounded by globalized development and urbanization. Greed and violence result in massive human rights violations under the pretext of economic development and security.

Living in harmony with nature and keeping their needs to a minimum, the Adivasi communities proclaim that the earth is the Lord's. Thus, it should not be used indiscriminately to satisfy human avarice. They register a powerful protest against a wasteful lifestyle devoid of any sense of responsibility to the world of nature. They send a strong message to the Western world,

criticizing their throw-away culture and showing that radical ecological democracy is an alternative path to inclusive and sustainable development. This path becomes an alternative vehicle of liberation that safeguards land and protects indigenous rights, treating even the poorest as global citizens who have equal dignity and privileges. How ironic that those whom Indian society considers the most "backward" may show us the way forward to true and lasting. We can also draw upon the Christian tradition to ground a land ethic.

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empowering tribal societies to preserve and conserve their traditional rights over natural resources. All the states with scheduled areas within their geographical boundaries were mandated to amend their existing Panchayat Raj acts incorporating provisions of PESA within a year, that is, by December 24, 1997. Of this, the State of Chhattisgarh added new provisions in its Panchayati Raj Act to enable the effective implementation of the PESA Act 1996. For further details, see

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## URBAN FORESTRY AND CLIMATE CHANGE MITIGATION

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### Abstract

Climate change is likely to impact all the natural ecosystems as well as socio-economic systems as per the National Communications Report of India to the UNFCCC. India has become the third emitter of GHGs after USA and China though its per capita carbon emissions average one-twentieth of the USA. The concentration of carbon dioxide, which was 280 Parts Per Million (ppm) two centuries ago has grown up to 430 ppm now and may reach 550 ppm by 2035. Sectoral distribution shows that the highest CO<sub>2</sub> emission contribution is from the energy sector (61%). The impact of global warming due to anthropogenic climate change can only be minimized through two pronged strategies, viz. adaptation and mitigation. The adaptation strategies include improving energy efficiency in energy, industry and transport sectors which contribute to global warming substantially. In climate change context, forests act as sink by sequestering carbon dioxide. The tropical rain forests of Congo of West Africa, Amazon basin of South America and Western Ghats of India serve as earth's gigantic carbon sinks. Globally, forests are the single largest source of mitigation of climate change and have been described as a "large and persistent" carbon sink with an estimated size of 2.4 Giga tonnes of Carbon (Gt C)/year. The annual increase of Carbon sequestration of Indian forests at 138 million tonnes of CO<sub>2</sub> is only modest compared to the strides being made by China at 301.23 million tonnes of CO<sub>2</sub>. India has undertaken eight missions including Green India Mission to combat climate change.

**Keywords:** Greenhouse, Economic, Forestry, Households, Survey, Urban heat.

### Introduction

In this context, Cities are major contributors to climate change as these areas concentrate economic activities of households, industries and infrastructure which are the hotspots for energy consumption as well as key sources

of emission of greenhouse gases. At the same time, cities are highly vulnerable to climate. More than half of the Global population now lives in urban areas comprising about 3percent of the Earth. Mega cities are on the rise [1]. There are

currently 47 such megacities around the globe each housing more than 10 million residents. According to a study by the Care Earth Trust, The population of Chennai almost doubled between 1981 and 2011 growing from 4.6 to 8.7million. The built-up area in Chennai increased from 47 Sq Km to 402 Sq km between 1980 and 2010 while the area under wetlands decreased from 186 Km<sup>2</sup> to 71 km<sup>2</sup>. Urban Forestry is a type of tree management involving ornamental horticulture, landscape architecture and park management and must be done in concert with the city managers. Urban forestry is central to delivering better health and ecosystem services to the people living in cities and provide number of benefits that include reduction of urban heat Island effect, pollution Control, water quality improvement and flood control. It provides essential habitat for urban wildlife especially avifauna in an ecosystem affected by land use changes [2].

### **Urban Heat Island Effect**

\*Formerly Principal Chief Conservator of Forests and Director of Environment, Government of Tamil Nadu. Advisor, Care Earth Trust, Chennai. *Email: balajisrinivasagopalan@gmail.com*) The narrow streets in Chennai block midnight sky for re-radiation and

reduce the cooling rates. The current urban heat Island effect will be exacerbated by predicted climate change. Urban forestry is beneficial in that it reduces high temperature. In Frankfurt, green belts reduce the temperature by 3.5°C through evapotranspiration compared with that of its City Centre. Trees also help in modifying temperature extremes; the shade of one large tree may reduce the temperature of a given building to the same extent as that of 15 air conditioners; energy savings through tree planting around houses ranges from 10 to 15% for cooling and from 4 to 22% for heating [3]. Trees with Complex broad and hairy leaves tend to capture more particles than others. Over 85% pollution in a park and up to 70 % in a street can be filtered out with trees A study conducted in Coimbatore indicate that broad leaved *Hibiscus tiliaceous*, *Bauhinia variegata* and *Sapindus emarginatus* are effective in dust clearing capacity while *Azadirachta indica* trees are effective in reducing lead content in the dust. These trees also attenuate noise pollution of 5 dB.

### **Megacity Trees Survey**

Theodore Endreny and his team of State University of New York's College of Environmental Science and Forestry surveyed 35 mega cities and calculated the

sum of all annual services provided by megacity trees had a median value of \$967000 per Sq Km of tree cover (Table -1) [4].

### **Ecosystem Service Valuation**

Large scale planned urban forestry is necessary to enhance urban sustainability. Beijing City implemented the one million - Mu (666 Sq Km) afforestation project between 2012 and 2015 planting over 50 million trees leading to 10% increase of overall forest cover. Chicago Metropolitan Agency for Planning (CMAP) USA began to incorporate a spatial planning tool called the Green Infrastructure Vision (GIV) into its regional planning and in its technical assistance to the local municipalities [5]. CMAP began to fund incremental improvements in the GIV, including better GIS and modelling capabilities and addition of ecosystem service valuation (<https://www.cmap.illinois.gov>).

### **Ecologically Sustainability**

*Urban forestry suffers from inadequate funding, low priority, lack of adequate land and lack of suitable organisation with skill (DN Tewary 1994)* The green cover in Chandigarh is 35.7 percent. While that of Delhi is about 20%. The per capita green cover in Chandigarh is 55 M<sup>2</sup> while that of Delhi is 21 m<sup>2</sup>. Mumbai, Bangalore and

Hyderabad city are having more green cover compared to Chennai which has about per capita green cover at 9.5M<sup>2</sup>.

Urban areas occupy 4% of the world's land area and are estimated to have less than 10 billion trees belonging to over 100 species now [6]. There is a potential to have 121 billion trees, if planted at global average tree density. In view of increasing population and staggering increase in built up area there is need to preserve the existing green-spaces besides wholehearted effort to undertake urban forestry to combat climate change. Let us think globally but act locally and resolve to make our cities green and ecologically sustainable.

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S. No.	Item	Cost Saving of Tree Cover in US \$	Unit
1	Air pollution Health care cost	930000	per Sq km
2	Capturing water run off	20000	per Sq km
3	Saving in building energy heating and cooling	478000	per Sq km
4	Carbon sequestration	17000	per Sq km

**Table 1. Cost savings by urban tree cover (Theodore Endreny, 2018)**

## ANALYZING RENEWABLE ENERGY IN CITIES: IMPACTS ON THE CLIMATE CRISIS

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**Abstract:** As the global community grapples with the challenges posed by the escalating climate crisis, the adoption of renewable energy sources has emerged as a pivotal strategy for mitigating environmental degradation. This research paper delves into the specific context of renewable energy implementation within urban settings and examines its potential impacts on mitigating the climate crisis. Through a comprehensive analysis of case studies, data, and existing literature, this paper aims to shed light on the effectiveness of renewable energy initiatives in cities and their role in addressing the broader climate challenge.

**Keywords:** Renewable Energy, Climate, Environment.

### 1. Introduction

Renewable energy sources have emerged as crucial components in the global effort to transition towards sustainable and environmentally friendly energy systems. Unlike conventional fossil fuels, renewable energy harnesses resources that are naturally replenished, offering a cleaner and more sustainable alternative [1-4].

The types of renewable energy show in Figure 1.



**Figure 1. Types of Renewable Energy**

#### a) Solar Energy

Solar energy, derived from the sun, is a plentiful and eco-friendly renewable resource. Photovoltaic and solar thermal technologies harness it, but challenges like intermittency, storage, and installation costs persist, limiting widespread adoption.

**b) Wind Energy**

Wind energy utilizes moving air masses to generate electricity through turbines in onshore and offshore wind farms, offering sustainability and low emissions. Challenges include intermittent wind patterns and visual impact.

**c) Hydropower**

Hydropower generates electricity from flowing water, employing dams and run-of-river systems for reliability. Environmental debates arise due to ecosystem disruption and social impacts despite its efficiency.

**d) Biomass**

Biomass energy transforms organic materials into biofuels or heat/electricity, considered renewable with sustainable practices. Challenges involve land use, emissions, and sustainable harvesting.

**e) Geothermal Energy**

Geothermal energy harnesses Earth's internal heat for electricity or heating/cooling, offering reliability and low emissions. Challenges include limited distribution and subsurface environmental impacts.

**f) Tidal and Wave Energy**

Tidal and wave energy harness ocean tides and waves for electricity, providing high density and

predictability. Challenges include harsh marine conditions and deployment limitations.

**2. Renewable Energy Policies and Initiatives in Cities in India**

India, with its rapidly growing urban population and increasing energy demands, has recognized the importance of renewable energy in mitigating climate change and ensuring sustainable development. The Figure 2. Shows the Energy Policies and Initiatives in Cities in India. Cities play a central role in the country's transition towards clean energy, and various policies and initiatives have been implemented to promote the adoption of renewable energy sources.

This section explores key renewable energy policies and initiatives in cities across India.



**Figure 2. Energy Policies and Initiatives in Cities in India**

**a) National Solar Mission**

The National Solar Mission, initiated in 2010, focuses on advancing solar energy in India, with cities leading through initiatives like rooftop installations, solar parks, and

incentives for residential and commercial projects, aligning with ambitious national targets.

**b) *Smart Cities Mission***

The 2015-launched Smart Cities Mission in India emphasizes sustainable urban development, with many cities integrating renewable energy solutions like solar lighting, energy-efficient buildings, and smart grid technologies for optimized energy use.

**c) *State-Level Renewable Energy Policies***

Various Indian states, such as Karnataka and Gujarat, have implemented distinct renewable energy policies, with cities playing a vital role in achieving regional targets. Pioneering projects in wind and solar energy have been initiated within these states.

**d) *Municipal Solar Rooftop Programs***

Cities in India, including Delhi, Mumbai, and Pune, have initiated municipal solar rooftop programs, offering incentives and simplified procedures to promote widespread adoption of solar panels on rooftops among citizens and businesses.

**e) *Green Building Norms***

Certain cities promote sustainable construction by adopting green building norms that incentivize

integrating renewable energy technologies like solar water heaters and rooftop solar panels into new constructions, fostering a more sustainable urban infrastructure.

**f) *Energy Efficiency Programs***

Indian cities actively pursue energy efficiency, upgrading to LED lighting, incorporating technologies in municipal buildings, and promoting conservation practices, aligning with renewable energy initiatives to reduce overall consumption.

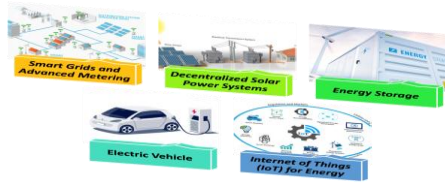
While significant progress has been made, challenges persist, including financing constraints, regulatory hurdles, and the need for greater public awareness [5-8]. Cities can explore opportunities for public-private partnerships, leverage international collaborations, and enhance community engagement to overcome these challenges.

**3. Technological Advances in Urban Renewable Energy in India**

India's commitment to sustainable development has spurred significant technological advancements in the field of urban renewable energy. The technological advances in renewable energy is shown in Figure 4. With a rapidly growing urban population and increasing energy demands, cities across India are at the forefront of adopting innovative technologies to harness clean and sustainable energy sources. This section



explores some notable technological advances in urban renewable energy in India.



**Figure 4. Technological Advances in Urban Renewable Energy**

**a) *Smart Grids and Advanced Metering Infrastructure (AMI)***

Smart grids, like those in Bengaluru and Pune, optimize urban renewable energy distribution. Advanced Metering Infrastructure enables real-time monitoring, enhancing demand-side management and grid efficiency

**b) *Decentralized Solar Power Systems***

Decentralized solar power, seen in Delhi and Chennai, gains prominence with rooftop installations and mini-grids, aided by efficiency improvements, cost reductions, and innovative financing. Enhancing grid resilience, reducing losses.

**c) *Energy Storage Solutions***

The integration of energy storage solutions has become a key technological advancement in urban renewable energy. Battery storage systems facilitate the efficient utilization of intermittent renewable sources, such as solar and wind. Cities like Mumbai and Hyderabad are

exploring large-scale energy storage projects to enhance grid stability, enable peak-load management, and ensure a consistent power supply.

**d) *Wind Turbine Technology***

Advancements in wind turbine technology have led to more efficient and cost-effective wind power generation. Cities located in regions with favorable wind conditions, such as Chennai and Coimbatore, have embraced modern wind turbine designs, including taller towers and larger rotor diameters, to harness higher wind speeds and increase energy yield.

**e) *Internet of Things (IoT) for Energy Management***

The Internet of Things (IoT) is being leveraged for real-time monitoring and management of renewable energy systems in urban areas. IoT-enabled sensors and devices collect data on energy production, consumption patterns, and equipment performance. Cities like Ahmedabad and Kolkata are exploring IoT applications for optimizing energy use in municipal buildings, street lighting, and public spaces.

**f) *Waste-to-Energy Technologies***

Several cities in India are adopting innovative waste-to-energy technologies to convert organic waste

into biogas or electricity. Advanced anaerobic digestion and gasification technologies are being deployed to treat organic waste efficiently. Cities like Pune and Indore are pioneering waste-to-energy projects that contribute to both waste management and clean energy generation.

**g) *Electric Vehicle (EV) Infrastructure***

The promotion of electric vehicles aligns with urban renewable energy goals. Cities like Bengaluru and Hyderabad are investing in EV infrastructure, including charging stations powered by renewable energy sources. Integrating EVs into the urban energy landscape requires advancements in battery technology, smart charging solutions, and sustainable sourcing of materials.

Despite these technological advances, challenges such as intermittent renewable energy supply, grid integration, and the need for robust storage solutions persist [9-11]. Continued research and development, along with increased investment in sustainable technologies, will be crucial for overcoming these challenges and furthering the adoption of urban renewable energy in India.

**4. Economic and Environmental Benefits of Urban Renewable Energy**

The integration of renewable energy sources in urban areas brings about a dual impact, yielding both economic and environmental benefits. Economically, the adoption of renewables stimulates job creation, facilitates local economic development, and attracts infrastructure investments, fostering sustainable urban growth.

Additionally, cities embracing renewable energy often experience long-term cost savings as well as reduced dependence on centralized energy grids. Environmentally, the shift away from fossil fuels significantly lowers carbon emissions, improves air and water quality, and promotes biodiversity conservation.

Furthermore, the utilization of inexhaustible resources such as sunlight and wind minimize the environmental impact associated with traditional energy sources. The transition to urban renewable energy also delivers social and health co-benefits, encouraging community engagement and contributing to improved public health outcomes.

Overall, the holistic integration of renewable energy in urban settings emerges as a key strategy for creating greener, healthier, and economically vibrant cities [12-14].

The Figure 5 shows the economic and environmental benefits of Urban renewable energy.



**Figure 5. Economic and Environmental Benefits of Urban Renewable Energy**

Moreover, the co-benefits extend to social and health dimensions, with renewable energy projects fostering community engagement and empowering residents as active stakeholders in sustainable urban development. This collaborative approach enhances awareness of energy issues and encourages a sense of ownership among the population.

As a result, the reduction in air pollution and greenhouse gas emissions associated with renewable energy contributes to better public health, minimizing respiratory diseases and promoting the overall well-being of urban communities. The intertwined economic, environmental, social, and health benefits underscore the transformative potential of urban renewable energy, making it a cornerstone for resilient, inclusive, and sustainable urban development in the face of global challenges such as climate change and rapid urbanization.

Policymakers, businesses, and communities must continue working

together to accelerate the widespread adoption of renewable energy technologies, ensuring a cleaner and more prosperous future for urban areas worldwide.

### 5. Challenges and Barriers

The climate crisis poses significant challenges and barriers to the effective utilization of renewable energies. One major challenge is the increasing frequency and intensity of extreme weather events, such as hurricanes, floods, and wildfires, which can damage or disrupt renewable energy infrastructure. For instance, storms can impact wind turbines and solar panels, leading to operational downtime and maintenance challenges. Additionally, unpredictable weather patterns can affect the reliability of renewable energy sources, introducing intermittency issues that hinder their ability to provide a consistent power supply.

Another challenge is the vulnerability of renewable energy installations to changing climate conditions. Rising temperatures, shifting precipitation patterns, and sea-level rise can impact the efficiency and longevity of renewable energy technologies. For example, higher temperatures can reduce the efficiency of solar panels, and sea-level rise can threaten coastal wind farms and hydropower facilities. These changes necessitate

adaptation measures and resilient design considerations for renewable energy projects.

Moreover, the climate crisis introduces uncertainties in resource availability. Changes in precipitation patterns affect water availability for hydropower, while alterations in wind patterns can impact the performance of wind turbines. These variations necessitate careful planning and adaptation strategies to ensure the continued viability of renewable energy systems.

Additionally, the economic viability of renewable energy projects may be challenged by climate-related factors. Increased frequency of extreme events can lead to higher insurance premiums, affecting the overall cost-benefit analysis of renewable energy investments. The uncertainty surrounding climate-related policies and regulations also poses a

## **6. Conclusion**

The technological strides in urban renewable energy are poised to revolutionize India's urban development, offering a pathway to sustainability and resilience. The ongoing growth and evolution of cities necessitate the integration of these innovations to meet sustainability goals and effectively curb carbon emissions. The embrace of advanced technologies in the urban

landscape not only contributes to a cleaner and more sustainable energy future but also addresses the pressing challenges posed by rapid urbanization. As India progresses towards a cleaner energy paradigm, continued commitment to technological innovation, supportive policies, and public engagement will be instrumental in ensuring that urban areas not only keep pace with their energy

barrier to long-term planning and investment in renewable energy projects. The climate crisis can exacerbate existing social and economic inequalities. Vulnerable communities, often disproportionately affected by the impacts of climate change, may face challenges in accessing and benefiting from renewable energy solutions. This highlights the importance of ensuring that the transition to renewable energies is equitable and considers the needs of marginalized populations. [15,16]

Renewable energies play a crucial role in addressing the climate crisis, they are not immune to the challenges posed by the changing climate. Mitigating these challenges requires a holistic approach that includes resilient design, adaptive strategies, and equitable policies to ensure the continued effectiveness and sustainability of renewable energy systems in the face of a rapidly changing climate.

landscape not only contributes to a cleaner and more sustainable energy future but also addresses the pressing challenges posed by rapid urbanization. As India progresses towards a cleaner energy paradigm, continued commitment to technological innovation, supportive policies, and public engagement will be instrumental in ensuring that urban areas not only keep pace with their energy

demands but also lead the way in environmental stewardship. The transformative potential of these advancements underscores their importance in shaping a greener and more prosperous future for India's urban populations.

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## STUDY, IMPACTS ON CO<sub>2</sub> EMISSION FROM AIR CONDITIONER IN INDIA AND MITIGATION OF CLIMATE CHANGE: A REVIEW

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### Abstract

In India's hot and humid climate, air conditioning systems are indispensable for ensuring comfortable indoor temperatures. However, their widespread use has raised concerns regarding their contribution to the escalating carbon dioxide (CO<sub>2</sub>) emissions. This review extensively examines the impact of CO<sub>2</sub> emissions from air conditioners in India, with particular attention to the main factors fuelling their prevalence and the ensuing environmental and socio-economic consequences. Analysing current trends, it emphasizes the urgent need for mitigation strategies to curb climate change, offering insights into potential solutions for a sustainable and cooler future.

**Keywords:** Carbon dioxide emissions, Air conditioners, Environment, Climate change.

### 1. Introduction

Ecological disruptions, climate change, and environmental degradation indicate carbon dioxide (CO<sub>2</sub>) emissions impact on the environment [1]. According to estimates, the G7 countries control nearly 50% of the global GDP and over 60% of the world's net wealth. Energy consumption has been significantly higher in recent times than in any other period in history [2]. Greenhouse gas emissions [3], commonly known as CO<sub>2</sub> emissions, are mostly caused by the use of fossil fuels for energy generation. The upward trend in CO<sub>2</sub> emissions witnessed in recent years is expected to continue in the years ahead.

India is committed to combating climate change and wants to lead by example for the rest of the globe [4]. India intends to cut its yearly CO<sub>2</sub> emissions by 32 million tonnes by 2030 [5], exceeding the goal established by the Paris Agreement [6]. With increasing urbanization and economic reform endeavours in India since 1991, energy consumption has tripled from 191 million tonnes of oil equivalent (Mtoe) in 1991 to 595 Mtoe in 2013 [7, 8]. The estimated increase is subject to uncertainty ranging from 3% to 25%, depending on the gases and major sectors. The source of electricity that powers air conditioners has a significant impact on

the amount of carbon emissions they produce [9-11]. In India, the mix of fuels used to generate power varies depending on location, but coal and other fossil fuels [12], which are major contributors to CO<sub>2</sub> emissions, make up a significant part of the mix [13-16]. The ability of air conditioning to reduce carbon emissions depends largely on the energy source used to power it [17]. In India, there are significant regional differences in the carbon intensity of energy production. Historically, India has relied heavily on coal and other fossil fuels, leading to increased CO<sub>2</sub> emissions. However, the country has now started using more renewable energy sources [18] like solar and wind. This shift can significantly lower the carbon footprint of producing power for air conditioning [19-23]. As more renewable energy sources are utilized, the emissions become more energy-efficient and environmentally friendly. The increasing demand for air conditioning in today's society has raised concerns about its impact on carbon dioxide (CO<sub>2</sub>) emissions. Energy is required for residential, commercial, and industrial air conditioning systems to function, and the source of this energy is where the carbon emissions related to air conditioning are produced. If the majority of the energy used for electricity generation comes from fossil fuels such as

coal or natural gas, the use of air conditioning systems can produce significant CO<sub>2</sub> emissions. However, the environmental impact may be reduced by switching to cleaner energy sources such as solar and wind power and using more energy-efficient cooling technology. Individual behaviour can also contribute to reducing the carbon footprint of air conditioning, such as responsible consumption and maintenance. Developing a sustainable and ecologically friendly cooling solution is crucial in the face of climate change and the need to reduce CO<sub>2</sub> emissions from air conditioning [24, 25].

Efforts are being made worldwide to reduce CO<sub>2</sub> emissions and transition to a zero-emissions economy. Air conditioning is a ubiquitous and indispensable technology that has transformed our daily lives, enabling us to endure extreme temperatures with comfort and ease. The advent of air conditioning systems has revolutionized the way we live, work, and relaxes, particularly in regions characterized by scorching summers and stifling humidity. However, the rapid proliferation of air conditioning technologies has raised a critical environmental concern [26]: the emission of carbon dioxide (CO<sub>2</sub>). As the world grapples with the consequences of climate change and the need to reduce greenhouse gas emissions, understanding the complex

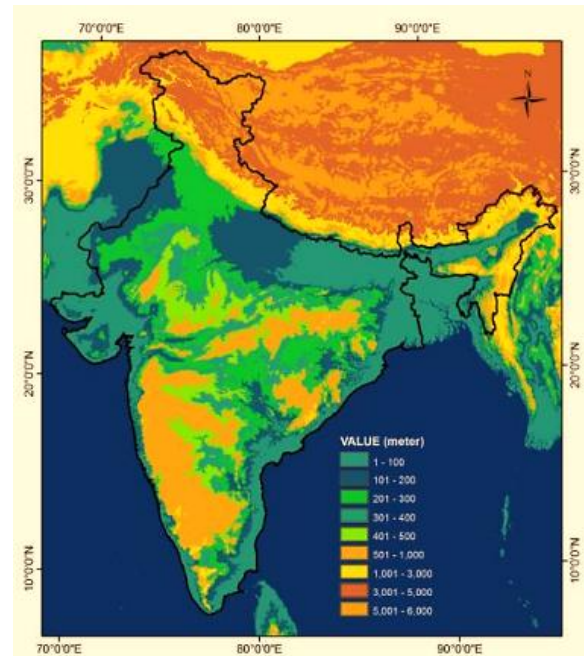


interplay between air conditioners and CO<sub>2</sub> is of paramount importance. This analysis delves into the multifaceted issue of CO<sub>2</sub> emissions from air conditioners, aiming to provide a comprehensive exploration of the subject. It encompasses the environmental impact of these emissions, the various factors that influence them, technological advancements, and mitigation strategies that can be employed to address this pressing issue.

## 2. Study Area

India is located between the parallels of 68440 N and 358300 N, and the meridians of 68870 E and 978250 E. The country displays significant regional variations in its topography, climate, and access to resources. Similarly, differences can be observed in the growth and spread of urbanization across different regions, resulting in disparities in the availability of energy sources [27]. India experiences various climatic subtypes due to its diverse geographical features (Fig.1). Deserts in the west, alpine tundra, and glaciers in the north, wet tropical regions with rainforests in the southwest, and island territories in the middle contribute to the country's climatic diversity. There are four distinct seasons in India: generally dry and chilly (December to February), dry and hot (March to May), monsoon rains (June to September) brought on by southwest marine winds, and a post-monsoon period

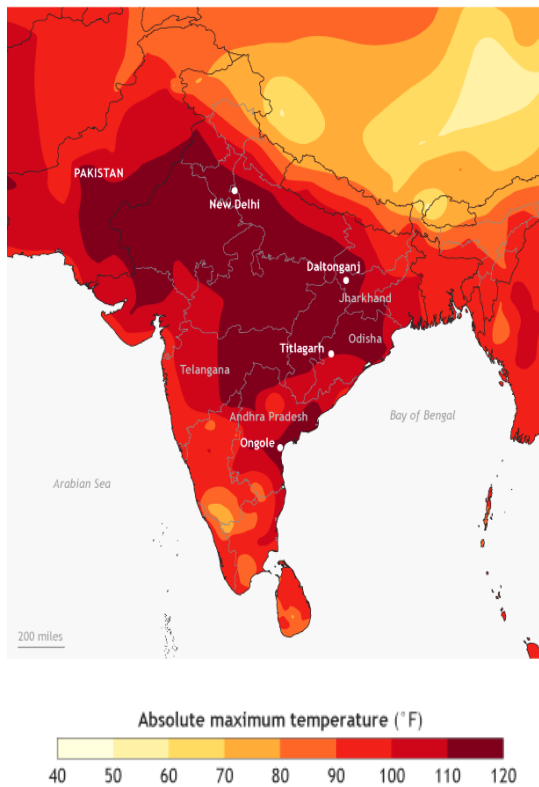
(October to November) marked by retreating dry monsoons from the northeast [28, 29].



**Figure 1. Study area delineated by black boundary**

Additionally, the microclimates of several Indian areas differ from one another. The nation's unique geographic and geological features also affect the local climate, particularly noticeable in the north where the Himalayas function as a barrier to the katabatic winds from Central Asia, moderating the temperature. In India, the urban population has significantly risen since mid-20th century. By 2026, it is expected that 33% of the Indian population will be in the elderly age category, compared to 28% in 2001. This demographic shift will make the health of people in India more susceptible to the consequences of climate change [30-34].

The recent heat waves in India have already affected the population significantly (Fig. 2).



**Figure 2. Heat waves across India**

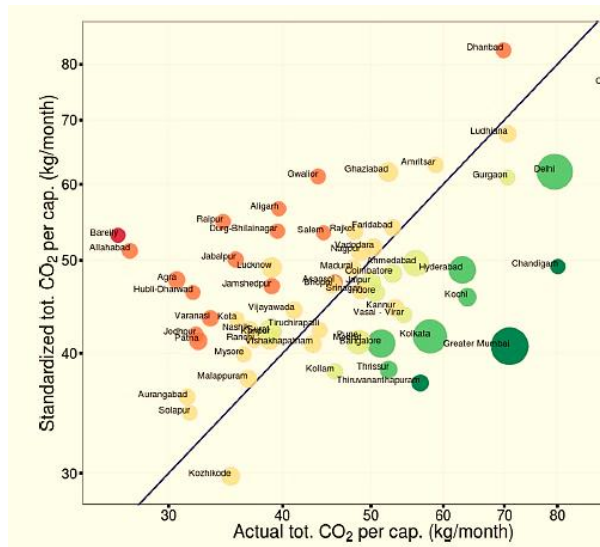
### 3. CO<sub>2</sub> Emission in India

The energy demand in India has surged considerably over a span of just over two decades, from 1991 to 2013, with consumption reaching 595 million tonnes of oil equivalent (Mtoe) or 24,911 petajoules (PJ). This growth is primarily driven by India's focus on economic reform and the increasing pace of urbanization. In the realm of emissions, the Ministry of Environment, Forests, and Climate Change (MoEFCC) within the Indian government has documented a notable increase in total carbon dioxide (CO<sub>2</sub>) emissions, excluding those linked to

land use, land-use change, and forestry (LULUCF) [35-37]. These emissions have risen from 779 million tons of CO<sub>2</sub> (Mt-CO<sub>2</sub>) in 1994, with an associated uncertainty ranging from 3% to 25% depending on the gases and major sectors, to 1574 Mt-CO<sub>2</sub> in 2010, demonstrating a compound annual growth rate (CAGR) of 4.5%. The overall growth rate for total greenhouse gas (GHG) emissions, including LULUCF, is 4.4%.

In India, a variety of studies have been carried out to investigate greenhouse gas (GHG) emissions. The predominant approach in these assessments has been the use of top-down methodologies, relying on annual energy statistics or employing input-output methods. Our emission estimations differ from other inventory assessments, such as those conducted by the Ministry of Environment and Forest (MoEF) [38-40]. This differentiation is primarily due to our application of the latest IPCC methodologies, our comprehensive bottom-up approach encompassing activity data, and the inclusion of emission factors specific to the country. Households in Bareilly and Allahabad emit the least CO<sub>2</sub> per capita, while Chennai and Delhi emit the most (Fig. 3) [41]. Urban areas play a crucial role in addressing climate change, as they are responsible for about 76% of global CO<sub>2</sub> emissions from final energy use and

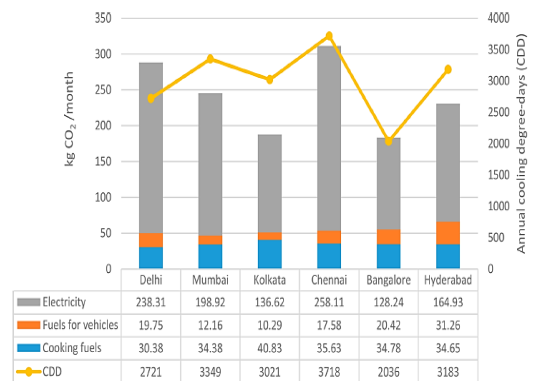
43% of CO<sub>2</sub> emissions related to primary energy worldwide. Urban policymakers are facing new and complex challenges as they try to reduce carbon dioxide emissions in response to climate change [42]. It is necessary to reconfigure urban environments, including energy systems, transportation, and physical surroundings, to achieve this important goal.



**Figure 3. Total CO<sub>2</sub> emission of 60 cities in India**

Moreover, urbanization is expected to have the most significant impact on emission structures in India in the future. Therefore, it is becoming increasingly important to investigate the unique contribution of Indian cities to the formation of GHG emission profiles. There are three main points to consider regarding research on energy usage and greenhouse gas emissions of cities. Firstly, the current research has mainly focused on the energy usage and emissions of cities as a whole,

without looking at individual homes. Secondly, the majority of studies have focused on a few selected cities, including Oslo, Europe, the US, China, and Japan. However, to find policy solutions that meet the needs of the individual population, we need to pay special attention to the home level. Lastly, India, with the second-largest urban population in the world, has enormous potential to impact the global trend towards low-carbon cities. However, it is also emerging as a major region for growth in greenhouse gas emissions. Several significant studies have already delved into the energy use and emissions of households in India, both at the national and urban level, while also considering the differences between rural and urban areas [43, 44].



**Figure 4. Monthly household CO<sub>2</sub> emissions (kg) in the top six Indian cities**  
It is noteworthy that Pachauri has conducted an in-depth analysis of Indian household’s energy consumption (Fig. 4), underscoring the sector's importance for

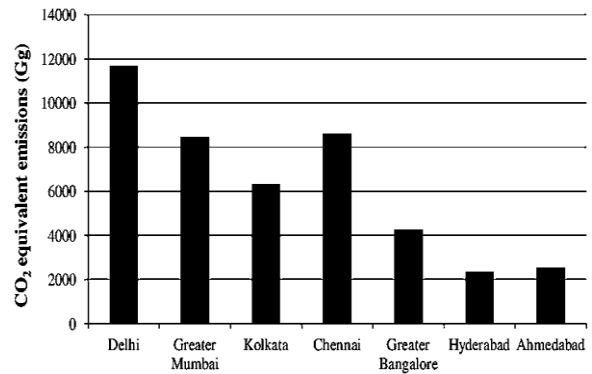
both growth and climate change mitigation efforts [45-50].

**4. CO<sub>2</sub> Emission From Air Conditioner**

There are certain lower-class towns with significant emissions, particularly secondary cities like Delhi and Chennai and megacities like Dhanbad, Ludhiana, Ghaziabad, Meerut, Amritsar, and Gurgaon. Large cities like Chennai and Delhi produce the greatest emissions per capita, whereas households in Uttar Pradesh's Bareilly and Allahabad produce the least (Fig. 5). Access to city amenities often leads to higher overall emissions. In a residence with electricity, the emissions per person are over 95% higher. The rise in CO<sub>2</sub> emissions from household power consumption was caused by the change in the percentage of homes having access to electricity, which increased from 25% to 74% [51-54]. Air conditioners (A/Cs) are becoming increasingly important in India due to climate change. They have been found to be particularly beneficial for people with heat-related health conditions [55-57].

Studies indicate that the use of A/Cs between 1971 and 1997 was associated with a decrease in heat-related deaths in regions such as Southeast England, South Finland, and North Carolina. Furthermore, several American studies have demonstrated that air conditioning is crucial in reducing the incidence of heat-

related diseases, heat stroke, and fatalities [58, 59].



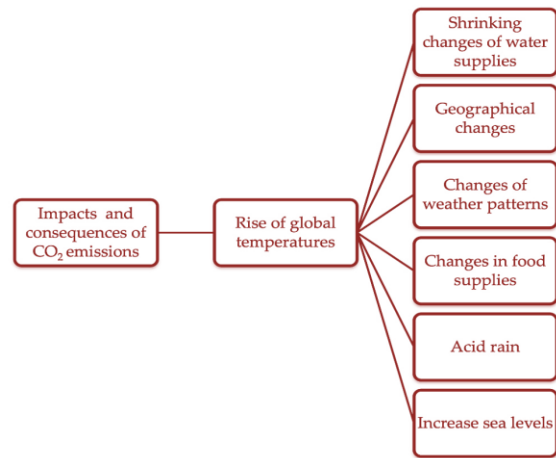
**Figure 5. CO<sub>2</sub> equivalent emission from domestic sectors**

In addition to measurable factors like temperature, intangible factors such as mental health, lifestyle choices, and educational achievements may also affect how comfortable people feel in their own skin. Due to their geographical location, most regions in India experience high temperatures throughout the year. As a result, the local population may have developed physiological acclimatization to cope with high temperatures. However, during a recent heat wave in India, where temperatures peaked at a daily maximum of 50°C (122°F), both people and animals fell victim to the scorching heat. It has been demonstrated that employing air conditioning helps reduce heat-related illnesses and deaths in both Europe and the US [60, 61]. When India experiences heat waves, when the local population is exposed to sudden, potentially fatal temperature surges that linger for many

days or weeks, air conditioners can be a helpful adaptation technique. Since the late 1990s, India's cooling technology business [62] has experienced rapid growth in the residential and commercial air-conditioning industries, with an average annual growth rate of 20%. As of 2001, households in Jammu and Kashmir, Uttar Pradesh, Haryana, Punjab, Rajasthan, and Madhya Pradesh had the highest ownership of A/Cs compared to other states in India. In fact, these were the only states where A/C ownership exceeded 10%. It is not surprising that these states have a higher distribution of A/C ownership, as they frequently experience higher temperatures due to their location in the north and north-central regions of India. With the exception of Punjab and Haryana, it is found that no significant states in rural India had more than 3% of the population in A/Cs [63-67].

Carbon dioxide (CO<sub>2</sub>) emissions have several environmental consequences, with climate change being the most significant among them. Studies have shown that these emissions are directly related to the socioeconomic development of urban areas. Hence, household CO<sub>2</sub> emissions are directly influenced by urbanization or socioeconomic growth [68-73]. Despite covering only a small fraction of the planet's land area, urban areas account for 70-80% of greenhouse gas emissions.

These emissions impact the material and energy cycles within ecosystems.



**Figure 6. Impacts of CO<sub>2</sub> emissions**

The Fig. 6 clearly shows the impacts of CO<sub>2</sub> emissions caused by the increasing global temperatures. These pollutants have severely affected the availability of water and the optimal time to harvest crops. One of the most significant impacts of climate change is the rise in sea levels, which is endangering the marine and coastal environments and leading to an increased demand for food crops. In addition, CO<sub>2</sub> emissions result in acid rain, which is harmful to plants and infrastructure [74-76].

### **5. Climate Change Mitigation Strategies**

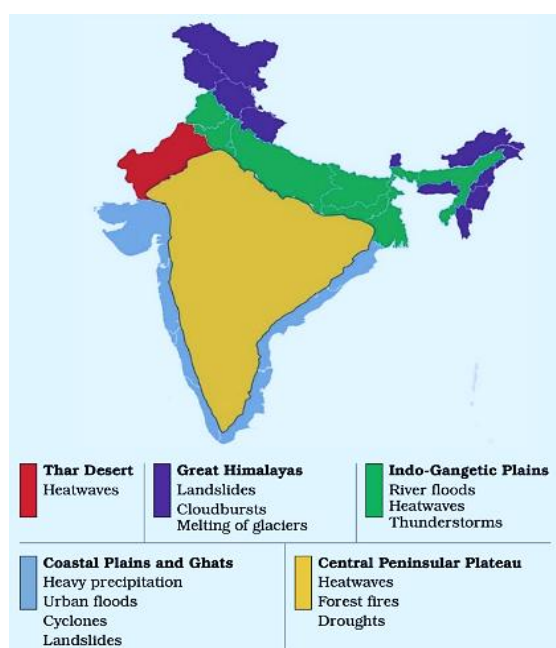
Climate change in India manifests in a complex array of challenges affecting diverse sectors and regions. Rising temperatures contribute to more frequent and severe heat waves, impacting public health, agriculture, and water resources. The erratic patterns of the monsoon lead to both droughts and floods, disrupting

traditional agricultural practices and posing threats to food security. Coastal regions are vulnerable to rising sea levels, resulting in erosion, salinity intrusion, and displacement of communities, while increased cyclones and extreme weather events affect infrastructure, agriculture, and livelihoods. Water scarcity intensifies due to changing precipitation patterns and glacial melt, posing challenges for agriculture, industry, and urban areas. Biodiversity faces threats as ecosystems experience disruptions, and agricultural productivity is compromised by shifts in climate conditions [77-80]. Health risks escalate with more heat-related illnesses and changing disease patterns. Socially and economically, vulnerable communities bear a disproportionate burden, exacerbating existing inequalities, while economic sectors like agriculture, fisheries, and tourism grapple with uncertainties and disruptions. Mitigation and adaptation strategies are imperative to foster resilience, protect ecosystems, and ensure sustainable development amid the ongoing and escalating impacts of climate change in India. Climate change manifests differently across India's geographical regions, impacting ecosystems, agriculture, and communities (Fig. 7). As climate change continues, understanding and addressing these regional variations becomes paramount for effective

mitigation and adaptation efforts. In a 2010 research study, Ezgi Akpinar-Ferrand analyzed the energy consumption of Indian households that used air conditioning [81-86]. The study focused on the impact of climate change and related energy demand, modelling the air conditioning energy demand as a function of income and cooling degree days (CDDs) [87, 88]. The coefficient of variation (Cdd) is used to assess the demand for heating and cooling services by measuring the difference between the average temperature and the base temperature [89, 90]. McNeil and Letschert carried out similar modeling for air cooling demand based on income growth and CDD values that were kept constant until 2030 in 2008 [91-93]. Isaac and Van Vuuren conducted more comprehensive research worldwide in 2009, examining India's air conditioning demand, climate change, and related emissions [94-97]. There are three primary strategies for mitigating climate change. First, decarbonization technologies and techniques such as fuel switching [98], nuclear power [99], renewable energy [100-102], efficiency improvements [103], and carbon capture [104-106], storage [107], and utilization [108-111] are used to lower CO<sub>2</sub> emissions in traditional mitigation efforts. Secondly, Carbon dioxide removal techniques, or negative emissions technologies, can be used to



capture and store CO<sub>2</sub> from the atmosphere. These methods have the potential to absorb and store CO<sub>2</sub> from the atmosphere. There is another approach to tackle climate change which modifies the Earth's radiation balance by controlling solar and terrestrial radiation. Unlike negative emissions technology, these methods are called radiative forcing geoengineering technologies, and they aim to stabilize or lower temperature without altering the atmospheric concentrations of greenhouse gases.



**Figure 7. Effects of climate change across the regions in India**

Mitigation strategies for climate change encompass a range of proactive measures aimed at reducing and preventing the emission of greenhouse gases (GHGs) into the atmosphere, ultimately mitigating the adverse effects of climate change [112]. These strategies address various sectors of

human activity, incorporating both technological advancements and behavioral changes to foster a sustainable and resilient future.

One of the fundamental pillars of mitigation is the transition to renewable energy sources. This involves shifting away from fossil fuels, which are the primary contributors to GHG emissions, and embracing cleaner alternatives such as solar, wind, hydro, and geothermal energy. Governments and industries worldwide are investing in the development and implementation of renewable energy technologies to create a more sustainable and low-carbon energy infrastructure. Energy efficiency plays a crucial role in mitigation efforts. By optimizing energy use in buildings, transportation, and industries, significant reductions in emissions can be achieved. This involves adopting energy-efficient technologies [113], improving insulation in buildings, and promoting sustainable practices in manufacturing processes. In the realm of transportation, the promotion of electric vehicles (EVs) and the development of efficient public transportation systems are key mitigation strategies. Shifting from traditional gasoline-powered vehicles to electric alternatives can substantially decrease emissions, especially when coupled with advancements in battery technology and the expansion of charging

## Carbon Dioxide Emission

infrastructure. Land use and forestry are integral components of climate change mitigation. Afforestation and reforestation projects contribute to carbon sequestration by planting trees that absorb CO<sub>2</sub> from the atmosphere. Sustainable land management practices, including preventing deforestation and restoring degraded ecosystems, help maintain the carbon sink capacity of forests and soils. Agriculture, while a source of emissions, also presents opportunities for mitigation [114-116]. Sustainable farming practices, such as precision agriculture and organic farming, can reduce emissions from agricultural activities. Additionally, advancements in livestock management and the development of alternative protein sources, like plant-based and lab-grown meats, contribute to mitigating emissions associated with traditional livestock farming. Carbon capture and storage (CCS) technologies [117-120] are emerging as essential tools in the mitigation toolbox. CCS involves capturing CO<sub>2</sub> emissions from industrial processes and power plants and then storing or repurposing it to prevent it from entering the atmosphere. This technology holds promise in reducing emissions from sectors where complete decarbonization is challenging. International cooperation is critical for effective climate change mitigation. Global agreements, such as the

Paris Agreement, provide a framework for countries to collectively work towards limiting global temperature rise. Nations commit to specific emission reduction targets and collaborate on technology transfer and financial support to facilitate mitigation efforts, particularly in developing countries. Incentive mechanisms, such as carbon pricing and subsidies for renewable energy, create economic drivers for businesses and individuals to adopt low-carbon practices [121-123]. By internalizing the external costs of carbon emissions, carbon pricing encourages the transition to cleaner alternatives and fosters innovation in sustainable technologies. Public awareness and education are essential components of successful mitigation. Encouraging sustainable lifestyles, promoting environmental awareness, and fostering a sense of responsibility for individual carbon footprints contribute to behavioral changes that complement technological solutions. Finally, climate change mitigation is a multifaceted endeavor that requires a holistic approach, combining technological innovation, policy frameworks, international collaboration, and individual actions. By implementing a comprehensive suite of mitigation strategies across various sectors, humanity can strive towards a more sustainable and climate-resilient future.



## 6. Conclusion and Future Perspective

Combining the findings of several research papers, this review study comes to the conclusion that immediate action is required to limit the consequences of CO<sub>2</sub> emissions from air conditioners. The article highlights the various aspects of the problem and makes the case for an all-encompassing strategy that incorporates behavioural adjustments, energy conservation, technical advancements, and robust regulatory frameworks. According to the analysis, air conditioning systems will be crucial in helping to mitigate climate change rather than making it worse. Sustainably designed cities, international collaboration, and continuous study are needed to arrive at a more environmentally friendly way to cool our living areas. This review paper provides a comprehensive analysis of various studies conducted on the impact of CO<sub>2</sub> emissions from air conditioners. The paper also puts forth practical recommendations for mitigating such emissions. The aim is to raise awareness about the issue and offer viable solutions to support global initiatives for building a sustainable and climate-resilient future.

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## PROTECTING OUR HEALTH: LOOMING CLIMATE THREAT DEMANDS URGENT ACTION

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### Abstract

Climate change, driven by greenhouse gas emissions, poses a multifaceted threat to human health across diverse geographical and socioeconomic contexts. Direct impacts include increased morbidity and mortality due to extreme weather events like heat-waves, floods, and droughts. Rising temperatures and altered precipitation patterns exacerbate air quality issues, with detrimental effects on respiratory health. Water quality degradation, fuelled by extreme weather and warming, increases the risk of waterborne diseases. Changes in climate patterns disrupt food production, jeopardizing food security and contributing to malnutrition. Indirect impacts encompass the expansion of vector-borne diseases like malaria and dengue fever due to shifting climatic suitability for disease vectors. Social and economic disruptions, further aggravated by climate change, disproportionately impact vulnerable populations, amplifying health inequities. Low- and middle-income countries, despite limited contributions to global emissions, bear the brunt of the health burden owing to resource constraints and inadequate infrastructure. Mitigating climate change through aggressive greenhouse gas reduction strategies and adaptation measures are crucial to safeguard human health in the face of a changing climate. Addressing this global challenge requires collaborative efforts from diverse stakeholders, including policymakers, healthcare professionals, and individuals, to ensure a healthier planet for all.

**Keywords:** Healthcare, Climate Change, Threats, Greenhouse.

### Introduction: A Shifting Landscape

Our planet's climate is undergoing a period of unprecedented change, primarily driven by human activities and the emission of greenhouse gases. While the consequences of this warming trend are far-reaching, their impact on human health stands as a critical and immediate threat. Climate

change poses a multifaceted challenge, jeopardizing human well-being across diverse geographical and socioeconomic contexts. This essay will delve into the various ways climate change disrupts the delicate balance of human health, focusing on direct and indirect impacts, with a

particular emphasis on vulnerable populations [1 – 3].

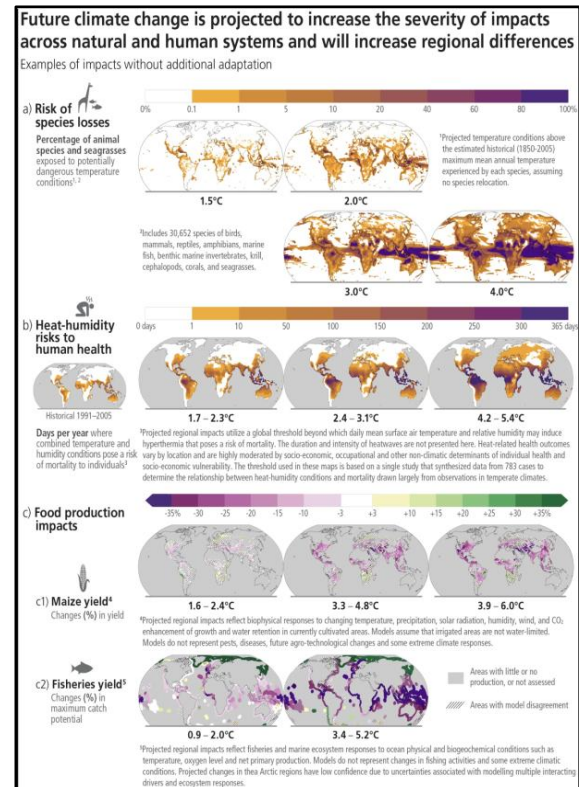
**Direct Threats: A Brutal Onslaught**

One of the most immediate threats posed by climate change lies in its ability to intensify extreme weather events. Rising global temperatures contribute to the increased frequency and severity of heatwaves, floods, and droughts. A study published in BMJ Open by Watts et al. (2018) highlights the association between climate change and these extreme weather events, emphasizing the rising risks of injury, illness, and death. Heatwaves pose a significant danger, particularly for vulnerable populations like the elderly and those with pre-existing medical conditions. Heatstroke, dehydration, and exacerbated medical conditions can lead to a rise in heat-related mortality.

Conversely, floods and droughts disrupt ecosystems, contaminate water sources, and displace populations, creating conditions ripe for outbreaks of waterborne diseases like cholera and diarrhea. Climate change also has a direct impact on air quality. Rising temperatures contribute to increased ground-level ozone and particulate matter pollution, particularly in urban areas.

Environmental Protection Agency (EPA) suggests that these changes can worsen air pollution, leading to detrimental effects on respiratory health, including asthma and

chronic obstructive pulmonary disease (COPD). Children, the elderly, and those with compromised respiratory systems are particularly susceptible to these air quality issues.

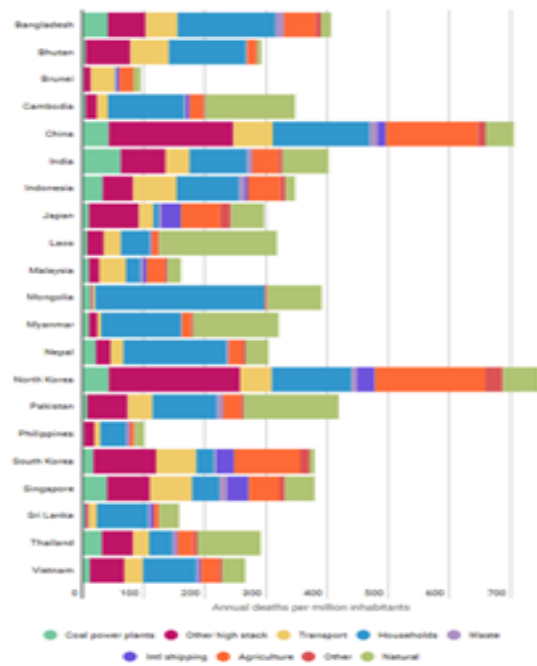


**Figure 1. Examples of impacts without additional adaptation** Research by the **Indirect Impacts: A Ripple Effect**

The ramifications of climate change extend beyond direct threats, creating a ripple effect that disrupts the very foundation of human health. One significant indirect impact is the threat to food security. Rising temperatures, erratic rainfall patterns, and extreme weather events disrupt agricultural production, leading to crop failures and food shortages. The Food and Agriculture Organization (FAO) warns that climate change poses a

significant threat to global food security, jeopardizing the nutritional well-being of millions. This can lead to malnutrition, particularly among children and pregnant women, impacting their physical and cognitive development. Climate change also presents a significant challenge to water security [4-6]. Erratic precipitation patterns and rising temperatures contribute to water scarcity. The World Bank warns that India is on track to become water-scarce by 2030, a situation likely to be replicated in other regions. This scarcity not only affects agricultural productivity but also creates breeding grounds for waterborne diseases. As water tables recede and extreme weather events disrupt sanitation systems, contaminated water becomes more readily available, leading to outbreaks of diarrhoeal diseases and posing a severe threat to public health. Furthermore, climate change can exacerbate the spread of vector-borne diseases. Rising temperatures and altered precipitation patterns create suitable habitats for disease-carrying insects like mosquitoes, ticks, and fleas. This can lead to the expansion of diseases like malaria, dengue fever, and Lyme disease, particularly in regions historically less affected. The World Health Organization (WHO) identifies climate change as a significant driver of vector-borne disease transmission, posing a threat to millions

globally [7].



**Figure 2 . Annual deaths globally**  
**Unequal Burden: The Vulnerability Factor**

The effects of climate change on health are disproportionately felt across different regions, with low- and middle-income countries bearing a significant share of the burden despite contributing less to global greenhouse gas emissions. This unequal distribution of impact stems from various factors. These nations frequently lack the necessary resources and infrastructure to effectively cope with the challenges posed by climate change, such as early warning mechanisms, resilient healthcare systems, and adaptive agricultural techniques. Moreover, prevalent poverty and social disparities exacerbate the vulnerability of populations in these areas to the adverse effects of climate-induced disruptions.

### Conclusion

Climate change presents a complex and multifaceted threat to human health across the globe. The consequences, ranging from direct impacts of extreme weather events to indirect effects on food security and waterborne diseases, disproportionately burden vulnerable populations. Addressing this crisis requires a multi-pronged approach, encompassing aggressive greenhouse gas reduction strategies to mitigate climate change alongside robust adaptation measures to build resilience. Collaboration is critical, demanding coordinated efforts from policymakers, healthcare professionals, and individuals alike. By prioritizing climate action and fostering global cooperation, we can safeguard the health of future generations and ensure a healthier planet for all.

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**IDENTIFYING MICROPLASTIC CONTAMINATION IN DRINKING WATER:  
ANALYSIS AND EVALUATION USING SPECTROSCOPIC METHODS**

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**Abstract**

Plastics are ubiquitous and so are microplastics. They have occupied an immensely vast space in our day today life. Plastics that are found in the environment slowly decays into small fragments called as microplastics. Shape, size, thickness and their shades play an important role in determining their degradation. Plastics that are less than 5 mm in diameter are microplastics. Microplastics that are identified are mostly filaments, fibres, pellets, fragments and irregularly shaped microplastics. Environmental exposure, Quality of the plastic and Plastic degradation are the three important factors that influences the shape of the microplastic. Long exposure in environment has multiple effects on the plastics for example the ends can get melted, turned up, broken or fuzzy. Microplastics get differentiated from plastics by their varied size and shape, reactivity and high surface to volume ratio proving them to be more vicious than plastics. Most of the plastics are not easily degradable, even small volumes, take years to dissolve. These non-biodegradable plastics get fragmented into much smaller non- biodegradable ones called as Micro/Nano plastics. Microplastics causes much burden not only to the human health and economy but to the whole ecosystem. Predominant way of microplastics entering the human body is via ingestion for example drinking waters, tank waters, eatables etc. Recent researches reveal the presence of microplastic in Human blood, Placenta, in the guts of whales, Fishes, turtles etc. As Micro or Nano plastics are invisible to the naked eye, they find their way into the gastro intestinal tract pretty easily causingirrevocable effects in the Human body.

One of the concerns in the research community especially in dealing with microplastics is that “there are no standard methods involved in analysing the microplastic samples”. In thispaper, A novel method is executed in analysing and determining the microplastic fragments. Also, the drinking water samples were tested and analysed proving the presence of microplastics in the drinking water.

**Keywords:** Micro-plastics, Pollution, Ground water, Plastic, Contamination.

### 1. Introduction

In 1972 the first peer reviewed papers were documented and published on plastic pollution in the natural world [1,2]. Since then, plenty of studies have happened on the accumulation of synthetic polymers in the environment which proves its ubiquitous existence in nature. From Macro to Micro synthetic polymers are found everywhere. In marine settings [3], including pelagic biome segments [4], coastal habitats [5], deep sea sediments [6, 7] freshwater lakes [8, 9] and related tributaries [10], plastics have been measured. Plastic particles have also been found in Arctic Sea ice [11] in biotas especially in fish [12], aquatic mammals [13], sea birds [14, 15].

Plastic production has been on the rise over the years, from 30 million tonnes in 1970 it has hiked to 380 million tonnes in 2020, studies report that by 2050 it might reach up to 590 million metric tonnes [16]. Even among developed nations with their well-established infrastructure and growth in recycling, the treatment for the plastic stream waste is still a question mark. For example, in the year 2012, of the total disposable plastics Europe recycled 26% where as in the same year in United States turned over only 8.8% [17]. It is difficult to research microplastics because of their varied composition. Although they are referred to as synthetic polymers made from petrochemicals that are shorter than 5 mm

in length in the literature, there isn't a single definition that everyone agrees upon. In general, plastics represent a large variety of materials, each with distinctive physical traits and chemical makes-ups. But only about 90% of the plastic produced worldwide belongs to any of these six groups: PP, PVC, PS, PET, HDPE, LDPE, and PP [18].

Plastics are well-known to absorb chemicals from the environment such PCBs, PBDEs, and PAHs [19,20,21], some of which are known to be carcinogens and reproductive toxicants (PBDEs (PAHs) | Toxic Substances |, n.d. Toxic substance; (PBDEs) | Toxic Substances |, n.d.; (PCBs) | Toxic Substances |, n.d.). Plastics are hydrophobic. Metals [22] and microbes [23,24,25] can also be ingested by plastic, often at quantities that are several times higher than their immediate surroundings [26]. Additionally, there is proof that some of these organic compounds, once consumed, can desorb in an animal's stomach [27]. Furthermore, synthetic chemicals like phthalates, alkylphenols, and bisphenol A can leach from plastics [28]. A recent study confirms that plastics causes cytotoxicity in human cells [29]. Further, invasive species can be transported by plastic trash and it can act as a special diversity and distribution for marine creatures [30, 31]. These difficulties show why microplastics are regarded as a rising



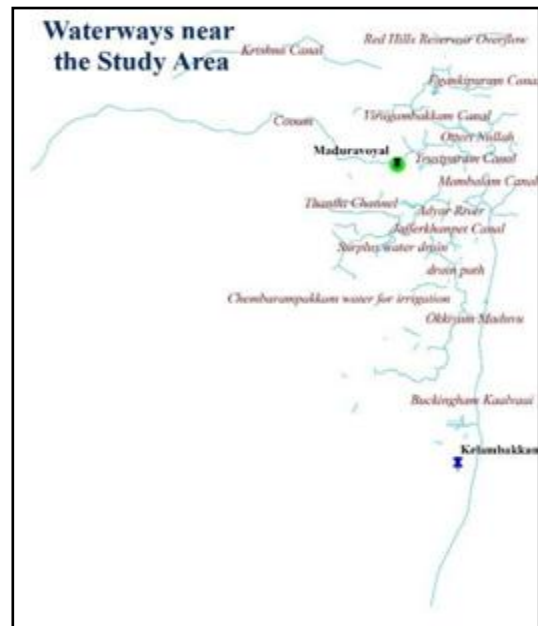
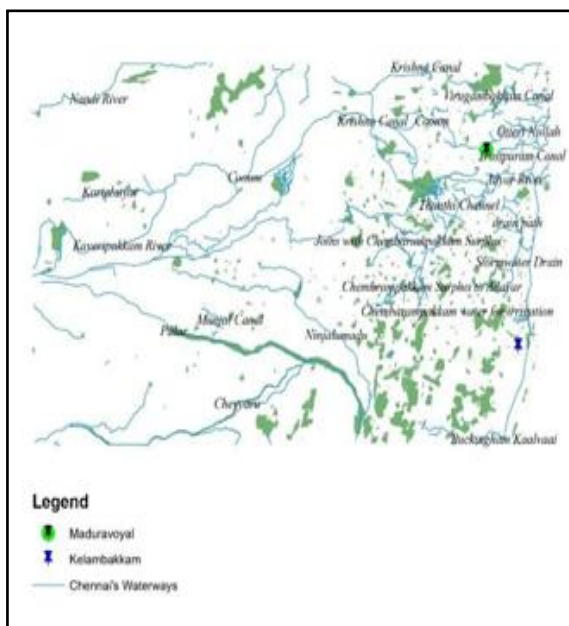
concern among contaminants [32, 33, 34]. Few research concentrates on the contamination of human products with synthetic polymers, despite mounting evidence of plastic pollution in the natural environment.

Human consumables such as tank water and tap water [35] were the subject of our study. The identification of the type of microplastic in the water was one of the goals of this investigation. This paper notably examined water from residences close to Chennai's extremely polluted Cooum and Great Salt Lakes [36].

Another major objective of this study was to find the reason of their existence in the particular region. There is very scarce amount of literature available for the presence of microplastics in drinking water, this study on tap and tank waters have never happened in Southern part of India.

## 2. Materials and Methods

### 2.1. Study Area

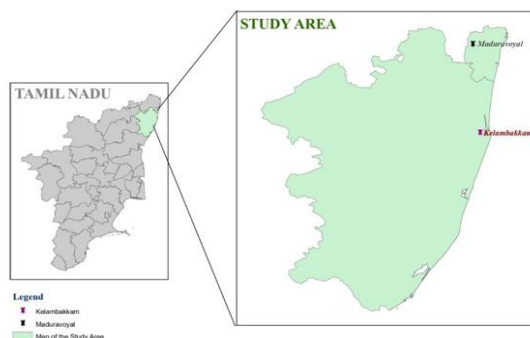


**Figure 1. Study Area of the Research**

Surface and underground water sources (Fig. 1) are used to supply the city of Chennai with water. Redhills, Poondi-Cholavaram, and Chembarambakkam lakes are the surface sources.

Red Hills Lake's water is extracted, processed, and then provided to Chennai City through water treatment facilities in Kilpauk, Surapet, and Puzhal, which are close to the lake. The Southern Coastal Aquifer, the Well Field at Poondi, Tamaraiyapakkam, Flood Plains, Kannigaipair, Panjetty, Minjur, and the beds of the Kadilam and Paravanar rivers are the sources of ground water. The Chennai Metropolitan Water Supply and Sewerage Board provides treated water to the city of Chennai and some of the nearby urbanised areas [37]. In the last 10 years annual temperature ranges from 36.6<sup>0</sup>C (highest) and 21.6<sup>0</sup>C (lowest). In which Kelambakkam and Maduravoyal (Table 1)

of Chennai region was selected as the study area (Fig. 2).



**Figure 2. Study Area of the Research**

Overall, the studies were performed from November 2021 to March 2022. The total geographical area of Kelambakkam is 176.3 hectares and lying within the coordinates 12.7897° N, 80.2216° E and Maduravoyal with coordinates 13.065600°N 80.160800°E.

Sample Collection	Latitude	Longitude
Location: Kelambakkam Study I	12.7897N	80.2216E
Location: Maduravoyal Study II	13.0616942N	80.1755160E

**Table 1. Latitude and Longitude of Study Area**

**2.1. Sample Collection:**

**i. Study I**

This study happened from November 2021 to February 2022. All precautionary measures were followed accordingly [38, 39, 40]. Three samples from same location on different days in Kelambakkam was

collected. 5-micron filter bag (Fig. 3) was tied to the drinking water tap (Fig. 4) and was left undisturbed for 24 hours.



**Figure 3. Collected samples**



**Figure 4. 5-micron filter bag tied on tap**

It was then dried and kept in a closed glass container to prevent from contamination. The filter bag was then cut open and was rinsed with deionised water stored in the glassware. This was then again filtered through the 47mm 0.2 µm synthetic nitrate film was added to antiseptic Petri dishes with a density of 1.6 g/ml and 10-14 ml of 5M NaI, as described in [41] To secure the thorough separation of MPs, the sample was centrifuged. After centrifugation, the particles that collected at the bottom were put into Petri dishes for additional analysis using a micro-infrared Fourier transform spectrometer.

**ii. Study II**



**Figure 5. HDPE bottles**

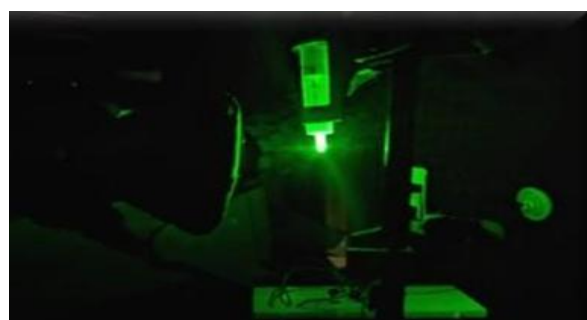
The same process was used for the second analysis, but the drinking water this time was drawn directly from water tanks at their highest temperature (refer table 2) on three different days and poured into 500 ml HDPE bottles (Fig. 5) until they were nearly full. The bottles were then filled twice, emptied twice, and then filled a third time before being sealed. Before collecting the last sample, the bottle was rinsed. Using a technique identical to that employed by [42]. Three times with deionized water, passing the rinse water through the same filter as the original sample, sample vials were rinsed to guarantee “thorough evacuation”. The filtrate was then run through a fresh filter and cleaned glassware after each water sample had been filtered and rinsed in triplicate. This second filtration was done to look for potential contamination "breakthroughs." For instance, even if synthetic fibres had an impractical length, their small diameter might allow them to pass past a filter. Particles discovered during the second filtration were combined with those

discovered during the corresponding sample. Then the previous procedures from was followed and the anthropogenic particles were sent for characterisation.

Place	Date	Time	Temp.
Maduravoyal	March 06 2022	12.30 p.m.	29.8°C
Maduravoyal	March 13 2022	1.00 p.m.	30.4°C

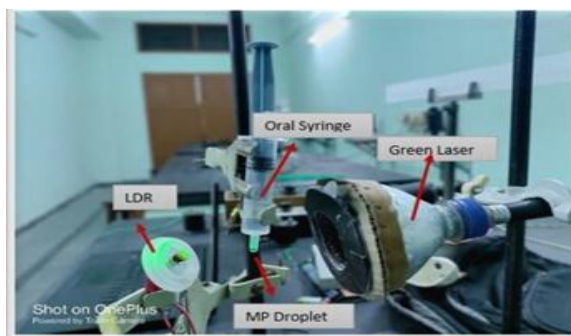
**Table 2. Sample analysis**

**iii. Study III**

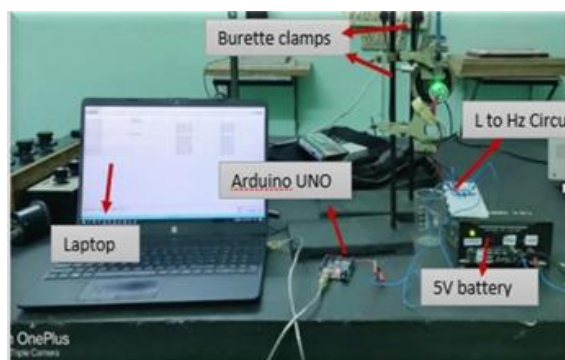


**Figure 6. Green Laser Technique**

A novel experimental method was incorporated in quantifying the microplastics from the same samples that were collected previously called The Green Laser Technique (Fig. 6). The objective of this study was to detect the frequency-change in a Microplastic droplet using a green laser. With the help of frequency-change plotting absorption intensity and wavenumber graph. Experimental setup is shown in (Fig. 7 and 8).



**Figure 7. Experimental setup**



**Figure 8. Experimental setup**

**Apparatus Required**

1. Green laser (520-530nm), 2. 555 timers,
3. LDR circuit, 4. Arduino UNO board, 5. Battery- 5V, 6. Syringe without the needle,
7. Burette Clamp \*2

**Method**

- Light to frequency circuit is constructed.
- Droplet of water is affixed in the burette clamp.
- Green laser of 532/520 nm is focused on the droplet.
- LDR is placed to the other side of the droplet.
- Arduino UNO is connected to the bread board. Continuous frequency change is spotted.

**Initial setup**

- The first burette clamps will hold the laser, the second one exactly opposite to it will hold the oral syringe where the droplet is made to hang at its tip.
- The second image gives much closer view of LDR detecting the frequency of light that has been passed through the droplet of MP.

**Working**

1. We can also see the LDR that is being rightly placed linearly to the second burette clamp to detect the intensity change.
2. This experiment is done in a dark room so that the LDR does not detect visible light.
3. Frequency changes are continuously illustrated using Arduino UNO.
4. Which is then stored csv file.
5. The same experiment was also conducted with a double distilled water sample.

**3. Results and Discussions**

**i. Study I**

Sample No.	Polymer Present	Matching Factor
1	Polyacrylamide	0.64
2	Fibre polyamide 6	0.56
3	Fibre polyamide 6	0.73

**Table 3.  $\mu$ -FTIR Characterisation Results for the First Study**

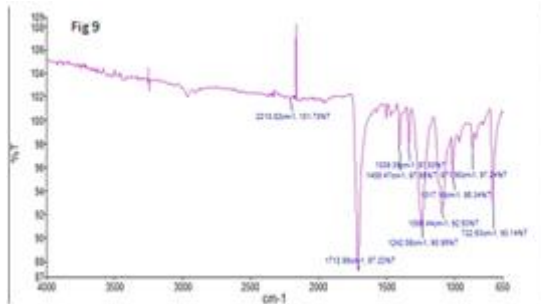
**Discussion**

Results from the FTIR Analysis for Sample No 1,2 and 3 (Fig. 9, 10 and 11) shows us the presence of Polyamides.

What are Polyamides?

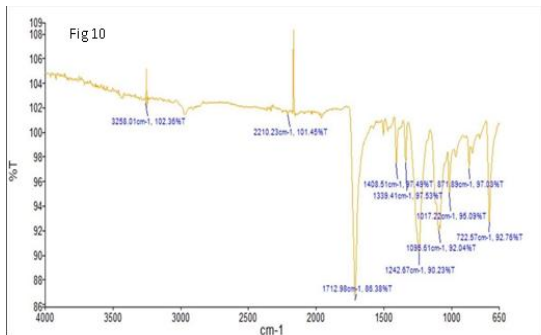
Polyamides are also a type of polymer which are used in textiles such as clothing and carpets it is widely parted in things that need strength and flexibility such as fishing nets, gears, electrical connectors and so on Polyamides is a chemical name for nylon.

Why?



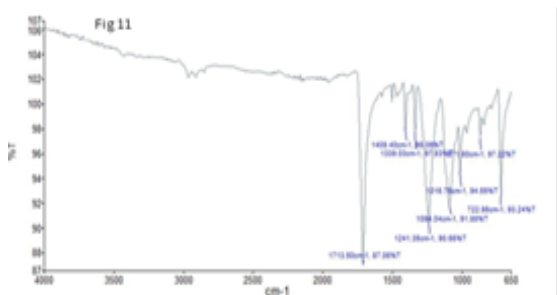
S  
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**Figure 9. FTIR analysis of sample 1**



S  
A  
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2

**Figure 10. FTIR analysis of sample 2**



S  
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3

**Figure 11. FTIR analysis of sample 3**

**Possible Reasons**

1. Presence of heavy chemical industry located near the banks of *The Great Salt Lake Kelambakkam* can be one of the reasons. There is a high risk of factory sewage outlet affecting the drinking water. The heavy chemical industry has had its foundation in 1973, which is now turning out to cause potential health issues in the surrounding.
2. Other reasons can be the tank was covered with the insulation material. Which was in a decaying state. This insulating material is combined with polyester and polyamide type of plastic. When both of these are added together researches say that it produces high resistance to heat.
3. There is also a slight possibility that when the MP meshes are taken with spatula there is moderate chance of the filter material getting attached to it. As the filter bag is also a type of nylon polymer.



ii. Study II

Sample No.	Polymer Present	Matching Factor
1	HDPE	0.86
2	Polyacrylamide	0.57

**Table 4.  $\mu$ -FTIR Characterisation results for the Second study**

**Discussion for Sample 1:**

After FTIR characterization the results for Sample No 1 and 2 (Fig. 12 and 13) shows us that there is HDPE present in the water samples. HDPE is showing a match with a factor of

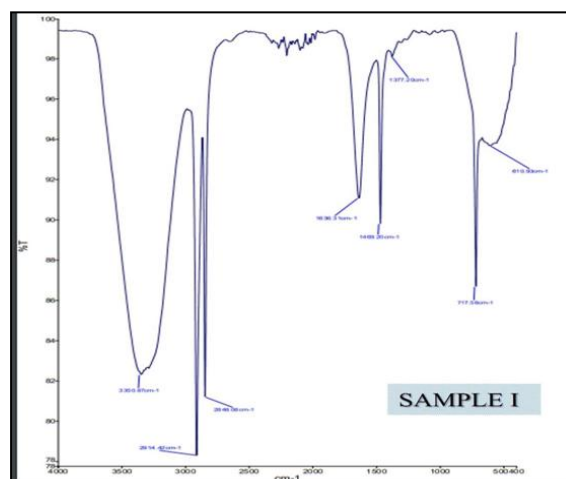
**0.86.** SEM images of the samples are shown in (Fig. 14 and 15)

- HDPEs are High Density polyethylene.
- HDPEs are Thermoplastic.

**Thermoplastics:**

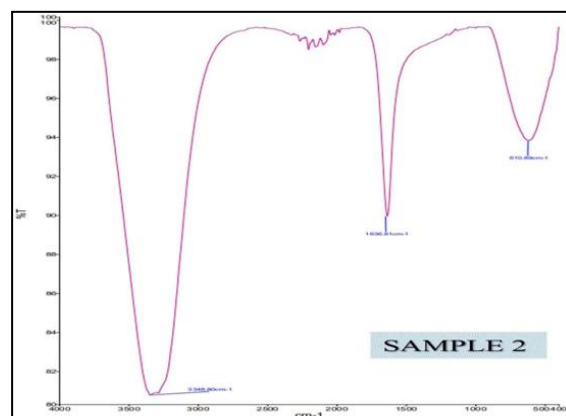
Thermoplastics are part of polymers which can be softened through heating followed by methods such as extrusion, injection, moulding, thermoforming and blow moulding.

**Examples of Thermoplastics are acrylic, polyester, polypropylene, nylon and Teflon.**



**Figure 12. Presence of HDPE in sample**

- They are non-biodegradable and take years to decompose.



**Figure 13. Presence of HDPE in water**

Recent researches show that, UV rays present in the environment degrades HDPE materials. They are not UV stable.



**Figure 14. SEM image of the sample**



**Figure 15. SEM image of the sample**

As these samples were taken at maximum temperature it can be interpreted that the Water

Tank which is PET when in contact with direct sun gets degraded.

#### **Human Health Effects:**

- Researches confirm that it is found to be dangerous to aquatic lives.
- HDPE plastics are considered to be low-hazardous plastic. But not to forget; that does not mean it is not hazardous.

#### **Discussion for Sample 2**

After FTIR characterization the results shows us that there is Polyacrylamide present in the water samples. Polyacrylamide is showing a match with a factor of **0.57**.

- Polyacrylamides (PAMs), are polymer-based materials used to facilitate erosion control and decrease soil sealing by binding soil particles, especially clays, to hold them on site.
- In addition, these types of materials may also be used as a

water treatment additive to remove suspended particles from runoff.

- Polyacrylamides are Organic polymers formed by acrylamide sub units.
- They are regarded as thermosetting plastics.

#### **Thermosetting Plastics:**

Thermosetting plastics are nothing but Irreversible. Once they react with heat and molded to one form, they cannot make it to their primary shape.

- Examples of Thermoplastics are acrylic, polyester, polypropylene, nylon and Teflon.
- They are non-biodegradable and take years to decompose.

**Polyacrylamide** is a thermosetting plastic, there is high chance of this material to have undergone a chemical reaction when they are exposed to UV rays

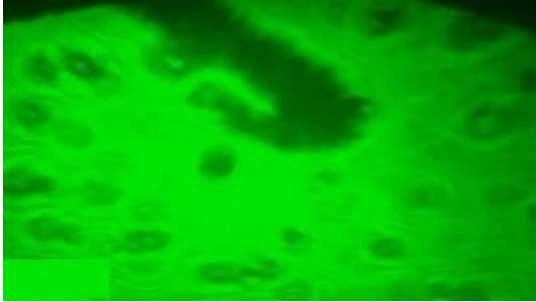
#### **Human Health Effects:**

Researches show that Polyacrylamide is **not toxic**, however, it can eventually break down into acrylamide, which is a skin irritant and toxic to ingest.

#### **iii. Study III:**

Through Deep learning and neural networks, we were able to identify bacteria's (Fig. 16 and 17), anthropogenic substances which were present in the droplet of the sample. The samples were

tested normally and also with the continuous flow (Fig. 18) for 40 minutes and the frequency variation was plotted.



**Figure 16. Bacterial identification**



**Figure 17. Identified bacteria in water**



**Figure 18. Sample analysis with continuous flow**

#### 4. Conclusion

Water has been our source of existence, and plastics have made their way through. This study revealed the presence of microplastics

both in drinking and tank waters. Particles were found almost in every sample, some particles were analysed and. This study also provides a novel method to identify micro particles that are present in a droplet of water. Which can be further developed to a prototype that will be helpful in identification. These findings contribute to the growing body of knowledge about the contamination of human products by plastic. It is crucial to investigate all types of plastics for their capacity to absorb chemicals from the environment and/or release these and other chemical additives employed during manufacturing as research attempts to understand the prevalence of synthetic polymers in human consumables continue. Although the aim of this study was not to produce an in-depth exposure analysis, we worked on identifying and interpreting their cause of existence which we have accomplished.

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## GLOBAL WARMING - A GLOBAL WARNING TO EXACERBATION OF CANCER INCIDENCE AND DEATH

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**Abstract:** Two major causes for the disease cancer are the environment and the life style and personal behaviors. According to a researcher's claim more than the environmental causes the personal life styles and behaviour takes an upper hand in the aetiology of cancer disease. However a perusal of the literature about the latest information about the global warming due to climate change infer the contrary. A single statistical note cautions that the incidences of cancers of the lungs, breast and prostate among the world populations are on the increase as compared to the past years which specifically attributed these cancers to some individuals risk factors and self-life styles. The implications of climate change due to global warming, such as the depletion of ozone, exposure to UV radiations, agricultural upsets in productivity, upheavals of pests and microbial pathogens, gene mutational frequencies, Radon emission and other radioactive materials, contamination of water by such carcinogens like Arsenic, air pollution etc., will exacerbate the cancer disease in human population throughout the world with either more severity in temperate people in contrast to tropics or more severity to tropical population than the temperate counterparts or in equal magnitude in both.

**Keywords:** Environment, Personal behaviors, Tropical, Global warming, Radiations.

### Introduction

This is the ultimate global warning to the forthcoming generations since birth from now on. It is high time to raise awareness about this grave situation and to question whether the world is going to be burdened with morbid or

healthy population. Both options depend upon the inaction and/or action on the part of individuals, community, countries and governance respectively [1].

## Global Warming to Exacerbation

Global warming and climate change are two important man made events of the past / last three to five decades. Consequent to the rapid and unprecedented phenomenon of industrial revolution and technology developments in both the developed and developing countries and also the innate Darwinian principle of prodigious reproduction of organisms including human individuals reproducing a lot more offspring than they should, due to their innate sexual potential and congenial / favourable environment. Human population has exploited the conducive environment for his own survival and sustenance to put it correctly by the sweeping statement of Machiavelli and Hobbes that is “Humans are selfish” and I can say at this juncture as a more selfish Human. Natural environments and / or the earths’ geographical landscapes (multifarious) have their own ecological diagnostic characteristics, which are the outcomes of the natural vagaries or the forces of each and every physico- chemical factor which ultimately resulted into a homeostatic repertoires of natural ecosystems viz.,

- Terrestrial lands/ terrains
- Mountainous landscapes (Montane)
- Forest ecosystems or Biomes
- Freshwater and marine ecosystems.  
Grass lands/ pastures.
- Mangroves . Arctic, Antarctic, and Green lands frozen ice capes.

- Air canopy or the top cover of the stratified layers of the earths’ atmosphere distinguished into-
- Deserts and barren rocks.

All these are the panoramic and highly diversified specializations and habitats of the earths’ environment which was gifted to all species of flora and fauna by the great force of nature. The whole earth in the beginning of evolution and after the establishment of vegetations and fauna before the cultural revolution of human species was like a paradise given unto to Adam and Eve the biblical lovers and the first couples, who enjoyed the lots of beauties and values of the natural earth or the environment , i.e, the Eden garden, which was heavenly and delightful resembling a paradise, with synonyms of the following; Adorable, alluring, angelic, blessed, blissful, celestial, cherubic, delicious, delightful, divine, enjoyable, entrancing, excellent, exquisite, lovely, luscious, holy, God like and immortal. The pioneer settlers in this heavenly earth didn’t aware of the word Hell and its meaning. They were the settlers of the riverside landscapes who developed the world civilization [2]. The notable examples are to cite a few,

- Ancient Egyptians who based on the river Nile.

The Mesopotamians in the Tigris/ Euphrates rivers

- The Ancient Chinese on the yellow river and
- The Ancient Indian culture on the Indus banks
- River settled human population started the revolution of cultural/ species diversity/ diversities in the different parts of the world. Thus, these Nomadic settlers became incessant forest hunters and these hunters became refined to cultivate their own foods and the modern man emerged to unravel the intricacies of technology which caused not only green revolution but revolutions in all walks of life.

The River culture delineates an Eco-Social approach to mitigate the biological and cultural diversity crisis in this earth. Rivers capes are regarded as an interface of aquatic and terrestrial conditions. The Whole society(ies) worldwide are in peril now due to technological revolution and its black lashes.

Since the dawn of mankind, the human species *Homo sapiens* lived in the past, harmoniously in peace with the environment and the environment was also in peace and health. When man emerged as a modern species, the ever growing troubles started due to his prodigality, avariciousness, selfish and destructive barbaric attitudes [3].

The above selfish attitudes became an aptitude of many countries which are self trumpeting as

more powerful and developed by virtue of their technological pursuits, developments, revolutions and new scientific innovations. Now the present generation is living amidst this background of Information technology revolution, Biotechnology Revolution and knowledge enriched foci in such pursuits as foods production and medicines, drugs and weapons of deadly force.

The technological boomerang of the 18<sup>th</sup> century is etiology to the drastic effects and repercussions and reverberations of environmental calamities of 21<sup>st</sup> century to which we belong to viz.,

- The present generation of Human population
- The present generation of developed countries
- The present generation of developing countries, all have made irreparable damage to all vital landscape of the earth and they are held responsible for the most internationally important, and daunting phenomenon of “Global warming” and the attendant “climate change”.
- The predominant and predacious phenomenon that seeded the above global warming are
- Population explosion to belching levels
- Deforestation
- Desertification of fertile lands

## Global Warming to Exacerbation

- Industrial revolution
- Air, Water and soil/ land pollution
- Energy upheavals in the form of gasoline production, thermal source of electricity, nuclearpower generation
- Radiation and Atomic war weaponry stock picking and testing etc.

The minds of modern leaders and populations work like the Evil geniuses bringing disaster to the whole mankind and the whole environment in which he lives and depends fully. The environment is so plastic and resilient that it will bear the brunt of manmade global warming impacts like a buffer and remain forever returning to normalcy / wilderness while man will perish that is the end result of environmental delusions made due to mans'/human action. Global warming is phenomenon, evolved in recent years as a result of remittance of about 31 greenhouse gases (GHGs) from the earth, among which the predominant one being the carbon dioxide (CO<sub>2</sub>) . The tentative upper threshold of global temperature due to global warming is predicted as 4<sup>0</sup> C which is fatal to both man and earth. Health-wise the effects of global warming pertains to several infective diseases in general and to the non-contagious disease cancer in particular. So far the mean global temperature crossed the 1.5 celsius. The implications to human cancers and its break through is imminent and inevitable inspite of

international earth summits conferences, in the long run that is future.

Before 1900 and after 1900 for a few decades, the disease cancer and its etiology was unknown. Even doctors considered the disease cancer as an enigmatic one due to some infections like any other microbial disease. After the promulgation of war on cancer” by the then US president Richard Nixon in his senate in 1971, the therapeutic research to find out the etiology and cure for cancer was started since 1971 and since that period/ year three modalities of treatment procedures viz., Chemotherapy, Surgery and radiation therapy were practiced in clinical settings with more than 300 cytotoxic drugs discovered by the chemotherapy. The present day cancer treatment has seen a sea change, and the survival and remission from the disease is assured for all the types of cancers, consequent to the convention or orthodoxic therapies [4].

However, it brings several doubts regarding the characters and functionalities of Doctors, Surgeons, Hospitals, Researchers, (Oncologists) scientists, Pharmaceutical industries, stores, Government agencies etc. The big questions that remain before us are the following

1. Whether American Medical Association and other countries medical Associations of Europe, Asia are really composed of personals dedicating their lives to the service of mankind,



especially the cancer patients.

2. Whether tens of thousands of researchers throughout the world are sweating and sacrificing their time, blood and energy towards cancer patients for a pecuniary monetary benefit.

3. Whether can we believe and faithfully trust our doctors, hospitals and staffs, pharmacies and drug houses?

4. This is not a botheration of all individuals until it becomes a botheration to them when they find themselves with cancer manifestation in their body.

In this platform I would like to shape the causes of global warming crisis on Human health especially the cancer disease in the light of the research reports and observations, in the field of oncology.

Even before the realization that global warming causes conspicuous environmental impacts and deleterious changes, an explosion of research investigations has been reported about the environmental factors and Human health, especially the cancers. The study of epidemiology describes the various exogenous and endogenous factors that could become prognostic risk factors for cancer. Among these some risk factors can be avoided. Some environmentally induced factors can cause carcinogenesis. Towards this, the following factors could be attributed to global warming as a cause of concern.

**Hormones:** The inevitable effect of global warming is the rise in mean global temperature will have a sequel effect over the women's body temperature. In this context impaired thermoregulation and immune function and occupational heat exposure exacerbated will cause several cancers and specifically the breast cancer.

Melatonin a hormone that protects us from cancer is produced by brain during sleep. Its anti-oxidant properties help to protect DNA from cancer-causing mutation increases after risk of cancer. Likewise cortisol imbalance can cause cancer. Insufficient melatonin could (due to less deep and disturbed sleep) affect levels of other hormones and increases the estrogen. High estrogen increases the risk of breast and prostate cancers. Chronic sleep problems cause higher production of inflammatory fibrinogen, interleukin-6 (IL-6) and C-reactive protein (CRP) which will drive cancer.

The diagnostic feature of body temperature aberrations is the increased production of estrogens in the ovaries and extra-ovarian organs of women in both-menopausal phase (pre-menopausal- post menopausal). The above increase combined with the transformation of normal cells into malignant cancers manifestations will have deleterious effects, since the hormone estrogen can induce active proliferation or metaplasia in vital organs like breast, cervix, uterus and ovary etc.

NEN (nor-epinephrine) will increase the growth rate of cancer by stimulatory tumour cells to produce two collagen-dissolving enzyme that breakdown the stroma around the tumour, and allow/enable the malignant cells to enter into the blood stream of the neo-angiogenic blood vessels. NEN stimulated the tumour cells to release VEGF which promotes angiogenesis. NEN also inhibits apoptosis.

Adrenaline affects the immune functions, as it blocks the neurochemicals of the brain to activate the immune cells. Adrenaline depresses immunity by decreasing the antibodies (B- lymphocytes).

The malignant cells with their own auto-synthesis of estrogen undergo rapid proliferation and growth in post-menopausal women with breast cancer. These cells will have enhanced aromatase activity. i.e estrogen synthase enzyme. In view of these, the global warming to women whose thermal regulation may go astray and induce more breast cancer incidences [5].

In USA the drug/estrogen hormone analog diethylstilbestrol (DES) was introduced as a “wonder drug” and given to women for fertility and to prevent miscarriages by mothers and the drug was in consumption and in vogue in drug stores since late 1940s. Later on in 1950s several reports revealed that girl children born to those who had taken DES on their doctor’s advice suffered vaginal cancers. i.e vaginal

adeno carcinoma, breast cancers, fibroid tumours etc. More than 10lakh women born to 20 lakh consumers of the drug suffered cancer. The male and female reproductive hormones are essential for mankind’s wellbeing and health. The processed foods especially the rice and then cereals are depleted off the above hormones by milling or in the refining process. So it will cause imbalance through food and diet. The pharma industries are involved in introducing drugs to correct the imbalance and many doctors even genuine doctors are misled by the imported medical firms and pharms that is why we call Hormone as bombs in cancer. Any hormone in normal acts as a chemical coordinator and metabolic turnover entity and any hormone in excess is toxic and being syndromes, any hormonal analogue or drug may be a cancer inducer former or cancer coordinator so be careful of Hormone Several food items of our daily life like milk, pasta, fatty items especially animal proteins etc can increase the blood level Insulin like Growth factor-1 IGF-1 a growth hormone that promotes cancer [6].

### **Global Warming- Viruses Epidemic-and Cancer**

One of the implications of global warming is the increase of viral contagions in the atmosphere viz., air and water mainly. A virus is a causative agent of an infectious disease in humans. It is a living morbid principle

transmitted to human body and inside the body cells they integrate themselves with the host cell genome. About 15 percent of the world wide cancer broken is attributed to the oncogenic viruses and it is the cause for second most frequent cancer in women viz., cancer of the cervix. About 80% liver cancers are due to viruses. The viruses directly linked to human cancers are

1. Epstein-Barr virus
2. Hepatitis B-virus
3. Papilloma virus of type 5,8,14,17,20 and 47, 16,18,31,35,39,45,52,56,58 etc.
4. HTLV-1

I - Virus (directly) linked cancers are

1. B-cell lymphoma
2. Burkitt's lymphoma
3. Nasopharyngeal cancer
4. Hodkin's disease
5. T-cell lymphoma
6. Hepato cellular carcinoma
7. Skin cancer
8. Cancer of the cervix
9. Anogenital cancer
10. Cancer of the tonsils
11. Cancer of the nail beds
12. Verrucous carcinoma
13. Adult T-cell leukemia

**II- Potential Human Tumour viruses include:**

- ❖ Novel Papilloma Virus Types
- ❖ HPV 16,18,33,57,73
- ❖ Herpes virus Type 8
- ❖ Hepatitis C
- ❖ JC, BK and SV 40like polyoma –type viruses

- ❖ Human endogenous Retroviruses (HERV-K)
- ❖ Adenoviruses

**The various Cancer Outcomes due to These Potential Viruses Include**

- ❖ Squamous cell carcinoma
- ❖ Cancers of the oral cavity, tongue, oesophagus.
- ❖ Kaposi Sarcoma
- ❖ Hepatocellular carcinoma
- ❖ Low grade lymphomas
- ❖ Brain tumours
- ❖ Pancreatic islet tumours
- ❖ Mesotheliomas
- ❖ Seminomas
- ❖ Germ cell tumours

Besides these the viruses indirectly involved in Human cancers are

- ❖ HIV I & II
- ❖ Herpes Simplex Virus (HSV)
- ❖ Cytomegalo virus
- ❖ Varicella zoster virus
- ❖ HIV

The causal involvement of oncogenic viruses and their infectious etiology could be traced before one hundred years/one century, since the first animal data on cancer induction by animal viruses is available before 110years.(Gross 1983;Rous 1911). The process or mechanism of transformation of a normal cell into a malignant one has been amply illustrated by studies in vitro on the carcinogenicity of HPV and its

tumorigenic potential. The varied reactions inside a cell after the infection and insertion of these viruses in human tissues are following.

- The DNA furnished by the infections virus will induce proliferation and promote malignant phenotypes. The cell culture experts proved by demonstration that viral DNA integration or specific viral gene functions are constructed to be paramount for carcinogenesis.
- The viral oncoproteins will to cellular proteins of the suppressor genes P53/TP53, pRB and override the cell cycle control mechanisms.
- The viruses will also bring of induce chromosomal aberrations towards transformation to malignancy.
- In the oncoviral induction of cancers, the physical carcinogens do have a contributory adjuvant role cellular P53 genes exhibit no deifications at sites exposed to chemical or physical mutagens followed by viruses eg Basal cell and squamous cell carcinomas of the skin (Sharmanin *et al* 1996). Similarly following X-irradiation the squamous cell carcinoma of the larynx exhibited expensive laryngeal papillomatosis (Zur Hausan 1977).
- Viral genes contribute to the immortalization of the Host tissue cells then the immortalized host cells become

cancer cells. Here another hormonal adjuvant activity responsible for the infected cells transformation is that of glucocorticoids. The use of oral contraceptives also plays like this in immortalization, transformation and manifestation of cervical cancers. Viruses also reduce the telomerase activity in the host cells for the immortalization.

- Immune unresponsiveness brought by the viruses proteins is also a molecular event in carcinogenesis wherein the virus- transformed cancer cells will not be recognized by host immune cells (T-cells)

Radiation effects in carcinogenesis due to global warming consequences may not be unexpected since the escalation of atmospheric GHGs cause ozonolysis and allow the penetration of harmful ultra-violet radiation to the earth. The consequent exposure to UV is therefore is inevitable. The best example for cancer prevalence as an after effect in Japanese population in the atomic bomb explosion happened in 1945 at Hiroshima and Nagasaki (the little boy and Fat man). It implies not only the direct radiation injury to cells and their transformation to malignant phenotypes, but the impact of other adjacent factors like thermal disturbance in body coupled with these the rise in temperature of the ambiences can also bring

collateral damage to body cells in the form of carcinogenic mutations and chromosomal changes like that of fusion elements, between chromosome 9 & 22 i.e the philadelphia chromosomes leading to AML and ALL, CML, cancers (Cowles 1965). As early as 1965 the reports have revealed that increasing the temperature caused increased rate of genetic mutations in the mammalian gametes (prospective) [7].

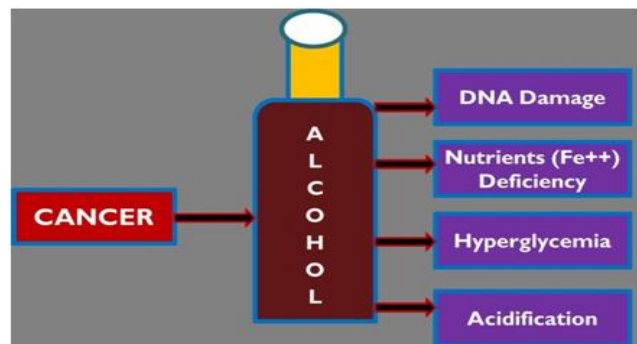
### **How Alcohol is an Inducer and Promoter of Cancers**

Whenever you see an alcoholic beverage in a bottle it is like death in a bottle i.e the visualization king Alcohol as a human carcinogen. Even moderate alcohol drinking can increase incidence of cancers like the breast, liver, rectum, mouth throat and oesophagus. There is no safe level threshold for alcohol consumption. All levels in the long run, chronic consumption can cause cancer. Our body iron exists in bound form in ferritin and transferrin proteins. Alcohol will release iron from these protective proteins, and the raise in the level of free iron in the body, cause intensely inflammation prior in tissue/cells for malignancy. A report in a 2011 Breast Cancer Research and treatment found that iron levels were five times higher in the human breast fluid.

### **Suffering Breast Cancers**

Global warming will witness the prevalence

and breakout of more pests in environmental which may destroy productivity in food sector. To the pest problem the corporate industries will produce more pesticides. The chlorinated pesticides are sure chemicals to forming cancer without any doubt. When chlorine comes out in environment in vaporized form it is 100 times more damaging than the chlorinated water.



Chlorine is an irritant pungent smelling chemical that can cause the following effects which in turn may turn the normal cells transform to cancers.

- ❖ It penetrates the skin and enters inside the tissue cells through cell membranes.
- ❖ It oxidizes the fatty acids in the cells producing free radicals.
- ❖ It damages DNA, it is tamarind that free radicals are one of carcinogenic agents (Ref) [An average American is accumulating about 175 organ-chlorine compounds in his body]
- ❖ Chloroform found in chlorinated water cause cancer in human (swimming pool waters).

- ❖ Higher levels of chlorine in the breast tissue of woman with breast cancer.

### **Forest Fires and Air Pollution**

Temperature increase causes forest fires naturally. This natural forest fire releases several gases which are pollutants like nitrogen oxides, ozone, and lead and carbon compounds. The retardants to also extinguish the forest fires contain Ammonia nitrate or Amin. Phosphate which is also toxic. It is predicted that Global Warming will segment and accelerate more forest fires. These chemicals will in future produce more cancer incidences.

In sum, the process of Global Warming is the total outcome of man's new inventions and technologies which gave increase benefits as well as inevitable evil consequences and back levels. Today the plight of man is comparable to the first mortal woman of Greek Mythology PANDORA who was given a mysterious box by the wife of ZEUS with the warning that she should not open the box. But she opened the box which was filled with gifts and more calamities. This spread throughout the humanity with all the disastrous consequences. Thus Pandora's box source of muck, sufferings, disasters, despairs, diseases and the hope for good is lying at the bottom which is bleak.

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## SOCIAL DETERMINANT OF HEALTH OF PALIYAR TRIBAL WOMEN IN DINDIGUL DISTRICT, TAMIL NADU

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### Abstract

Tribal are indigenous people, practice their own distinctive culture, reside in geographically isolated and live with poor socio-economic condition. The Sustainable Development Goal (No.3 & 5) focus on the health and wellbeing and safe drinking water and sanitation for all the vulnerable community group to emancipate from their poor health status. The tribal women requires attention on socioeconomic issues like illiteracy, early marriage, employed in very menial job, low-income, improper diet and lack in decision making at home and in community. The highest burden on women's health is faced by tribal women due to gaps due to malnourishment, poor accessibility of health care services and superstitious believes on health aspect. The main focus of this analysis is to identify the basic health condition of tribal women, in order to enhance their health and wellness. For this the researcher adopted sequential explanatory research design and selected 110 respondents by applying simple random sampling technique from three panchayat of Dindigul district, Tamil Nadu. The researcher utilized both primary and secondary data for the research. The primary data was collected by applying self-structured interview tool for quantitative study to identify the real health issues faced by Paliyar tribal women. The study analysed frequency, chi-square test and Carl Pearson coefficient of correlation. The results of the study reveal the poor female literacy, socioeconomic condition child marriage, insufficient resident facilities and poor sanitation among the respondent leads to insufficient food consumption prevail among the tribal women. Nearly one third of the tribal women have poor BMI level. The study propose the government to take up solid initiatives to enhance the health status of the tribal women in Kodaikanal hills.

**Keywords:** Health status, Tribal women, Socio-economic condition, Food consumption.

### **I. Introduction**

In this third millennium, India become the 1<sup>st</sup> place in the population of having 1.41 billion on May 2023 in the world. Among the tribal population are holding 10.2 per cent of the total population. In Tamil Nadu the total tribal population fall around 8 lakhs named 36 tribes. The Paliyar community reside in Madurai, Dindigul and Tirunelveli Districts among the study which we have taken in Dindigul Dt. of Paliyar community reside in Kodaikanal, Sirumali and Palani Hills. The Paliyar tribal community got their legal rights in 2006, so the development process of this particular community is recent one and lacking behind in accessing basic amenities which intern affects the health status [1]. This study focus on Sustainable Development Goal (SDG), No.3 &6 on Health and Wellbeing, and Safe Drinking Water and Sanitation which is very basic for all human being. The tribal people are not aware of these and are alienated from these developmental goals. Among the tribal women are far away from the process of development which the study would like to highlight [2].

### **II Literature Review**

The social, economic and political determinants of health along with healthcare institutional facilities. According to the social determinants of health, it be defined as ‘the environment in

where the particular person born and brought up, reside, earn for livelihood and grown, and institutional services assist in getting access to good health. (WHO 2008) [3].

Tribal people in general are indigenous groups, reside in a in particular geographical location and are highly disease prone. They fail in acquiring the basic health facilities due to their poor health seeking behaviour. These people are, neglected, exploited by the health care institutions and poor intake of food leads to extreme susceptible to illnesses with high unit of malnourishment, mortality and morbidity. The occurrence of under nutrition among the tribal adolescent girls in Kodaikanal region is quiet high. The anthropometric assessment identify the under nutrition among the study population [4].

The WHO propose that the three components on the socioeconomic, physical t, and the individual’s health seeking behaviours are the basic three components which determine the health. The environment, especially the climate condition and the access to clean and pure natural resources also contribute to determine their health. Moreover, the individuals are unable to directly control over the many aspects of the health determinants. (WHO, 2017). The health-seeking behaviour which is closely



connect with their tradition, myths, superstitious believes and practices with diseases and health. The India the conditions of tribes is at threat due to the genetic disorder, non-communicable, communicable and occupational diseases are heavy economic burden for the tribal women [5].

### **III Research Methodology**

#### **3.1 Operational Definition**

The tribes refers to a particular group of people live in an isolated and unpolluted environments, specific geographical location that is, forests and mountains that are far from the highly developed modern civilization. They have their own specific cultural practice, language and livelihood condition depend on the forest produces.

Health is not only the absenteeism of disease, rather a condition of a person having good physical, psychological and social well-being. This compiles the holistic aspect of a person to lead his/her life with dignity [6].

#### **3.2 Objectives**

- To understand the demographic characteristic of Paliyar tribal women.
- To identify the socioeconomic determinants of health of the tribal women respondent.
- To suggest strategies for the enhancement of the health status of the respondent.

#### **3.3 Research Design**

The descriptive research design was applied to study the health status of the respondents In this design, researcher collected the quantitative, numeric data from 110 respondent [7].

According to 2011 census 1057 tribal family reside in Kodaikanal hills, have taken as universe. One married adult women aged 18 above and 60 below from each house hold randomly selected for the study from total population of the village. Kodaikanal hills station function under 17 village panchayat, among three village Panchayats namely Kamanur, Thandigudi and Pannaikadu randomly selected. Based on the population the 5 villages from three Panchayat were selected, among Moolaiyaru, Vadagaraiparai, and Vazhagiri fall under Pannaikadu, Kaduguthadi come under Thandigudi and Maliyakadu village from Kamanur Panchayat. The respondent from each village were randomly selected based on the total population of the village.

The structured interview schedule applied to collect data from the tribal women on the demographic profile, health assessment on Body Mass Index (BMI) scale, and for the socio-economic assessment the researcher applied the Kuppusamy Socio-economic scale (2023) reversed version. The self-structured psycho-social wellbeing, 5 point Likert

acceptance scale was drafted, based on review of literature under two major category Psychological and Social wellbeing status of the women [8].

The study applied SPSS tool to analyse the data. The frequency and Correlation analysis were done to identify the health status of the women. The normality, reliability and validity was analysed based on the individual items of the scale which was drafted.

### 3.4 Hypothesis Drafted

***Ho<sub>1</sub>***: There is no significant relationship between demographic variables

***Ho<sub>2</sub>***: There is no significant relationship between demographic variable with Body Mass Index

***Ho<sub>3</sub>***: There is no significant relationship between demographic variable with Socio-economic status

***Ho<sub>4</sub>***: There is no significant relationship between demographic variable with psychosocial wellbeing

## IV Interpretation and Analysis

### 4.1 Age of the Respondent

Table 4.1, the age group of the respondent are presented. Nearly more than one third of the respondent 41 or 37.3 fall around 25 – 35 age, followed by nearly one fourth of the respondent 25 or 22.7 below 25 age

fall around 35 – 45 age. The 23 or 20.9 percent of the respondent 45 above age followed by 21 or 19.1 percent of the respondent come around below 25 age.

### 4.2 Socioeconomic Status of the Respondent

The Socioeconomic condition (SES) is valued in calculating family income of both husband and wife and the income from the agricultural land, level of education the individual received, and occupation of the individual. SES is assessed with the very basic dimension of the respondents overall health and the access to resources [6].

The Figure 4.1, Kuppusamy Socioeconomic scale is a common tool to assess the socio-economic status of the respondent. It comprises the score which has three domains, namely Education, Occupation and Income of the Family. After calculation of each domain the total score calculated within a range between 5–29. Based on different ranges they are categorised in this figure; The lowest range ( $\geq 5$ ), 12 or 11.8 percent, the upper lower fall under 89 or 80 percent, the lower Middle 7 or 6.4 percent, finally very minimum upper middle 2 or 1.8 percent. This shows that the majority 80 per cent of the tribal women live in upper lower socioeconomic condition. Here the government need undertake strategically intervene to increase the socioeconomic

condition of the tribal community. This will reduce the prevalence of child Marriage and increase the educational status of women [9].

#### **4.3 The Resident Pattern of the Respondent**

Table 4.2 explain about the housing pattern of the respondent. Nearly half of the respondent 52 or 47.3 percent of the respondent live with the cement wall with centring house. The remaining half of the respondent put up the house on their own or with the financial assistance of the NGOs. Among these the one fourth 24 or 21.8 percent resident in cement wall with sheet, the other 16 or 14.5 percent in mud wall with sheet, the remaining 12 or 10.9 percent in mud wall with roof. The good resident facilities give the people to protect themselves from natural climate condition thus leads to good health status, especially in the hill station [10].

#### **4.4 Sanitation Facilities Available**

The table 4.3, show the sanitation facilities available for the respondent. There are nearly half of the respondent 51 or 46.4 percent can access the individual toilet facilities. The other close to one quarter 21 or 19.1 percent depend on common toilet facility. The other one third 38 or 34.5 percent are still practicing the open defecation. This will lead the tribal community prone to communicable

diseases like diarrhoea, malnourishment etc.

#### **4.5 Food Consumption Pattern of the Respondent**

The table 4.4 portray the food intake pattern of the tribal women. There are more than one quarter 31 or 28.2 percent of the respondent take two meals per day due to poverty. The other remaining three fourth 79 or 71.8 percent of the respondent take three meals per day but the food is full-fledged nutritional contend is questionable. The socioeconomic condition is directly linked with the intake of meals.

#### **4.6 The Body Mass Index**

The table 4.5 illustrate the BMI level of the respondent. The majority, more than half 62 or 56.4 percent of the respondent are in healthy weight category followed by one third 35 or 31.8 percent of the respondent are underweight category. The remaining 13 or 11.8 percent of the respondent are overweight category. Here the study recommend the government intervention to enhance the tribal women health status in order to bring the underweight category to access nutritional food to improve the health status of the tribal women [11].

#### **4.7 Normality Test for Psycho-Social Wellbeing Scale**

The normality test used to investigate whether the set of scores Assessment of

Psycho- Social Wellbeing scale was normally distributed. Statistical tests like Skewness and Kurtosis were calculated to examine the assumption of the normal distribution.

The mean score for health status of tribal women in table 4.6, showed that, the Psychological wellbeing mean score ( $\bar{X} = 3.26 \pm 0.791$ ), followed by Social Wellbeing ( $\bar{X} = 3.55 \pm 0.913$ ), Thus, the values indicated that the tribal women Psycho-social wellbeing are quiet high. The range of skewness and kurtosis portrayed that, skewness ranged from -0.427 to 0.716 and kurtosis ranged from -0.234 to -0.807 for the Psycho-social wellbeing of the respondent.

#### **4.8 KMO And Bartlett's Test for Sample Adequacy of Psycho-Social Wellbeing Scale**

The KMO test is applied to determine, a set of data is suitable for investigation, at the same time the adequacy of sampling is also tested. The strength of the relationship between variable is assessed through Bartlett's of Sphericity (Noor, 2016).

Kaiser recommends a minimum of 0.5 value of KMO as low not fit, and the value between 0.5 to 0.7 as mediocre, value between 0.7 and 0.8 as good, value between 0.8 and 0.9 as great, and value between 0.9 and above as excellent (Graeme & Nick, 1999).

The above table 4.7 showed that, the KMO value for the Scale for Psycho-Social Wellbeing for the tribal women scored as 0.717 with the significance of Bartlett's test Sphericity at 0.05 level. Thus the KMO value indicated that the data was adequate for the analysis.

#### **4.9 Principle Component Analysis For Psycho-Social Wellbeing Scale**

The statistical software applied to analyse the Principle Component Analysis (PCA). The PCA examined the variability between the 21 items of Scale for Measuring the Psycho-social wellbeing of the tribal women. As a criterion to retain items, as Eigenvalues >1 was retained. In addition, within items, the items that loaded 0.5 or higher on the expectant items was retained. On the basis of these criteria, all the 9 items of the Scale for 2 dimensions of the Psycho-Social Wellbeing on health status. The total value signified that 9 items have been reduced into two significant constructs with total variance of 52.81 per cent. The individual variance was statistically significant at 0.05 level, leading to the formation of two predominant constructs with appropriate variable loading [12].

The table 4.8 portray that the items established under two dimensions such as Psychological Wellbeing, Social Wellbeing of health status. It is also depicted that the variance among the 9

items ranged from 0.518 to 0.868. This described that the variance ranged from 27.387 per cent to 52.819 per cent, which indicated.

The reliability coefficients of individual items of the variables in this study has adequate value ( $\alpha > 0.7$ ). Therefore the internal consistency of the constructs in this study is very higher in reliability coefficients.

#### **4.10 Correlation Between Demographic and Health Status of the Respondent**

The WHO define Health as full-fledged state of mental, physical, and social wellbeing and not merely the absence of diseases. The health condition of each individual and community is determined by the people live around and its causative factors of Age, Education, Marital Age, Socioeconomic status in relation with BMI (physical), Psychological (mental) and Social wellbeing.

As shown in table 4.9, the age shows that the significant high negative correlation with education ( $r(110) = -0.611^{**}$ ;  $p < 0.01$ ), very poor negative correlation with age of marriage  $r(110) = -0.235^*$ ;  $p < 0.05$ ), moderate negative correlation with socio-economic status  $r(110) = -0.306^{**}$ ;  $p < 0.01$ ), and poor positive relationship with the Body Mass Index value ( $r(110) = 0.235^*$ ;  $p < 0.05$ ). The study conclude the younger age group women get a higher educational opportunity and becoming literate compare to the aged population. At

the same time the young women got married after the matured age compare to elders. Regarding the health aspect the senior age women are having balanced BMI than the young age women.

Education show significant moderate positive correlation with age of marriage ( $r(110) = 0.535^{**}$ ;  $p < 0.01$ ), that means the higher the women are educated the increase the age of marriage. The significant moderate positive correlation with the education, this indicate the higher the women are educated the higher the socio-economic condition of the respondent. On the other hand significant poor negative correlation with Body Mass Index and education ( $r(110) = -0.192^*$ ;  $p < 0.05$ ). The higher the women are educated, the care of physical aspect become poor. Though the women gat school education will never enhance the health seeking behaviour.

The socio-economic condition indicate moderate positive relationship with the marital age ( $r(110) = 0.446^{**}$ ;  $p < 0.05$ ). The higher the socio-economic condition the increase of marriage age. On the other hand the socioeconomic condition show low negative correction with BMI ( $r(110) = -0.277^{**}$ ;  $p < 0.05$ ). This indicate that the women work hard to increase the socioeconomic condition fail to take care of their health status. The psychological wellbeing has moderate positive

correlation with social wellbeing ( $r(110) = 0.475^{**}$ ;  $p < 0.05$ ). The social network bring positive psychological wellbeing of the respondent.

### **Suggestions**

- Intake of regular nutritional food in their daily diet will keep the proper health condition of the respondent.
- The study illustrate the poor resident pattern of the respondent in Kodaikanal hills. Priminister Asaz Yojana (PMAY) need to be implemented by providing the proper residence for this tribal community people.
- The poor sanitation facilities contribute a lot that the women and children be prone to vector borne diseases. The Swatch Bharath Abiyan need to keenly observe that status of the tribal people and provide them with proper sanitation facilities.
- Screening major non-communicable diseases and provide preventive medication will lower down them from chronic illness.
- The ASHA Workers need to give awareness on nutritional food intake, health and hygiene and legal measurers of the marital age etc. thus will bring a drastic

changes among the tribal women to enhance their health status.

- The poor socioeconomic status illustrate the poor educational status and poor income status of the respondent. This explains the high dropout rate among the tribal women. This dropout of young girls need to have special attention with vocational skills training on processing of non-timber forest product to increase the income status of the tribal women.
- The future health status of the tribal society is calculated in terms of the present health status of the tribal community. Henceforth, the health issues of the tribal community need to be seriously taken into consideration through strategically health policies.

### **Conclusion**

The literacy, subsequent awareness on nutritional food and health behaviour in life are the key factors for healthy life for all human societies. Paliyar tribal women often have poor access to education, entangled into child marriage, do not enter the organized sectorial labour force, and do not have access to sanitation facilities thus leads to face severe health risks. Tribal women's income is a key factor for the basic fulfilment of household

expenditure; moreover tribal women work as daily wagers in unorganized sector labour force. The study observed that socio economic status of Paliyar tribal women is not in escalation rather stagnation mode. Accesses to government programmes and policies on development are in snail pace to reach the target community. Since history Tribal community and women are the most marginalized community and denied even their basic rights. Most of the social security and welfare measures do not benefit the tribal women. The intervention on improvement of tribal need to be the focal to bring the holistic development of the target community.

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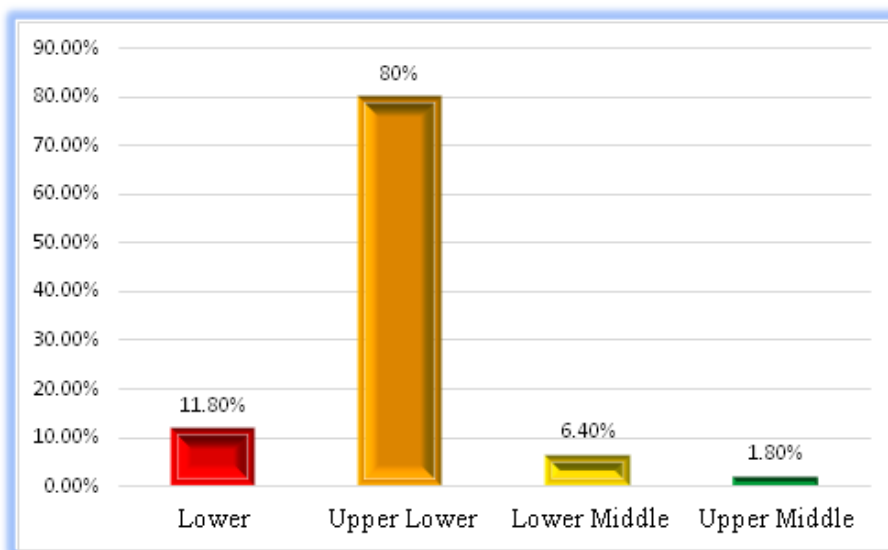
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**Figure 1. Socioeconomic Condition of the Respondent**

Age Category				
Sl. No	Age	Frequency	%	Total
1	Below 25	21	19.1	21
2	25 - 35	41	37.3	41
3	35 - 45	25	22.7	25
4	45 Above	23	20.9	23
<b>Total</b>		<b>110</b>	<b>100</b>	<b>110</b>

**Table 1. Age of the Respondent**



Sl. No	Type of Residence	Frequency	%	Total
1	Cement wall/Centring	52	47.3	52
2	Cement wall / Tiled	6	5.5	6
3	Cement / Sheet	24	21.8	24
4	Mud Wall / Sheet	16	14.5	16
5	Mud Wall / Roof	12	10.9	12
<b>Total</b>		<b>110</b>	<b>100</b>	<b>110</b>

**Table 2. The Resident Pattern**

Sl. No	Sanitation Facilities	Frequency	%	Total
1.	Individual Toilet	21	19.1	21
2.	Common Toilet	51	46.4	51
3.	Open Defecation	38	34.5	38
<b>Total</b>		<b>110</b>	<b>100</b>	<b>110</b>

**Table 3. Sanitation Facilities Available**

Sl. No	Food Consumption	Frequency	Percent	Total
1	Two Meals Per Day	31	28.2	31
2	Three Meals Per Day	79	71.8	79
<b>Total</b>		<b>110</b>	<b>100.0</b>	<b>110</b>

**Table 4. Food Consumption Pattern**

Sl. No	BMI Category	Frequency	Percent	Total
1	Under Weight	35	31.8	35
2	Healthy Weight	62	56.4	62
3	Over Weight	13	11.8	13
<b>Total</b>		<b>110</b>	<b>100</b>	<b>110</b>

**Table 5. The Body Mass Index**

Well Being	Mean	SD	Skewness	Kurtosis	N = 110 Minimum = 1 Maximum = 5
Psychological Well being	3.26	0.791	-0.427	-0.807	
Social Wellbeing	3.55	0.913	-0.716	-0.234	

**Table 6. Normality Test for Psycho-Social Wellbeing**

Health of Paliyar Tribal Women

<b>Kaiser-Meyer-Olkin Measure of Sampling Adequacy.</b>		<b>0.717</b>
Bartlett's Test of Sphericity	Approx. Chi-Square	370.267
	df	45
	Sig.	.000

**Table 7. KMO And Bartlett's Test for Psycho-Social Wellbeing Scale**

Variable Name	Construct	Items	Extraction	Total Variance %	$\alpha$
PsyWe1	Psychological Wellbeing	I am happy in my life	0.752	<b>27.387</b>	<b>0.746</b>
PsyWe2		I can handle anxiety in my life	0.774		
PsyWe3		I have positive scope about my future	0.802		
PsyWe4		I accept myself as I am	0.548		
PsyWe5		I am satisfied with the relationship with the tribe	0.518		
SocWe1	Social Wellbeing	The tribe which I belong give enough support	0.721	<b>52.819</b>	<b>0.714</b>
SocWe2		I feel I am one among the member of my tribe	0.602		
SocWe3		I have good terms with the people around	0.624		
SocWe4		I contribute for the betterment of my community	0.868		

**Table 8. Principle Component Analysis**

	Age	Education	Marital Age	Socio-Economic	BMI	Psychological Wellbeing	Social Wellbeing
Age	<b>1</b>						
Education	<b>-.611**</b>	1					
Marital age	<b>-.235*</b>	<b>.535**</b>	1				
Socio-Economic	<b>-.306**</b>	<b>.653**</b>	<b>.446**</b>	1			
BMI	<b>.235*</b>	<b>-.192*</b>	-.167	<b>-.277**</b>	1		
Psychological Wellbeing	.033	-.030	-.009	-.036	-.144	1	
Social Wellbeing	-.038	-.061	-.106	.007	-.082	<b>.475**</b>	1

\*\* . Correlation is significant at the 0.01 level (2-tailed).

\* . Correlation is significant at the 0.05 level (2-tailed).

**Table 9. Correlation Between Demographic and Health Status of the Respondent**

## INDIGENOUS VALUES AND SUSTAINABILITY

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### Abstract

Indigenous Peoples in all diversity, are stewards of over 25% of the world's surface area and approximately 80% of earth's biodiversity is located within those areas. biodiversity is conserved where the indigenous communities continue to live. A harmonious co-existence is seen between the indigenous communities and ecological surroundings. A healthy environment creates a healthy human community free from sickness, famine and depravity. A healthy community and healthy environment would mean a human and ecological community free from all corruptions, injustices and exploitation. The social, cultural and economic life of indigenous communities are intertwined. There is a beautiful blend of work, worship and celebrations in tribal life and culture which they draw from their natural surroundings. The feasts and celebrations are closely linked with agricultural operations and as such they reflect the harmony that exists between the tribe, nature and their ritual practices. The spiritual vision of indigenous life can show a way for sustainable and harmonious co-existence.

**Keywords:** Biodiversity, Co-existence, Harmony, Ecology, Sustainability, Conservation.

### Introduction

Indigenous peoples, including hunters, fishers, herders, nomads, semi-nomads, PVTGs, tribals, first nations, aboriginals and others, are stewards of over 25% of the world's surface area; approximately 80% of earth's biodiversity is located within those areas. As global biodiversity is threatened, echoing impacts are anticipated for the well-being of Indigenous peoples including all living beings. The political will and current

approach of the recent Global Summits and environmental protective measures by the world leaders on biodiversity conservation are not sufficient to address the problems. Many efforts and measures tend to be colonial in origin, which are based on narrow disciplinary perspectives and as a result they have systemically marginalized Indigenous values and voices across the globe. The economic activities and orientations of the colonial governments in many parts of the world

were oriented to suit the purpose and interest of the then colonial powers. The ruling powers in the post-colonial countries by and large followed the footsteps of their colonial masters aiming at “development as economic growth.” The social evils like discrimination on the basis of caste, gender, social groups, poverty, corruption etc. continued to grow together with economic growth in the name of ‘development.’

The practices of development in general have resulted into hazardous consequences on humanity, ecology and environment. With the passage of time the increased negative impacts of ‘development as economic growth’ have forced the world leaders, researchers, scientists, social scientists and planners to rethink about development. It is here the world and worldview of the Indigenous communities with their symbiotic living style, perceptions of human life in a general continuum, their co-existence and interrelations with nature and its surroundings can show us the way. In the light of this premises, I present “Indigenous Values and Sustainability” for a sustainable living.

### **The Indigenous Social Conception**

The core of the economic philosophy assumed within the ideology of tribal economy and society are production for consumption and not for amassing for

future. There is a general belief that the future will take care of the future generation. As long as the symbiotic relation within natural- human and supernatural world is maintained the world will continue nurturing each other always. On the contrary, we find, the dominant Indian society is highly hierarchical and is characterized by caste and class, high and low, and domination and subordination. Naturally, the philosophy of life will be very different in the above-mentioned two types of human societies.

There is a beautiful blend of work, worship and celebrations in tribal life and culture which they draw from their natural surroundings. The feasts and celebrations are closely linked with agricultural operations and as such they reflect the harmony that exists between the tribe, nature and their ritual practices. The values the tribal communities cherish the most are-

### **Connection with the Land and Forest (Natural Resources)**

Land is the greatest asset for the tribals. This greatest asset is the source of their life. “Everything spring forth from the earth. The trees, the rivers, the flowers, fruits, grains and so on. People may live [1] by what the land provides”. Thus, the land is a life giving source which has the germinating power in it which provides everything to tribals. Secondly land is a

sacred gift of God for their survival and for the stewardship of the land. God is the Creator therefore land belongs to God and to the tribal community. There is no individual ownership in the land. Tribals are inseparably and intimately connected with the land that they consider it as their loving parents. They are born out of the earth. The earth or the land is the parents, who always deserve reverence and care. Hence, the land should be protected and cared for rather than to be sold and misused.

Forest is the wonderful creation of God in which there exist all kinds of trees and plants, creepers and leaves, flowers and fruits, herbs and vegetables, springs and rivers, grounds and mountains, and the birds and animals. Tribals' lives are very much associated with the forest. "They depend on forests for food, fuel, wood, housing material, herbal medicines, fodder for cattle and material [2] for agricultural implements". Though, they make use of the forest for various needs yet they are the care taker of the forest. By nature they are forest loving beings. Chirping of the birds become their song, swinging of the leaves and branches become their dance, fruits, flowers and vegetables their food, rivers and springs their life and the animals of the forest become their helper. Thus, the whole reality of tribals' lives can be

understood from the perspective of land and the forest.

Today, when the whole world is worried about losing the biodiversity and has concern for protecting the forest and various species the tribal community had this concern from much earlier times. These simple tribals might have not comprehended the scientific reasons and the biological harm by being indifferent towards the forest and the environment. However, they have a pure friendly and filial concern for the ecology.

Socio-Cultural Resources (Indigenous Values)

### **Ecological Sensitivity**

Ecological sensitivity is inborn in tribal psyche. Tribal communities have always cherished their autonomous life in the lap of nature. The nature and various happenings in the nature by way of natural cycle throughout the year, the agricultural cycle and socio-cultural practices adopted according to the rhythm of cycle in nature train an individual into a true indigenous way of life. It is here an individual grows in the close human and ecological sensitivity. It is in this setting that, humans, nature and other created beings become complementary to each other.

Environmental contamination and degradation affect the human health and well-being of all. Such contaminations and degradations caused by profit-making

tendencies in humans are often the direct result of violation of the collective rights of indigenous peoples and nature. The environmental contaminants from sources such as mining, oil and gas industries, as well as climate change and resource depletion have serious health consequences for local indigenous communities. The siphoning out of uranium in Jadugoda in Jharkhand has caused serious environmental contamination and degradation of the nature. There is a direct impact of contamination and degradation of nature on people; as a consequence, the dust particles of uranium unearthed by human means have grave ecological hazards in the surrounding regions of Jharkhand. The environmental contamination has a lasting effect even on the forthcoming generation. Besides the people, animal and environment almost every new born baby is born with some physical and mental deficiency and deformity. The consciousness that human well-being flows from the well-being of nature and ecology, animal world and other human beings comes from the indigenous worldviews very emphatically. The ill-effects of contamination and environmental degradation migrate to other regions by air, canals, rivers, radiation, atmosphere and ocean transport cause massive deaths and health hazards.

Neither the governments nor the transnational corporations seeking profit in these industries share the values of conservation and sustainability practiced by indigenous peoples for thousands of years.

### **Harmonious Co-existence**

As keepers of life sustaining resources, indigenous peoples have proven to be successful in developing mechanisms and techniques in harmony with their environment. The economic use of land, forest and water and other resources points towards a harmonious co-existence of indigenous peoples with their surroundings. The indigenous peoples use land for cultivation but not to the extent of exploiting land's fertility for maximum production by the use of fertilizers which finally prove to be harmful for the life of soil, its productivity and health of crops and finally health of the consumer. Similarly, they use forest and its resources for their sustenance and to fulfill their needs and not for their amassing of wealth to the extent of harming the forest and its resources that cause deforestation or depletion. Indigenous peoples heavily depend upon the land, forest, water and natural resources and in turn these resources also depend upon people for their economic and sustained use. This is the indigenous knowledge that is inbuilt in indigenous and tribal people which they

imbibe by being born in the tribal community in an atmosphere of natural surroundings. In this regard the UN Department of Economic [3] and Social Affairs have to say the following, “Although indigenous knowledge is different from the Western paradigm of development, the knowledge of indigenous peoples is of particular interest for environmental assessment because it is systemic and comprehensive and offers an all-encompassing understanding of a territory that is utilized and known in its entirety.” (ST/ESA/328, 2009:113)

Indigenous peoples’ idea of safeguarding resources and their subsistence-base is an idea to secure a sustainable future. They may not be profit oriented and may not amass wealth for future but to secure a healthy and sustainable future is a prime concern for them. A close inter-dependence is felt by tribals with the nature, animals and other human beings. Any collateral damage to any of the party is owned by them. Obviously, humans must own up responsibility for any damage or gain for the environment which is caused by human choices. Similarly, responsibility must be owned up by the capitalists, corporate and governments for any consequences that occur in terms of environmental degradation and contamination due to their choices for development. Harmonious co-existence is

best articulated in the letter of Chief Seattle, Chief of the Suquamish Indians which, he supposedly wrote to the American Government in the 1800's. In response to the Government's offer to buy the land from the Indigenous Peoples the Chief Seattle wrote, “We are part of the earth and it is part of us. The perfumed flowers are our sisters. The bear, the deer, the great eagle, these are our brothers. The rocky crests, the dew in the meadow, the body heat of the pony, and man all belong to the same family” (Chief Seattle's Letter, p.1)

### **Connection to the Land and Community**

Indigenous communities have very deep and emotional connection with the land. When and how their connection to the land developed cannot be known for sure; but as the first settlers in Indian subcontinent (including the people now known as Adivasis/tribals) they developed connection and bonding with the land at a very early phase of history. Some historians like Burton Stein, Irfan Habib, Romila Thapar, K.L. Bhasha etc. hold the opinion that the first settlers in India developed the art of agricultural activities soon after the post-Harappan time. There are some traces found that the practice of agriculture among the pre-history communities started around 7,000 BCE. As Burton Stein writes,

Around 7,000 BCE Neolithic communities began to be founded in the valleys draining the mountains which separated the Indian subcontinent from Afghanistan and continental Asia. Before 4000 BCE, hunter-gatherers had merged into more complex and advanced communities of farmers and artisanal specialists in settlements of circular mud-covered bamboo huts. The earliest known of these are found in Baluchistan, with similar communities appearing shortly after in the Gangetic plain and on the Deccan plateau. There, archaeologists have discovered Neolithic assemblages: domesticated cattle, sheep, goats and plants, including rice [4].

As the Adivasis got engaged as settled agriculturists they had constant connection with the land. In the process of early agricultural era, they most likely may have developed some bonding with the land as a means of sustainable living. The tribals generally bury their dead in the ground. The ancestors who are buried in the land are believed to be the invisible members of the family and living community. On particular occasions during the year, special sacrifices are offered and the ancestors are venerated. Thus the relationship between the dead and the living are renewed from time to time. Thus land not remains as mere 'property' but it is also connected with the existence and continuation of the living humans. There is

an intimate spiritual dimension of land attached with the tribal way of life. They believe that the Indigenous law and life originate in and is governed by the land. A close connection to the land gives them identity, sustenance and a sense of belonging. The tribals also believe that the land owns the community and gives them their identity.

### **A Holistic Perspective**

As against the Western Perspectives and perspectives of the dominant national societies the Indigenous Peoples' perspectives are essentially different. In most cases the perspectives of the dominant national society are driven by profits and needs. Therefore, it can be said that the Western 'scientific and technological knowledge-based view' is the essence of 'resources-based-perspectives.' The modern scientific knowledge system is based on pragmatism often focusing on verbal thinking and use analytical approach to learning. The Indigenous perspective in contrary addresses the whole person, encompassing their mental, physical, emotional and spiritual capabilities in relation to all living things. The Indigenous worldviews accept that all forms of beings are interconnected and therefore the survival of one life form is depended on the survival of other life forms.



The tribal/Indigenous worldviews find a unified vision of things rather than an artificial fragmentation of concepts [5]. They draw a sense from the surroundings that animate the life forms which is derived from an unseen but knowable spiritual realm. Thus their worldview asserts that all life is sacred and that all life forms are connected. All life forms in the Indigenous worldviews are respected and are seen equally as human beings.

### **Stewardship**

Indigenous communities often see themselves as stewards of the land, responsible for preserving it for future generations. They prioritize sustainable land management practices, including rotational agriculture, agro-forestry, and controlled burning. The attitude of stewardship and ownership of the land, forest and biodiversity by the indigenous communities show close affinity to the surroundings. They draw their spiritual resources from the rocks, hills, trees, forests and inanimate beings. The symbiotic relationship between humans and nature cherished by the indigenous communities reveal that the indigenous way of life is intrinsically associated human, nature and divine. The modern development strategies based on a sense of superiority of the 'modern' and 'scientific' and which fails to take seriously the cultural and social dimensions of societies

– not only destroys - culture and social life but fail to cure the problems.

### **Conclusion**

A harmonious co-existence is seen between the indigenous communities and ecological surroundings. A healthy environment creates a healthy human community free from sickness, famine and depravity. A healthy community and healthy environment would mean a human and ecological community free from all corruptions, injustices and exploitation. The social, cultural and economic life of indigenous communities are intertwined. There is a beautiful blend of work, worship and celebrations in tribal life and culture which they draw from their natural surroundings. The values the tribal communities cherish the most are harmonious co-existence, community-centeredness, religiosity, economy in resource use, ecological sensitivity, interconnectedness and the like.

As we embark upon a very important and urgent areas for discussion, I encourage you to remain open to new ideas, engage in thoughtful discussion, and lend your insights to the ongoing discourse on Climate Crisis and Biodiversity: Mitigation for Sustainable Development and Livelihood keeping in mind the underlying principles of Indigenous Values and Sustainability and Wellbeing. The future of human life is not a determined

path, but a journey we must navigate together with wisdom, foresight, and a deep sense of responsibility. I hope that the ideas thrown here contribute to our collective understanding of the challenges and opportunities we face and to march ahead firmly holding on the values that guide not only our present but also our future generations to come. I wish that this National Seminar may inspire you, challenge you and ignite meaningful conversations that lead us towards a future where humanity flourishes by harnessing values coming from different corners in creative and valuable ways. Challenge before all of us is to find ways of increasing wellbeing without indiscriminately destroying valued ways of living and knowing and without placing unbearable strains on the environment.

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# JOURNAL OF CONVERGENCE

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4. Cook, A, PhD thesis, Edinburg University (Edinburg, UK, 1995).

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