A Study On Forest Fire And Their Impact On Environment With Special Reference To Chennai

AUTHOR:

MANJARI.J.P

B.Com.LLB[Hons.]3 rd year

REGISTER NO.: 132204021

SAVEETHA SCHOOL OF LAW

SAVEETHA INSTITUTE OF MEDICAL AND TECHNICAL SCIENCES (SIMATS)

CHENNAI-77

ABSTRACT:

Forest fires, also known as wildfires, are uncontrolled fires that spread rapidly across vegetation, causing significant damage to ecosystems. These fires can be ignited by natural factors, such as lightning, or human activities, including agricultural practices and negligent behaviors. The impact of forest fires on the environment is far-reaching, affecting air quality, biodiversity, and the climate. One of the most immediate effects is the release of large quantities of carbon dioxide (CO_2) and other greenhouse gasses into the atmosphere, contributing to global warming. Forest fires also produce harmful particulate matter and toxic gasses, which degrade air quality and pose serious health risks to both humans and wildlife. Biodiversity is greatly affected as fires destroy habitats, displacing species and leading to loss of flora and fauna. Some species may face extinction if their habitats are permanently altered. This study was based on an empirical research method. The data was collected within India by adopting the convenient sampling method and the sample size is 206. The tool used for the study is the structured questionnaire. The loss of vegetation also increases soil erosion, reducing the land's ability to retain water, which can lead to further degradation of ecosystems. Forest fires also disrupt the carbon cycle. Forests act as carbon sinks, absorbing CO_2 from the atmosphere; when they burn, not only is this ability diminished, but stored carbon is released. This exacerbates climate change and alters weather patterns, potentially increasing the frequency and severity of future fires. In sum, forest fires are both a consequence and

a cause of environmental degradation, significantly impacting air quality, biodiversity, and the global climate system.

KEYWORDS:

Wildfires- Fire ecology- Deforestation- Carbon emissions- Wildlife displacement

INTRODUCTION:

Forest fires play a dual role in ecosystems. In some regions, they are natural ecological processes that contribute to forest regeneration, nutrient cycling, and habitat creation for certain species. However, the growing prevalence of large-scale, uncontrolled fires has raised global concern due to their far-reaching environmental, economic, and social impacts. Forest fires not only destroy vast tracts of forested land but also affect biodiversity, air quality, and climate systems, making their effects a critical environmental challenge of our time. One of the most immediate effects of forest fires is the release of enormous amounts of smoke and pollutants into the atmosphere. Forest fires emit fine particulate matter (PM2.5) along with gasses such as carbon dioxide (CO_2), carbon monoxide (CO), methane (CH_4), and volatile organic compounds (VOCs). These pollutants reduce air quality, posing health risks for humans and animals. In areas downwind of large wildfires, people may experience respiratory issues, eye irritation, and worsening of pre-existing conditions such as asthma or cardiovascular diseases. Prolonged exposure to wildfire smoke can also lead to long-term health consequences, especially for vulnerable populations like children, the elderly, and those with underlying health conditions. On a larger scale, forest fires contribute to global atmospheric pollution. For example, during severe wildfire seasons in regions like California, Australia, or the Amazon, smoke from these fires can travel thousands of miles, affecting air quality in distant locations. The global transport of pollutants from wildfires exacerbates issues of transboundary air pollution and can lead to poor air conditions even in regions far removed from the fire's origin. Forest fires significantly influence global carbon cycles and contribute to climate change. Forests act as carbon sinks, absorbing CO_2 from the atmosphere through photosynthesis and storing it in plant biomass. However, when forests burn, the stored carbon is released back into the atmosphere in the form of CO_2, contributing to the greenhouse gas effect. In large-scale fires, this carbon release can negate the carbon sequestration efforts achieved over decades or even centuries. Furthermore, the loss of forest cover reduces the Earth's capacity to absorb future CO_2 emissions, intensifying the cycle of climate change. Rising temperatures, prolonged droughts, and changing precipitation patterns all consequences of climate change create conditions conducive to more frequent and intense fires, which in turn release more carbon and further exacerbate global warming. This feedback loop is one of the most pressing concerns for climate scientists studying wildfire impacts. Forests are among the most biologically diverse ecosystems on the planet, providing habitat for a wide variety of species. Forest fires can destroy these habitats, leading to the displacement, injury, or death of wildlife. Some species, especially those with limited mobility or those that rely on specific habitats, may struggle to survive in post-fire landscapes. Forest fires can cause significant damage to soil health. The intense heat from fires can destroy the

organic matter in soil, leading to reduced fertility and compromised soil structure. This can result in increased soil erosion, as the protective vegetation cover is removed. In hilly or mountainous regions, post-fire erosion can lead to landslides, further destabilizing the landscape. As climate change continues to exacerbate wildfire conditions, it is essential to adopt sustainable land management practices, improve fire prevention and response strategies, and enhance global efforts to reduce greenhouse gas emissions. The future of forests and their role in maintaining ecological balance depends on our ability to address the underlying causes of forest fires and mitigate their effects on the environment.

OBJECTIVES:

- To find out the effect and impact of forest fires on biodiversity
- To enumerate the causes of forest fire
- To ensure the importance of forest vegetation

REVIEW OF LITERATURE:

Change Wang & et.al, (2023) analyzed that in recent years,with global temperature rise, extreme weather and climate events, especially high temperature and droughts, occur more frequently, and as a result, forest fires too. Studies show that, climate warming increases the amount of flammable materials in forests, prolongs the fire season, and raises the frequency of lightning fires and wildfires. Yet, the number of fires and the total burned area in the past decade have declined in China.

Alex, Amerh, (2022) analyzed that forest fires are key ecosystem modifiers affecting the biological, chemical, and physical attributes of forest soils. The extent of soil disturbance by fire is largely dependent on fire intensity, duration and recurrence, fuel load, and soil characteristics. The impact on soil properties is intricate, yielding different results based on these factors.

Arshad A. & et.al, (2022) analyzed that fire is a common hazard in forest which plays an important role in shaping a community with its ecosystem components. Recent fire records show an increasing trend in fire incidents with manipulated fire regime due to anthropogenic activity. Changes in the fire regime cause a negative impact on forest vegetation and ecosystem processes.

Chengliang Wu & et.al, (2022) discussed that forest fires threaten not only the forest ecosystem but also the safety of human health and property. The Chinese Government has issued corresponding policies to strengthen the emphasis on forest fire prevention. The panel data from 31 provinces, municipalities and regions in China establish a multiple regression model to study the relationship between the forest fire prevention policy and the health of forest resources, and it draws relevant conclusions.

Dinesh Bhatt & et.al, (2022) analyzed the Uttarakhand State of India is rich in forest wealth with 45.4% forest cover (India State of Forest Report). However, forest cover may change due to a number of anthropogenic and environmental factors. One of the factors leading to forest degradation is forest fires. Forest fires are related to factors that may be biotic, such as heavy accumulation of Chir pine needles on the forest floor influencing fuel load accumulation and flammability.

Gajendra Kumar & et.al, (2022) examined the MODIS based study exhibited the recurrence of fire incidences in central and southern parts of forests and affected substantial parts of the deciduous broadleaf forest and deciduous needleleaf forest, shrubland, mixed forest, with the major forest fire peaks during March and April, while negligible fire incidences were observed in plantation and grassland. the high susceptibility of forest fire in deciduous forests in Central India necessitated proper management of forest fires.

Gusto Ayu, Citra Pradnya, (2022) studied that land and forest fires in Indonesia have occurred almost every year since 1997. The main cause of fires is related to human activities. In Indonesia, fires have an impact on the economy and health. Coordination between institutions is necessary for controlling forest and land fires. Factors that affect coordination are authority, communication, control, and leadership. Coordination needs to be improved in the context of preventing forest and land fires.

Himanshu Bargali & et.al, (2022) discussed the significant differences in species diversity observed across the fire frequency classes. While species diversity increased in the low fire frequency class, an increase in fire frequency led to a decline in diversity and increased dominance of certain fire-tolerant species. The diversity of herbs decreased with increasing fire frequency, from a minimum of 12 species in the high fire frequency class to a maximum of 37 in the no fire frequency class.

Inna Pivovarova, Matveev, (2022) identified and analyzed the general climatic trends for the study area. The correlation between the interannual variability of fires and climatic characteristics is clearly shown. The results of the work on determining the degree of influence of the main fire-hazardous factors in specific territories will make it possible to further identify areas of potential fire danger and make decisions on fire prevention strategies.

Laura Patricia & et.al, (2022) analyzed the Uttarakhand State of India is rich in forest wealth with 45.4% forest cover (India State of Forest Report (2021). However, forest cover may change due to a number of anthropogenic and environmental factors. One of the factors leading to forest degradation is forest fires.

Madhusmita Murmu, Arijit Roy, (2022) discussed that emissions from forest fires give out huge amounts of greenhouse gasses into the atmosphere degrading the surrounding air quality. Climate change results in prolonged summer days and less precipitation thus increasing fuel accumulation facilitating recurring forest fires

in the Western Himalayan regions. Most of the forest fire cases are human ignited that damages the forest irreparably.

Muhammad Ahmed Baballe, (2022) discussed that forest is considered one of the most important and indispensable resources. Forest fires represent a constant threat to ecological systems, infrastructure, and environmental aspects of a community. Forest fire detection is a very important issue in the pre-suppression process. Among the great disasters on this earth are forest fires. The problem is that the sensor is less responsive in detecting the presence of the fire.

Satyam Verma & et.al, (2022) studied that forest fires are an important ecological force that shaped the forest ecosystems, but uncontrolled fires also cause great loss of biological diversity, as well as economic The results of the present study would improve understanding of carbon stock present in different fire frequencies and could be used to enhance the carbon sequestration potential in fire-affected areas through conservation and proper management.

Sneha Dobhal & et.al, (2022) examined that frequent forest fires have emerged as one of the most devastating threats to Himalayan biodiversity, adversely affecting the natural regeneration and productive capacity of forests. Forest fire adversely affects soil quality, wildlife population & habitat, and forest produce, resulting in the negative effect on the rural economy and ecosystem services. It has been classified as wildfire, brush fire, bushfire, etc. depending upon its severity and the resultant damage.

Mehak Vashisth, (2021) examined that forest fire has become extreme and has increased in frequency worldwide with India being no exception. The forest cover in India found that though the North-Eastern cluster encompasses the maximum area (55%) of all the clusters in India, it accounts for a meager 16% of the burnt forest area. The central cluster has been found to be the most vulnerable to forest fires as ~56% of the total burnt area lies in this region.

Som Sharma, Pallavi Saxena, (2021) studies that the ecurrent and large forest fires negatively impact ecosystems, air quality, and human health. Moderate Resolution Imaging Spectroradiometer fire product is used to identify forest fires over central India domain, an extremely fire prone region. Some years such as 2009, 2012, and 2017 show anomalously high forest fires.

Sandeep Bhatt & et.al, (2020) examined that remote sensing techniques are effectively used for measuring the overall loss of terrestrial ecosystem productivity and biodiversity due to forest fires.Two Light Use Efficiency models were used to quantify the terrestrial Net Primary Productivity (NPP) of the forest ecosystem using the open-source and freely available remotely sensed data.

Shamuganathan, (2017) discussed that forest fires are an important ecological force that shaped the forest ecosystems, but uncontrolled fires also cause great loss of biological diversity, as well as economic wealth. Fires are critical pathways of carbon loss from a tropical dry deciduous forest. Carbon stock has the same pattern as that biomass accumulation. The results of the present study used to enhance the carbon sequestration potential in fire-affected areas.

Krishna Chandra & et.al, (2015) studied that forest fire is very common in all the ecosystems and plays an important role in ecosystem dynamics. The impact of fire on established trees of Shorea robusta and Tectona grandis has no longer effects and they recover just on the onset of favorable climatic conditions. The most significant effects of fire are reported to oak and coniferous forest which takes a long time to recover because these species catch high intensity.

Amit Parashar, Sas Biswas, (2003) analyzed that frequent fires in the Himalayan region of Uttaranchal have been blamed for forest deterioration. It causes air pollution, mar quality of stream water, threatens biodiversity but fire plays an important role in forest ecosystem dynamics. If fire is managed wisely it can be used as the cheapest means of forest management. For this purpose different fire characteristics are assessed together with their interrelationship with forest flora.

METHODOLOGY:

The study was based on an empirical method of research. The data was collected within Chennai by adopting the convenient sampling method and the sample size is 206. The questionnaire used for study is the structured questionnaire. The independent variables included in the study are age, gender,qualification, occupation and locality. The dependent variables used in the study are main cause, impact, long term effect lead to decrease in ecosystem, impact animal biodiversity, primary roles, forest vegetation, vegetation plays a crucial role and whether government initiatives are effective.The tools used for analysis are bar charts.

ANALYSIS:

Figure 1:
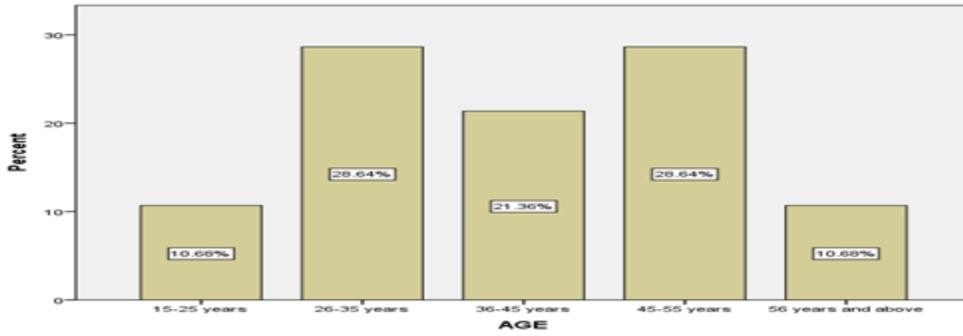
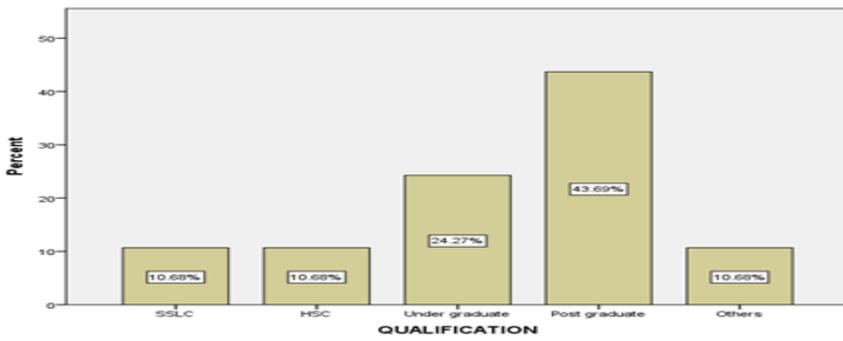Legend: Figure 1 depicts the age of the respondents.

Figure 2:

Legend: Figure 2 depicts the gender of the respondents.

Figure 3:

Legend: Figure 3 depicts the locality of the respondents.

Figure 4:

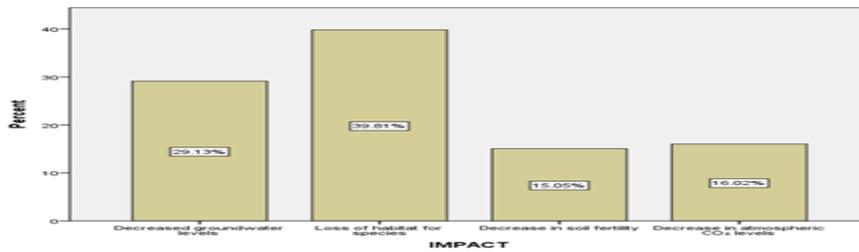Legend: Figure 4 depicts the qualification of the respondents.

Figure 5:

Legend: Figure 5 depicts the occupation of the respondents.
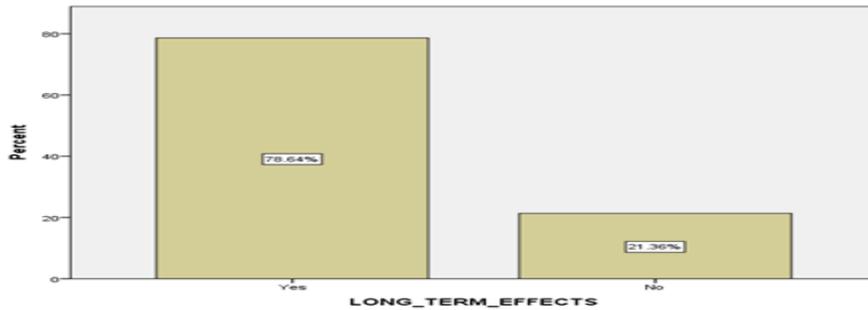
Figure 6:

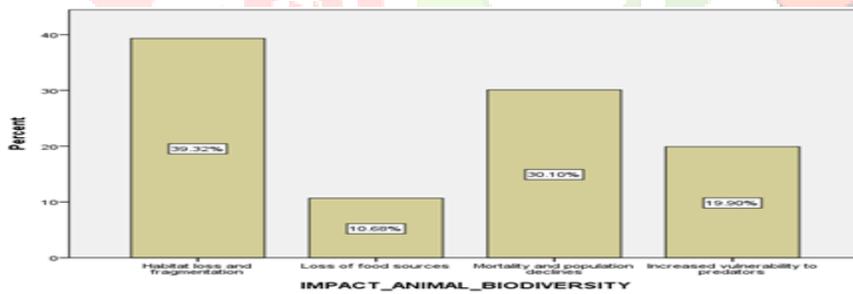Legend: Figure 6 depicts the main cause of forest fire.

Figure 7:

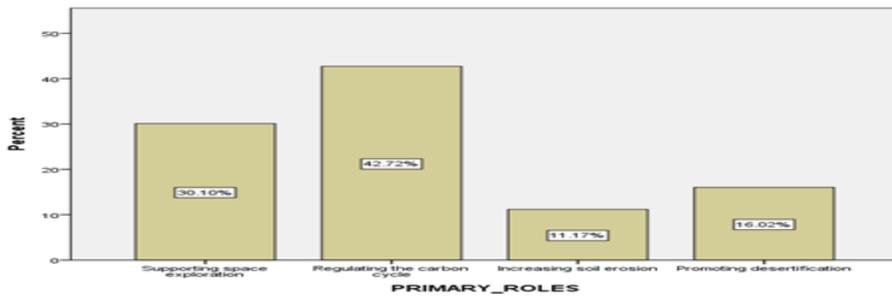Legend: Figure 7 depicts the impact of forest fires on biodiversity.

Figure 8:

Legend: Figure 8 depicts the long-term effect of frequent forest fires on biodiversity will lead to decrease in ecosystem complexity.
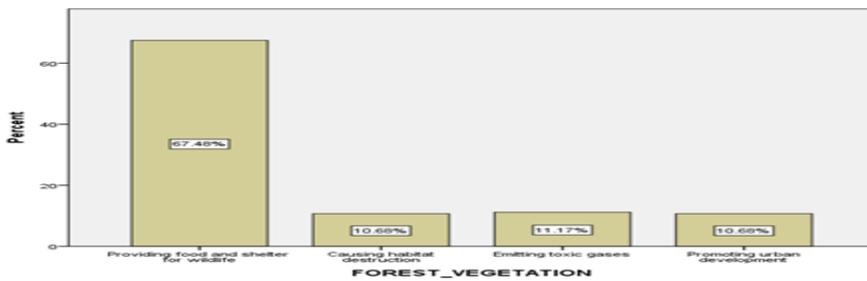
Figure 9:

Legend: Figure 9 depicts the way in which forest fires impact animal biodiversity.
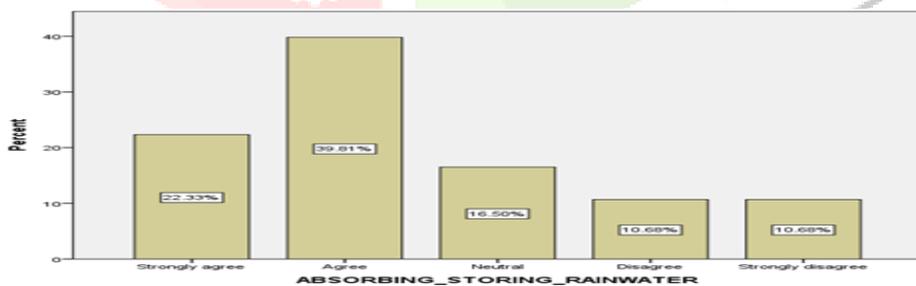
Figure 10:

Legend: Figure 10 depicts the primary roles of forest vegetation in the global ecosystem.
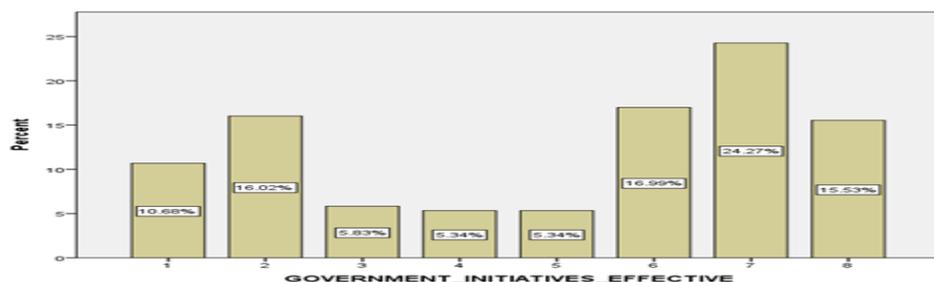
Figure 11:

Legend: Figure 11 depicts forest vegetation contributing to maintaining biodiversity.
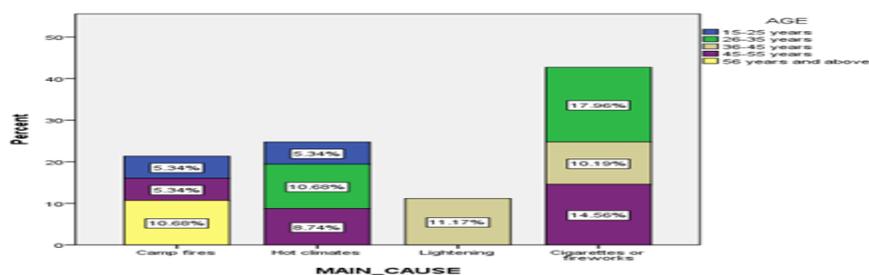
Figure 12:

Legend: Figure 12 depicts that forest vegetation plays a crucial role in the water cycle by absorbing and storing rainwater.
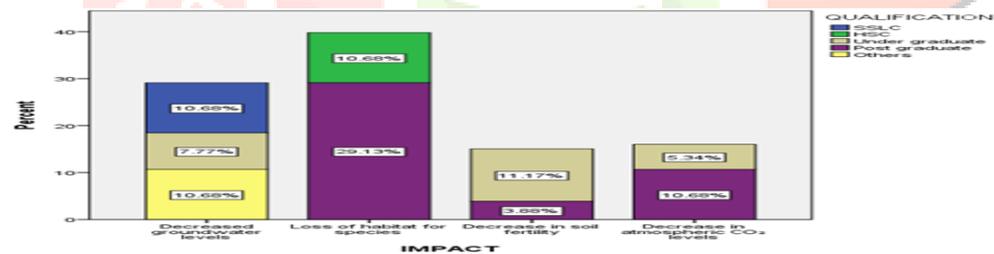
Figure 13:

Legend: Figure 13 depicts that the government initiatives are effective in order to prevent forest fires.
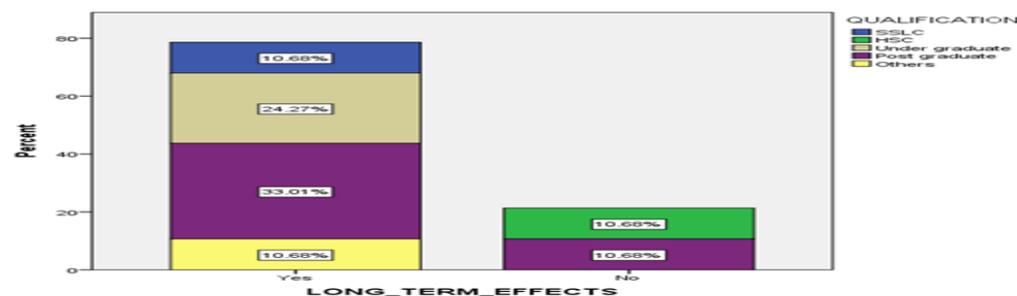
Figure 14:

Legend: Figure 14 depicts the age of the respondents and the main cause of forest fire.

Figure 15:

Legend: Figure 15 depicts the qualification of the respondents and the impact of forest fires on biodiversity.

Figure 16:

Legend: Figure 16 depicts the qualification of the respondents and the long-term effect of frequent forest fires on biodiversity will lead to decrease in ecosystem complexity.

Figure 17:
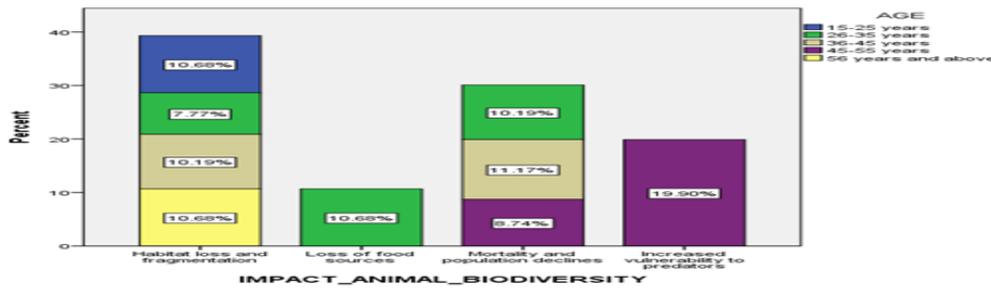
Legend: Figure 17 depicts the age of the respondents and the way in which forest fires impact animal biodiversity.

Figure 18:
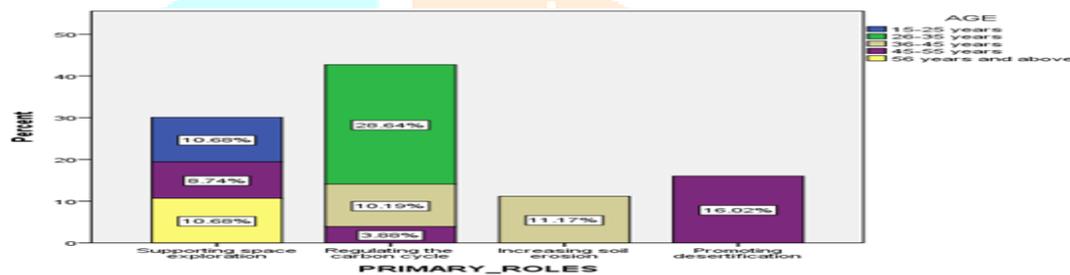
Legend: Figure 18 depicts the age of the respondents and the primary roles of forest vegetation in the global ecosystem.

Figure 19:
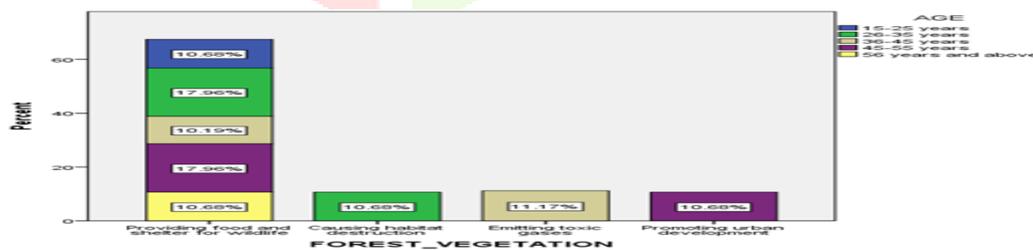
Legend: Figure 19 depicts the age of the respondents and forest vegetation contribute to maintaining biodiversity.

Figure 20:
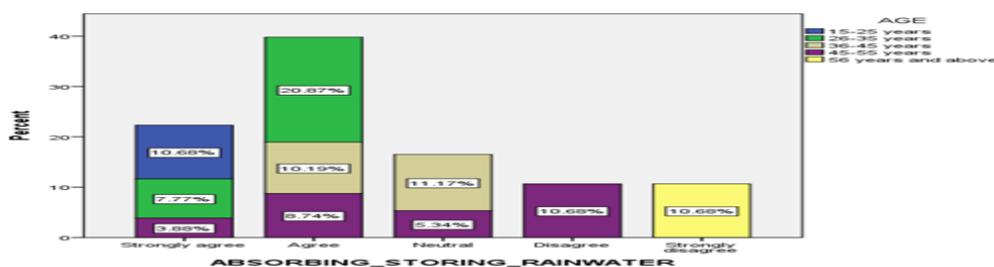
Legend: Figure 20 depicts the age of the respondents and that forest vegetation plays a crucial role in the water cycle by absorbing and storing rainwater.

RESULT:

Figure 1, depicts the age of the respondents, most responses from 26-35 years and 45-55 years (28.64%), next from 36-45 years (21.36%) and least from 15-25 years (10.68%). **Figure 2,** depicts the gender of the respondents, responses from males (55.83%) and from females (44.17%). **Figure 3,** depicts the locality of the respondents, most responses from semi urban areas (39.81%) and least responses from rural areas (21.36%). **Figure 4,** depicts the qualifications of the respondents, most responses from post graduate (43.69%) and least responses from HSC and SSLC (10.68%). **Figure 5,** depicts the occupation of the respondents, most responses from the private sector (29.13%) and least responses from others (10.68%). **Figure 6,** depicts the main cause of forest fire, most responded to cigarettes or fireworks (42.72%) and least responded to lightning (11.17%). **Figure 7,** depicts the impact of forest fires on biodiversity, most responded to loss of habitat for species (39.81%) and least responded to decrease in soil fertility (15.05%). **Figure 8,** depicts the long-term effect of frequent forest fires on biodiversity will lead to decrease in ecosystem complexity, most responded yes (78.64%) and least responded no (21.36%). **Figure 9,** depicts the way in which forest fires impact animal biodiversity, most responded to habitat loss and fragmentation (39.32%) and least responded to loss of food sources (10.68%). **Figure 10,** depicts the primary roles of forest vegetation in the global ecosystem, most responded to regulating the carbon cycle (42.72%) and least responded to increasing soil erosion (11.17%). **Figure 11,** depicts forest vegetation contributing to maintaining biodiversity, most responded to providing food and shelter for wildlife (67.48%) and least responded to providing urban development (10.68%). **Figure 12,** depicts that forest vegetation plays a crucial role in the water cycle by absorbing and storing rainwater, most agreed with the statement (39.81%) and least strongly disagreed with the statement (10.68%). **Figure 13,** depicts that the government initiatives are effective in order to prevent forest fires, most rated 7 (24.27%) and least rated 4 (5.34%). **Figure 14,** depicts the age of the respondents and the main cause of forest fire, respondents from most age groups responded to cigarettes or fireworks. **Figure 15,** depicts the qualification of the respondents and the impact of forest fires on biodiversity, post graduates mostly responded to loss of habitat for species, ug responded to decrease in soil fertility and remaining qualification responded to decrease in groundwater levels. **Figure 16,** depicts the qualification of the

respondents and the long-term effect of frequent forest fires on biodiversity will lead to decrease in ecosystem complexity, respondents from all qualifications responded yes. **Figure 17,** depicts the age of the respondents and the way in which forest fires impact animal biodiversity, respondents from all age groups responded to habitat loss and fragmentation. **Figure 18,** depicts the age of the respondents and the primary roles of forest vegetation in the global ecosystem, respondents from all age groups responded to regulating the carbon cycle. **Figure 19,** depicts the age of the respondents and forest vegetation contribute to maintaining biodiversity, respondents from all age groups responded to providing food and shelter for wildlife. **Figure 20,** depicts the age of the respondents and that forest vegetation plays a crucial role in the water cycle by absorbing and storing rainwater, respondents from all age groups agreed with the statement.

DISCUSSION:

In figure 1, most responses were from 26-35 years and 45-55 years (28.64%), because most responses were collected from the general public. **In figure 2,** responses from males (55.83%), because most responses were collected from the general public. **In figure 3,** most responses were from semi urban areas (39.81%), because most responses were collected from the general public. **In figure 4,** most responses were from post graduates (43.69%), because most responses were collected from the general public. **In figure 5,** most responses from the private sector (29.13%), because most responses were collected from the general public. **In figure 6,** most responded to cigarettes or fireworks (42.72%), because in rural or forested areas, debris burning can get out of control and lead to wildfires. Discarded lit cigarettes, especially in dry areas, can ignite grass, leaves, or other flammable material.Fireworks can cause wildfires when used irresponsibly, particularly in dry, windy conditions. **In figure 7,** most responded to loss of habitat for species (39.81%), because when a forest fire occurs, it can destroy vegetation and alter ecosystems, displacing or killing plant and animal species that rely on the forest for shelter, food, and breeding grounds. The loss of habitat can lead to a reduction in species populations, and in some cases, it may even result in local extinctions if species are unable to migrate or adapt to new environments. **In figure 8,** most responded yes (78.64%), because frequent fires can destroy habitats, reducing the variety of environments available for different species to thrive. When habitats are repeatedly burned, some species may not have time to recover or relocate, leading to their local extinction. **In figure 9,** most responded to habitat loss and fragmentation (39.32%), because forest fires destroy vegetation, which many species rely on for food, shelter, and breeding. This sudden loss of habitat forces animals to either migrate or face heightened risks of starvation, exposure, and predation. **In figure 10,** most responded to regulating the carbon cycle (42.72%), because forests act as carbon sinks, meaning they absorb more carbon dioxide (CO_2) than they release, helping to balance atmospheric CO_2 levels. This process is critical for mitigating climate change because excess CO_2 is a major greenhouse gas driving global warming. **In figure 11,** most responded to providing food and shelter for wildlife (67.48%), because forests are home to a wide range of species, including plants, animals, insects, fungi, and microorganisms. The variety of vegetation in forests creates diverse habitats that support different species' needs for food, protection, and breeding. **In figure 12,** most agreed with the statement

(39.81%), because forests act as natural sponges by absorbing and storing rainwater. This water is gradually released into the atmosphere through a process called transpiration, and into the ground, replenishing groundwater reserves. **In figure 13,** most rated 7 (24.27%), while there are effective initiatives in place, their success often hinges on implementation, community involvement, and the challenges faced in specific regions. **In figure 14,** respondents from most age groups responded to cigarettes or fireworks, because in many places, especially in dry, fire-prone environments, human activities (including cigarettes and fireworks) are significant contributors. **In figure 15,** post graduates mostly responded to loss of habitat for species, because when fires become more frequent or intense due to human activities or climate change, they can have overwhelmingly negative impacts, pushing ecosystems beyond their ability to recover. **In figure 16,** respondents from all qualifications responded yes, because forests typically go through stages of ecological succession, where different species dominate over time. Frequent fires can prevent ecosystems from reaching their climax stage (where biodiversity is typically highest), maintaining them in earlier, less complex successional stages. **In figure 17,** respondents from all age groups responded to habitat loss and fragmentation, because forest fires burn patches of forest unevenly, they create fragmented landscapes. This breaks continuous habitats into smaller, isolated patches, making it difficult for species to move between them, which disrupts migration patterns, gene flow, and breeding. For many animals, such fragmentation increases their vulnerability to extinction. **In figure 18,** respondents from all age groups responded to regulating the carbon cycle, because trees and plants absorb CO_2 during photosynthesis, storing carbon in their biomass (trunks, branches, leaves) and soils.Organic matter, including dead plants and tree roots, adds carbon to the soil, where it can be stored for long periods. **In figure 19,** respondents from all age groups responded to providing food and shelter for wildlife, because forests offer nesting sites, protective cover from predators, and microclimates that allow species to thrive. This complex web of interdependent species helps maintain ecosystem balance and resilience, further promoting biodiversity. By supporting various forms of life, forests play a crucial role in maintaining the planet's biodiversity. **In figure 20,** respondents from all age groups agreed with the statement, because forests help regulate the flow of water in rivers and streams, reducing the risk of floods during heavy rainfall and maintaining a steady flow during dry periods. Additionally, their root systems stabilize soil, preventing erosion, and improve the infiltration of water into the soil, which supports the water cycle overall.

LIMITATION :

Due to lack of time, study was restricted within a limited sample frame. A large area was unable to be studied. There is a major constraint in the convenient sampling method,the survey was conducted through questionnaires by google forms to collect responses from the people. Another limitation is the sampling size is 206 which cannot be used to assume the thinking of the entire country,state or city. The physical factors have a larger impact, thus limiting the study.

CONCLUSION :

Forest fire, also known as a wildfire or bushfire, refers to an uncontrolled and rapid spread of fire in forested areas or vegetated landscapes. forest fires have wide-ranging effects on both the environment and society. A wide range of natural causes include lightning strikes, dry weather conditions, and the natural flammability of certain vegetation and human activities, such as agricultural practices, encroachment, uncontrolled logging, and negligence, also contribute significantly to forest fire occurrences. Ecologically, they can result in the destruction of habitat, loss of biodiversity, and alteration of ecosystems. Forest fires also release large amounts of carbon dioxide into the atmosphere, contributing to climate change. Additionally, they pose a significant risk to human lives, property, and infrastructure, causing the displacement of communities and economic losses. Efforts to prevent and manage forest fires are crucial, including implementing effective fire management strategies, promoting sustainable land practices, and raising awareness about the importance of preserving and protecting our forests. Forest fires can have a devastating impact on the rich biodiversity of India's forests. They destroy vegetation, disrupt ecosystems, and threaten the survival of numerous plant and animal species. Many endemic and endangered species are particularly vulnerable to these fires, leading to a loss of biodiversity and ecological imbalance. While forest fires are often associated with negative consequences, they can also have positive impacts on ecosystems like ecosystem regeneration , nutrient cycling and habitat diversity.

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