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THE ROLE OF FORESTS IN THE COMBATING GLOBAL WARMING FOR SUSTAINABLE DEVELOPMENT: AN INTEGRATIVE REVIEW

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ABSTRACT

Afforestation and forests are essential to human life and the environment because they affect biodiversity, climate regulation, and human health. In many countries, reforestation has been a major factor in improving socioeconomic growth. This demonstrates how it affects, among other things, biodiversity, livelihood security, climate change, and job creation. Although reforestation is a significant technique for removing carbon dioxide, it can have detrimental effects on land and food systems. The planting of trees on terrain that hasn't had any vegetation for more than 50 years is known as afforestation. They absorb CO_2 emissions and produce clean oxygen for human consumption through photosynthesis. Forests are significantly impacted by climate change, which both promotes and threatens their growth. The ability of afforestation to combat climate change and global warming is its most important advantage. Trees are essential for mitigating the greenhouse impact because they absorb carbon. As a result, afforestation and reforestation are now essential parts of global climate change mitigation plans. state-of-the-art information on how trees can help mitigate climate change by absorbing and storing carbon. Afforestation and reforestation's ability to mitigate climate change depends on local forest conditions, strategic planning, and implementation. Reforestation and afforestation combined with other carbon removal strategies may improve carbon storage's long-term efficacy. In the end, developing and restoring forests is just as important as cutting greenhouse gas emissions in order to effectively mitigate climate change.

Keyword- Forest, Afforestation, The impact of the forest on human life, climatic changes effect, Environment impact on human and Agriculture, Different Government Scheme

INTRODUCTION

Afforestation and forests are essential to human life and the environment because they affect biodiversity, climate regulation, and human health. A forest is a vital natural element that preserves ecological and environmental equilibrium **[48, 75]. Abdullaha *et al.,* [2]** reported that this can be achieved by halting unintended climate change and maintaining the equilibrium of ecosystems between people, plants, animals, and other abiotic elements in **Figure 2**. **Pataki *et al.,* [62]** suggested that forest acreage has a direct impact on agricultural productivity and is vital to the quality of the air and water. According to **Kazungu [49]** the long-term viability of forest ecosystems is becoming increasingly dubious due to global climate change. **Kramer *et al.,* [50]** reported that everyone benefits much from trees and greenery, and forests have a lasting impact on human life. According to **Kobal *et al.,* [47]** forest restoration initiatives frequently ignore how people view and interact with these ecosystems, despite the fact that forests offer vital ecological and socioeconomic advantages. He was also reported that it is impossible to forget the value of greens during pandemics and chronic illnesses. Many ailments can still be effectively treated with herbal medication, and the weather is greatly influenced by vegetation. The condition of the world's forests and biodiversity, as well as how they have changed over time due to climate influences and difficulties, is crucial because forests and vegetation are essential for maintaining ecosystem patterns, ensuring food security, and benevolently influencing the environment for living things (**Figure 1**) **[6, 20]**. **Orsi and Bosch [60, 22]** suggested that the because they provide benefits including carbon sequestration, water quality, timber production, biodiversity protection, soil conservation, and climate regulation, forests are crucial to both human well-being and environmental sustainability. Rising leisure time, improved information availability, and growing worries about mental and physical health have all contributed to their rising significance for recreation. Boosting domestic travel has financial advantages as well **[27]**. **Baumgartner [21]**, reported that in order to address a number of environmental issues, including protecting biodiversity, repairing ecosystems, slowing down climate change by capturing carbon, and enhancing ecosystem services, forestry research is essential [**55]**. It's critical to stay abreast of developments and identify areas in this discipline that require additional research. **Castillo *et al.,* [25]**

reported that forest restoration initiatives frequently ignore how people view and interact with these ecosystems, despite the fact that forests offer vital ecological and socioeconomic advantages. **Gitz *et al.,* [32]** reported that in addition to providing a variety of nutrient-dense foods (like nuts, oils, vegetables (leafs, roots, fruits, flowers, fish, herbs, mushrooms, tubers, and insects), forests, trees, agroforestry also provide bioenergy for boiling and cooking water, formal and informal employment and income, and ecosystem services that are essential to agriculture and food production both now and in the future. According to **Beatty *et al.,* [16]** the proof linking forests and human health is demonstrated in a recently published scientific paper. According to reports, he investigated five areas of possible forest-human health interactions: infectious diseases, environmental exposures, food and nutrition, physical dangers, and noncommunicable diseases like diabetes and cancer. **Margaretha [53]** reported that the experience of being in a forest elicits a more profound and complex reaction than the mere act of being in a forest, according to research on the interaction between humans and forests. The role of forests in supplying oxygen and sequestering carbon, improving climate resilience, sustaining biodiversity, and giving millions of people a means of subsistence highlights how urgent it is to match forestry science research with the Sustainable Development Goals (SDGs) of the UN **[13, 29]**. **Melinda *et al.,* [56]** also reported that unlike juvenile forests and monoculture forests, old forests provide oxygen, fix significant amounts of atmospheric CO_2, and create valuable habitats and microclimates. Worldwide, forests provide a significant portion of the oxygen that is necessary for human living **[18, 35]**. In the equally essential carbon sequestration equation, old-growth forests have frequently been overlooked. **Dai *et al.,* [26]** Stated that among the several potential therapeutic applications for forest bathing, the utilization of this practice to combat COVID-19 stands out in light of current world circumstances. **Khan *et al.,* [46]** suggested crucial role that forests play in delivering vital services for human well-being, biodiversity, forest products, and climate stabilization; it also highlights the importance of comprehending and incorporating human values into forest planning and management.

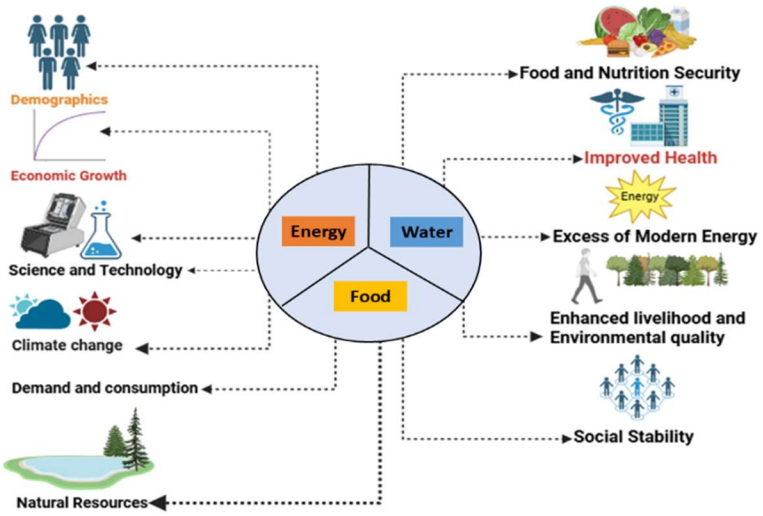

Figure 1: Food Energy and Water in compliance for sustainable development

State wise Maximum increase and maximum decrease in forest area and tree cover

Top four states showing maximum increase in forest and tree cover are Chhattisgarh (683.62 sq km) followed by Uttar Pradesh (559.19sq km), Odisha (558.17 sq km) and Rajasthan (394.46 sq km) whereas top four states maximum decrease in forest and tree cover are (612.41 km²) in Madhya Pradesh followed by Karnataka (459.36 km²), Ladakh (159.26 km²), and Nagaland (125.22 km²). According to Indian Forest State Report, 2023 total cover area of forest is 8,27,357 lack square km (25.17%) geographical area in which 7,15,343 lack square km (21.76%) and 1,12,014 lack squire km (3.41%) and 4,992 thousand square km mangrove cover **(Figure 2 & 3)**.

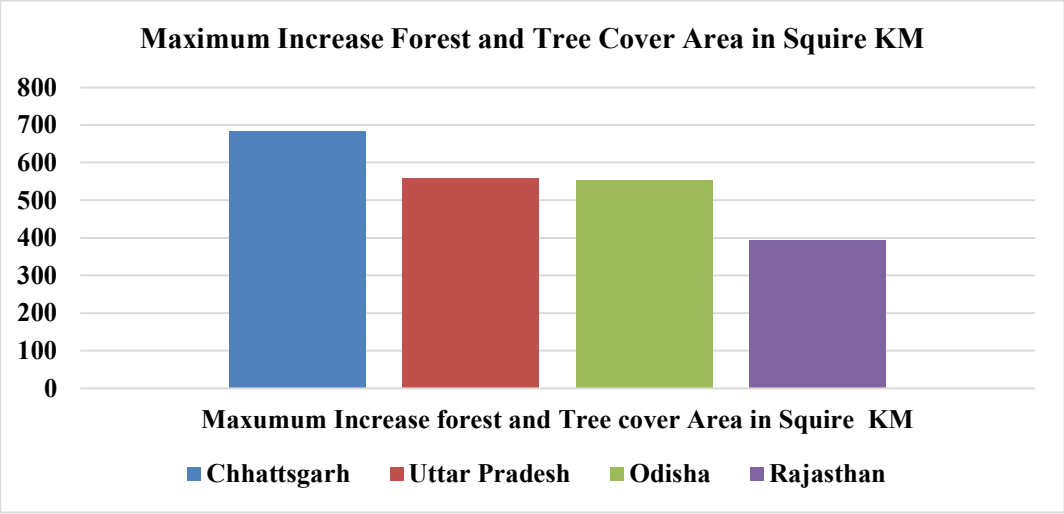

Figure 2: Indian State Forest Report (2023)

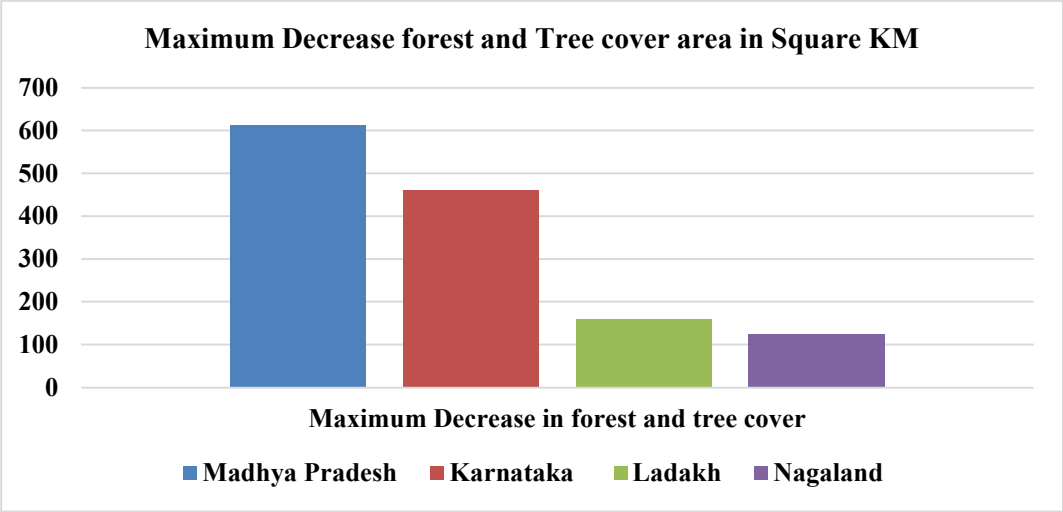

Figure 3: Indian State Forest Report (2023)

Afforestation

Afforestation is a vital tactic in the human toolbox of answers in a time when worries about climate change, biodiversity loss, and environmental degradation predominate **[5]**. According to **Mandziuk *et al.,* [58]** in instance, a number of afforestation projects have been carried out in urban areas in recent years as promising techniques to mitigate/adapt to climate challenges and boost biodiversity in built-up regions, improving the provision of ecosystem services **(Figure 4) [62]**. Graphical representation of ecosystem services linked with different conservation measure show in **Figure 4 [14] [15]**. **Herve *et al.,*** [**40]** reported that extensive afforestation initiatives are typically promoted as efficient means of boosting the terrestrial carbon sink while maintaining biodiversity and water availability. **Benjamin *et al.,* [17]** reported that India intends to increase tree cover to 33% of its land area as part of its nationally set contributions and national forest policy goals. Afforestation of marginal and abandoned arable land is a favorable non-agricultural land use choice for mitigating climate change, **Holtako *et al.,* [38]** reported that Regarding carbon uptake, afforestation and reforestation (R&A) are two of the most promising natural climate solutions. The major purposes of forest health welfare are to nourish the body, mind, temperament, wisdom, and morality—all of which are advantageous to human physical and mental health **[36]**. **Qiao *et al.*, [65]** reported that asserts that green areas and natural settings offer ecosystem services that improve people's health and well-being.

Figure 4: Graphical Representation of Ecosystem Services Linked With Different Conservation Measures

The impact of forest on human life

Various tree parts, including the bark, root, leaf, flower, bole, and gums, are used as medicines to cure a variety of illnesses, including convulsions, epilepsy, and painful urination **[11]**. Government programs like Van Dhan Yojana, TRIFED, and the Minimum Support Price (MSP) for MFP. **Ajitha and Sadasivam [7]** reported that are designed to solve these problems by promoting value chain growth and sustainable management. According to **Raf *et al.*, [66]** minor forest products are an essential resource for rural indigenous populations' existence. **Geeta and Shekh [33]** looked on how MFPs helped indigenous tribes in different Indian states grow economically. Her research showed that MFPs provide significant economic support to populations that depend on forests. The planet's and people's social, cultural, and environmental conditions are influenced by forests. For example, tropical forests are essential to rural populations' livelihoods because they provide services like weather regulation, air quality, and soil erosion, as well as meeting their physical requirements like food, fuel, and medicine. **Gross *et al.*, [31] Stated** that because they control the climate, store carbon, support biodiversity, and boost local and national revenues, forests are also essential for advancing sustainable development methods **[59]. Wang *et al.*, [78]** Stated that capsules, tablets, lotions, soaps, shampoos, and other useful products are made from the tree's stems, roots, leaves, and immature fruits. **Bhupendra *et al.*, [19]** Stated that trees are a significant source of products and precursors utilized in a number of industries, such as agrochemicals, food, cosmetics, and medicines. Additionally, it is said that the traditional Indian medical system, such as ayurveda, rose to prominence as a result of the progressive use of folk medicines. According

to **Pallabi [63]** large tracts of trees and bushes make up forests, which are essential to the ecology and play a variety of roles. She was also suggested that they continue to give people food, raw materials, oxygen, carbon dioxide absorption, and a means of subsistence in addition to mitigating some of the effects of climate change and natural calamities **(Fig 1)**. **Raj [67]** Claim that one of the most pressing issues facing the world today is climate change, which calls for immediate action to cut greenhouse gas emissions, prepare for its repercussions, and guarantee that everyone lives a long and healthy life. According to reports, there are various ways that climate change is affecting various ecosystem components, including air, water, plants, animals, and people, with a particular emphasis on the economic implications.

Role of climatic changes in forest and human life

One of the most important worldwide issues of our day is climate change **[80]** which has profound effects on ecosystems, economics, and society **[45]. Yu *et al.,* [79] Stated** that Although forests offer valuable ecosystem services, they are also being impacted by climate change, possibly directly through the impacts of rising atmospheric CO2 on plant physiology as well as changes in temperature and precipitation(Fig.5). In this regard, scientists, decision-makers, and environmentalists have all become more aware of the critical role forests play in halting climate change **[43].** According to **Marshet and Fekadu [54]** species distributions, forest growth rates, and forest structure are all significantly impacted by climate change since forest ecosystems are climate-sensitive. **Banerjee and Banerjee [12]** Reported that climate change is also said to have a significant impact on the forest ecosystem by changing the growth, death, and reproduction of trees. **Safen *et al.,* [69]** claim that the rapidly shifting air quality, coupled with rising levels of greenhouse gases (GHGs), trace gases, volatile organic compounds (VOCs), and ozone (O_3), also contributes to global warming and climate change, which together create difficult conditions for the forest ecosystem. **Vijaya and Mishra [76]** suggested that forest health is negatively impacted by climate change elements such as greenhouse gases (GHGs) including CO_2, methane (CH_4), nitrous oxide (N_2O), and O_3, as well as extreme weather events like drought, floods, heat stress, and heavy precipitation. **Clarke *et al.,* [24]** stated that sea level rise, extreme weather events including drought and flooding, temperature rises that cause wildfires, and increased

rainfall variability are some of the direct effects of climate change. **Abram *et al.,* [4]** also reported that warming climate-induced increased land evaporation can worsen drought conditions, increasing the likelihood of wildfires and lengthening their seasons. **Fayaz *et al.,* [30]** Reported that **the** sensitivity of the forest ecosystem and the importance of climate change have an effect on the forest's development pace and structure. They also directly affect species composition, tree growth, mortality, and tree reproduction. **Abera [3]** suggested that the timing, frequency, and severity of disturbances to the forest ecosystem are also influenced by climate change, which may exacerbate a number of forest risks, including fires, pest outbreaks, human activity, and drought. According to **Matilda *et al.,* [57] forests** and climate change are inextricably intertwined, and addressing climate change requires improved forest management. In addition to providing clean air and regulating temperature and precipitation, forests also absorb carbon dioxide during photosynthesis and produce oxygen. Additionally, he reports on how forests are affected by climate change and how they help mitigate and adapt to it, especially in the Indian setting. **Shilpa *et al.,* [71]** stated that plantation forestry produces renewable resources, sequesters carbon, and fosters economic growth, it is essential to the fight against climate change and the advancement of sustainable development. **Kobal and Bončina [47]** reported that forests are significantly impacted by climate change, which both promotes and threatens their growth. On the other hand, because of their impact on the energy exchange between the land and atmosphere and the massive amounts of CO_2 that they absorb through photosynthesis, forests can help slow down climate change. **Huber *et al.,* [37]** claim that for forest management in particular, there is still a great deal of uncertainty about the local effects over wide areas (i.e., regions to countries). **World Meteorological Organization [77] assert** that important ecosystem services are provided by forests, but they are also being impacted by climate change. **Stanikzai [73]** also stated that changes in temperature and precipitation, as well as possible direct effects on plants due to increased atmospheric CO_2. **Swetha *et al.,* [72] suggested** that temperature increases have altered the early bud, leafing, and flowering stages of trees' life cycles. **Morin *et al.,* [52]** In general the change in climate has a directly and indirectly impact on forest ecosystems. **Liu *et al.,* [51]** suggested that global productivity fluctuates as a result of changes in climate directly effects on tree

health and ecosystem functioning. According to **Amit *et al.*, [8]** through modifications to the diversity and composition of tree groups, climate change also indirectly affects forest ecosystems. **Harkin *et al.*, [39]** stated that there are two ways that climate change affects trees: directly through influences on physiological systems like photosynthesis or water transport, or indirectly through drivers of mortality like insect biotic attack. Nevertheless, its impacts might go far beyond the physiology and ecology of trees. **Gupta and Niyogi [34]** reported that to guarantee whole health from the start, the environment is a well-established concept that consists of both living and non-living elements. Living things like people, animals, plants, and birds are equally as beneficial to preserving the sociological and cultural legacy as non-living factors like the soil, sun, and water, which do eventually ensure our most reliable livelihoods. The objects we live in are referred to as our "environment" in this context. It might be our occupations, our schooling, our culture, and so on. **Abbass *et al.*,[1]** claim that food instability, decreased access to and quality of drinkable water, biodiversity loss, infectious disease spread, infrastructure degradation, and public health stress are only a few of the negative effects of climate change that have been connected to it.

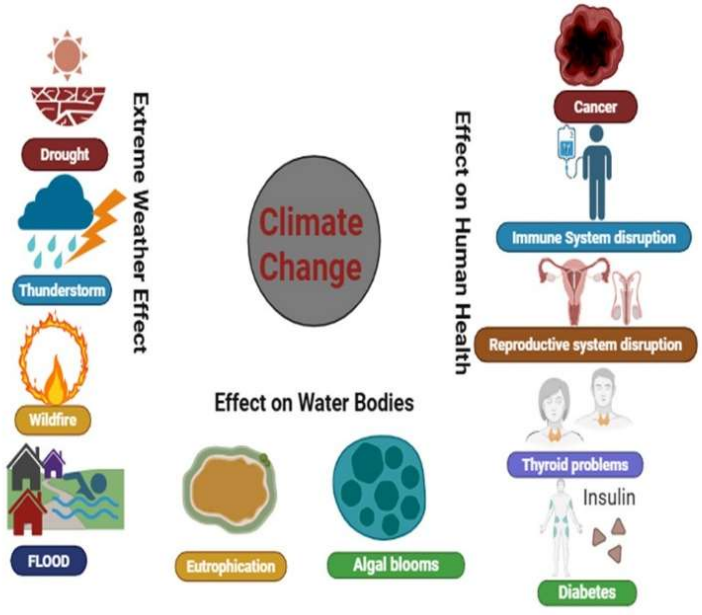

Figure 5: Impact of Climate Changes in Biotic and Abiotic Factors

Environment Impact on human life

According to **Amina *et al.*, [9]** a variety of external elements, such as air quality, availability to green areas, pollution exposure, and climate change, have a continuous impact on human health. According to **Verkerk *et***

***al.,* [75]** models, there is an 80% chance that global warming will approach 1.5°C above pre-industrial levels in the coming years, with serious direct and indirect effects on human health. The temperature of the atmosphere is still rising as a result of climate change. **Saurabh *et al.,* [70]** reported that many environmental pollutants have a substantial impact on human health, influencing both public and individual health as well as climate change, leading to higher rates of morbidity and mortality. According to **Paudel [61]** in order to maintain life in the natural environment and lessen human impact that undermines ecologically sustainable development, human health and welfare primarily depend on restoring and preserving the integrity of natural systems like fresh air, clean water, biodiversity, toxic waste management, and appropriate land reform. **Jacob *et al.,* [42]** suggested that cardiovascular morbidity and mortality are increasingly linked to environmental stressors brought on by human activity (such as noise and air pollution, nighttime light disturbances) and climate change (such as heat, wildfires, and extreme weather events) **(Figure 6)**. **Petropoulou [64]** stated that the most vulnerable groups are impacted by air pollution, which is the largest environmental health concern of our time. It is associated with lung disorders, heart disease, strokes, lung cancer, and other organ ailments. Additionally, it can cause childhood asthma and cancer, impair children's neurodevelopment and cognitive ability, and later in life, it can result in chronic illnesses like heart attacks.

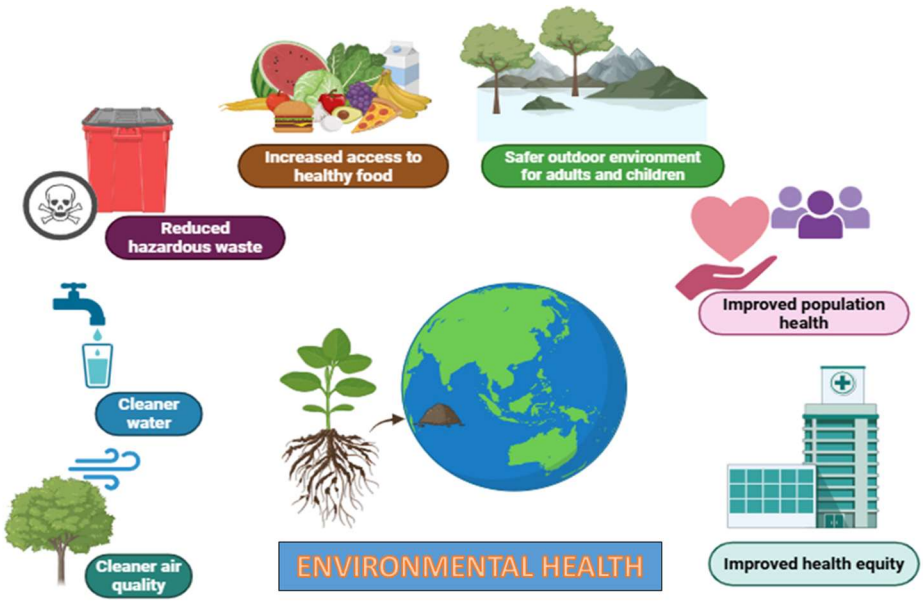

Figure 6: Multiple Benefits of Environment on Human Health

Different challenges in forest Development

Deforestation, the effects of climate change, unsustainable logging, illicit activities, and the introduction of exotic species and illnesses are some of the major issues facing forest development. Issues like unlawful encroachment, forest fires, and land-use change are also emphasized, along with the repercussions of each. **Estoque *et al*., [28]** stated that global forest cover is still declining. Land-use shifts toward agriculture, inappropriate forest management, urbanization, mining, and wildfires are the primary causes of this loss and the continuous fragmentation of the surviving forests additionally **[23]** proposed that forests are being adversely affected by climate change. For instance, in some temperate locations, longer droughts have increased fire frequency and severity and increased sensitivity to pests, which has already led to the destruction of forests in vast parts of Europe and the United States, according to **Rawat *et al.,* [68]. Appiah *et al.,* [10]** reported that because local populations in tropical and sub-tropical areas frequently rely directly on natural forest resources, the loss and degradation of forests can have a detrimental effect on their socioeconomic growth.

Government initiative of forestry development

According to PIB and Drishti IAS, the Indian government is aggressively encouraging afforestation through a number of programs, such as the PM Van Dhan Yojana, the National Agro-forestry Policy, and the Green India Mission **(Figure 8)**. **Javed *et al.,* [43]** claim that the in order to improve research and innovation, NAP was instrumental in transforming the National Research Centre in Agroforestry (NRCAF) into the Central Agro-forestry Research Institute (CAFRI). Additionally, it was projected that India's tree cover increased by 4,904 square kilometres between 2011 and 2021, increasing agro-forestry to 8.65% of the country's territory by 2023. **Indu and Poornima [41]** reported that the In addition to making money from the production and sale of timber, India's forest policies to date have mostly focused on conservation, easing the strain on forests, and providing biomass to the country's enormous population that depends on forests for fuel and food. **Srivani *et al.,* [74]** suggested that the Prime Minister introduced the Pradhan Mantri Van Dhan Vikas Yojana (PMVDVY) program on April 14, 2018. Additionally, he was informed that the primary goal of this program is to increase the income and standard of living of Tribal people, particularly Tribal women, by giving them work opportunities through various value-

adding activities of tribal products and empowering them to become self-sufficient. According to **Verkerk *et al*., [75]** stated that by encouraging people to organize into clusters and process forest products, the Van Dhan Yojana initiative seeks to advance the growth of indigenous communities and increase the value of those products **(Figure 7)**. A number of crucial actions are included in the Pradhan Mantri Van Dhan Yojana (PMVDY) in order to empower tribal communities and build Van Dhan Vikas Kendras (VDVKs). These consist of SHGs with Form 20 members, training, raising awareness, developing capacity, storage and logistics, establishing VDVKs, adding value to minor forest produce (MFP), and establishing connections with markets.

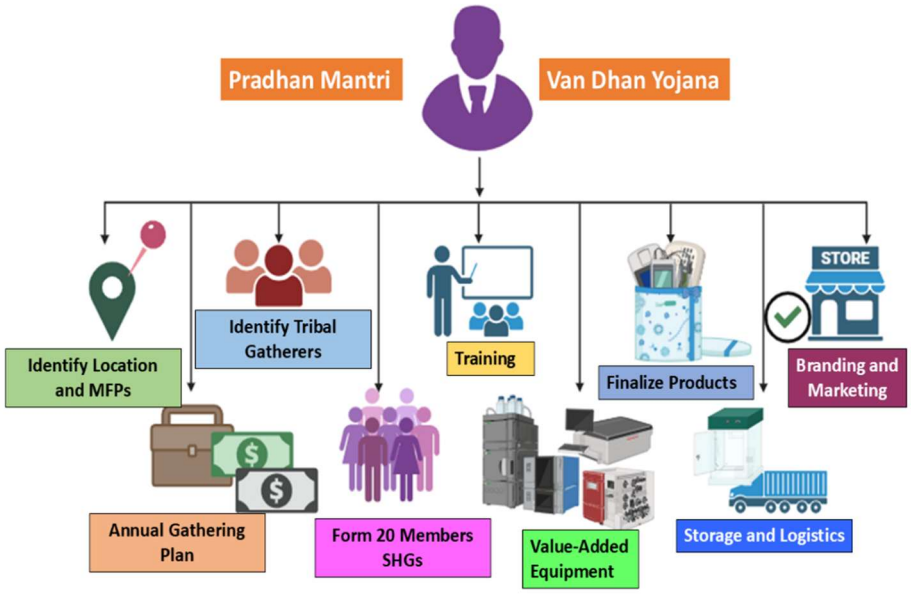

Figure 7: Different Steps of Pradhan Mantri Van Dhan Yojna for Country Development

Figure 8: Green India Mission objective, target areas, challenges and its importance

CONCLUSION

In conclusion, trees are essential for human existence and agriculture, and afforestation increases these advantages. Important ecological services that forests offer include soil stability, water regulation, and climate control—all of which are critical for both human well-being and agricultural output. Deforestation and agricultural growth, however, can have a detrimental effect on the ecosystem, resulting in climate change, biodiversity loss, and soil degradation. Planting trees in previously unfrosted regions, or reforestation, can help lessen these adverse effects and repair damaged ecosystems.

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REFERENCES

[1] Abbass K, Qasim, MZ, Song H, Murshed M, Mahmood H and Younis IA. (2022) review of the global climate change impacts, adaptation, and sustainable mitigation measures. *Environ. Sci. Pollut. Res*, 29, 42539–42559.

[2] Abdullaha A (2023). Impact of forestry on environment and human health: an evidence-based investigation. *Front. Public Health,* 11, 1260519.

[3] Abera AB (2021). Impacts of Climate Change on the Forest Ecosystems in Ethiopia. *American Journal of Agriculture and Forestry*, 9 (6**),** 348-351.

[4] Abram NJ, Henley BJ, Gupta A, Lippmann, TJR, Clarke H, Dowdy AJ (2021). Connections of climate change and variability to large and extreme forest fires in southeast Australia Commun. *Earth Environ,* 2, 8.

[5] Adi SP (2024). Afforestation**:** A Pathway to Environmental Restoration and Sustainability. *Journal of Research in Environmental Science and Toxicology,* 13 (4), pp-1-2

[6] Addas A and Maghrabi A (2022) How did the COVID-19 pandemic impact urban green spaces A multi-scale assessment of Jeddah megacity (Saudi Arabia). *Urban For Urban Green,* 69,127493.

[7] Ajitha G and Sadasivam K (2025). Minor Forest Produce (MFP) A Catalyst for Tribal Economic Development In India. *Bodhi International Journal of Research in Humanities, Arts and Science,* 9 (2**)**, 151-158.

[8] Amit R, Dilip K and Bisham SK (2024). A review on climate change impacts,

models, and its consequences on different sectors: a systematic approach. *Journal of water and climate Change,* 15 (1), 104-126.

[9] Amina S, Lavan C, Omer, M, Alex B and Josep V (2024). The Effects of Environmental Factors on General Human Health: A Scoping Review. *Healthcare,* 12 (21), 21-23.

[10] Appiah M, Blay D, Damnyag L, Dwomoh FK, Pappinen A and Luukkanen O (2009). Dependence on forest resources and tropical deforestation in Ghana. *Environ. Dev. Sustain,* 11, 471–487.

[11] Awoted BF, Akala AO, Omolola T, Owoey EA, Olaoti-Laaro SO and Ogunsiji, A.O. (2021). Some underutilized indigenous timber trees with high medicinal values: Its challenges and prospects. *World Journal of Advanced Research and Reviews,* 10 (2), 161–168.

[12] Banerjee SK & Banerjee S (2020). Interrelationship between Forests and Climate Change. A Review. *Indian Journal of Forestry,* 43 (3), 193-205.

[13] Basak E, Cetin NI, Vatandaslar C, Pamukcu-Albers P, Karabulut AA and Caglayan, S. D. (2022). Ecosystem services studies in Turkey: A national-scale review. *Sci. Total Environ,* 844, 68.

[14] Bastin JF (2019) The global tree restoration potential. *Science, 365,* 76–79.

[15] Griscom BW (2017) Natural climate solutions. *Proc. Natl. Acad. Sci., U.S.A.* 114, 11645–11650.

[16] Beatty CR, Stevenson M, Pacheco P, Terrana A, Folse M and Cody A (2022). The Vitality of Forests: Illustrating the evidence connecting forests and human health, Washington DC: Worldwide Fund for Nature.

[17] Benjamin C, Ruth D and Jagdish K (2021). India's Commitments to Increase Tree and Forest Cover: Consequences for Water Supply and Agriculture Production within the Central Indian Highlands. *Water*, 13 (7), 95

[18] Beresford-Kroeger D (2018). The medicine of trees. In: The Ninth Haig Brown Memorial Lecture. Campbell River Community Arts Council, Campbell River, British Columbia.

[19] Bhupendra S, Ramkaran C and Aditya K.J. (2022). Studies of important forest tree species and their medicinal uses in Hadoti region of Rajasthan. *The Pharma Innovation Journal,* 11 (9), 2957-2961.

[20] Bhatt RP (2024). Restoration of global forests and biodiversity through green energy. *International Journal of Biological Innovations*, 6(1), 25-38. https://doi.org/10.46505/IJBI.2024.6104

[21] Baumgartner RJ (2019). Sustainable development goals and the forest sector A complex relationship. *Forests, 10*,152.

[22] Bosch M, Peter E, Kristin, F, Martin L, Christoph M, Roland O, Anne,R., Heike S, Bettina S and Priska, W. (2018). Forest Ecosystem Services in Rural Areas of Germany: Insights from the National TEEB Study. *Ecosystem Services, 31*, 77–83.

[23] Curtis PG, Slay, CM, Harris NL, Tyukavina A and Hansen MC (2018). Classifying drivers of global forest loss. *Science, 361*, 1108–1111.

[24] Clarke B, Otto F, Stuart-Smith R and Harrington L (2022). Extreme weather impacts of climate change: an attribution perspective. *Environ. Res.: Clim,* 1 (1), Article 012001, 10.1088/2752-5295/ac6e7d.

[25] Castillo MJ and Cecilia SR (2024). The Need for Holistic Approach in the Identification of Priority Areas to Restore: A Review. *Restoration Ecology,* 30 (8), e13637. doi:10.1111/rec.13637.

[26] Dai H, Han J and Lichtfouse, E. (2021) Smarter cures to combat COVID-19 and future pathogens: A review. *Environ Chem Lett, 19*, 2759–2771.

[27] EEA. European Environmental Agency. (2020). Available online: https://www.eea.europa.eu/ (accessed on 25 November 2024).

[28] Estoque RC, Dasgupta R, Winkler Avitabile V, Johnson B and Myint SW (2022). Spatiotemporal pattern of global forest change over the past 60 years and the forest transition theory. *Environ. Res. Lett, 17,* Article 084022. https://doi.org/10.1088/1748-9326/ac7df5.

[29] Fujimori S, Hasegawa T, Takahashi K, Dai HC, Liu JY and Ohashi H (2020). Measuring the sustainable development implications of climate change mitigation. *Environ. Res. Lett,* 15, 9966. doi: 10.1088/1748-9326/ab9966.

[30] Fayaz A, Palak C and Siya M (2025) Impacts of Climate Change on Forest Ecosystem Dynamics and Management Strategies. *International Journal of Environment and Climate Change*, 15 (1), 273-86.

[31] Gross-Camp N (2018). Tanzania's community forests: their impact on human well-being and persistence in spite

of the lack of benefit. *Ecology and Society*, 22(1), 37.

[32] Gitz V, Pingault N, Meybeck A, Ickowitz AS, Sunderland T, Barbara V, Powell B, Termote C, Jamnadass R, Dawson, I and Stadlmayr B (2021). Contribution of forests and trees to food security and nutrition. Research Program on Forests. *Trees and Agro-foresty,* 10, 17528

[33] Geeta MP and Shekh MG (2023). How Minor Forest Produces Helpful in the, Minor Forest Produce and its importance. *International Journal of Creative Research Thoughts***,** 1 (9), 795-807.

[34] Gupta R and Niyogi P (2022). The Environmental Inconsistency is a Natural Behavior of Nature upon Human Life. *Journal of Ecology,* 11 (3), 125-129

[35] Huang J and Liu X (2018) The global oxygen budget and its future projection. *Sci Bull*etin, 63,1180 1186. https://doi.org/10.1016/j.scib.2018 .07.023.

[36] Hou-jian, Xin-qiu, D, Shi-hao L, Yong S, Hong C and Yan H. (2018) Health rehabilitation and recreation in forests: concept connotation, product type and development route. *Chin J. Ecology*, 37, 2159–69.

[37] Huber N, Bugmann H, Cailleret M, Bircher N and Lafond V (2021). Stand-scale climate change impacts on forests over large areas: transient responses and projection uncertainties. *International Journal of Innovative Research In Technology,* 10 (5), 88-95.

[38] Holtako J, Holubik O, Hammerschmiedt T, Vopravil J, Kintl A and Brtnický M (2022). Afforestation of agricultural land affects soil structural stability and related preconditions to resist drought. *J. Forest. Sci,68* (12), 496-508.

[39] Harkin H, Ana B, Adrian JD, Adriane EM, William HM, Jordi MV, Nate GM, Jeenifer SP, Thomas, AMP and Carig DA (2022). Climate Change Risks to Global Forest Health: Emergence of Unexpected Events of Elevated Tree Mortality Worldwide. *Annual Review of Plant Biology,* 73, 673-702.

[40] Herve D, Richard P, Allan P and Rosie A (2024). Fisher Call for caution regarding the efficacy of large-scale afforestation and its hydrological effects. *Science of The Total Environment*, 950, 175299,

[41] Indu KM and Poornima K (2019). Forests Policies and Programmes in India: Implications for Climate Change

Adaptation. *Open Journal of Forestry, 3* (9)**,** 226-240.

[42] Jacob RB, Matthew J, Quishel NM, and Sharine W (2024). Environmental Impacts on Cardiovascular Health and Biology. An Overview. *Circular Research, 134,* (9), 1048–1060.

[43] Javed R, Shiv KD, Arunachalam A, Jean CR and Archana S (2024). The National Agroforestry Policy in India, transforming Indian agriculture landscape and inspiring other nations: The role of ICRAF and its partners. *Indian Journal of Agroforestry*, 26 (1), 1-11

[44] Khalid M and Amjad I (2018). The application omutagenesis in plant breeding under climate change. *Bulletin of Biological and Allied Sciences Research*, 15 (1), **https://doi.org/10.54112/bbasr.v2018i1.15**.

[45] Kramer RD, Ishii HR and Carter KR (2020). Predicting effects of climate change on productivity and persistence of forest trees. *Ecological Research*, 35, 562–574.

[46] Khan NM, Mujtaba G, Khalid M and Amjad I (2023). Effects of Global Climate Change: Adapting Agricultural Crops for a Warmer World. *Biological and Agricultural Sciences Research Journal,* (1)**,** 15.

[47] Kobal GD and Bončina A (2024). Integrating basic human values with forest ecosystem services: pathways to sustainable forest management. *Front Psychol, 9*, (15)**,** 1444775.

[48] Kyriaki P, Georgios T and Anastasia KP (2024). An Overview of the Role of Forests in Climate Change Mitigation. *Sustainability*, 16 (4), 6089.

[49] Kazungu M and Hunziker M (2025). Exploring societal perceptions of forests, ecosystem benefits, and restoration. A case study in Sweden, Scotland, Germany, Serbia, Croatia, and Spain. *Journal of Environmental Planning and Management*, 1–23**.** **https://doi.org/10.1080/09640568.2025.2490716.**

[50] Kramer RD, Ishii HR and Carter KR (2020) Predicting effects of climate change on productivity and persistence of forest trees. *Ecological Research,* 35:562–574

[51] Liu T, Mao P, Shi L, Eisenhauer N, Liu S and Wang X (2020). Forest canopy maintains the soil community composition under elevated nitrogen deposition. *Soil Biol. Biochem, 143,*

107733. doi: 10.1016/j.soilbio.2020.107733

[52] Morin X, Fahse L and Jactel H (2018). Long-term response of forest productivity to climate change is mostly driven by change in tree species composition. *Sci Rep,* 8, 5627.

[53] Margaretha H (2019). Being in the forest—A matter of cultural connections with a natural environment. *Plants People Planet,* 40 (1)*,* 73-97.

[54] Marshet NG and Fekadu HH (2019). Review on Effect of Climate Change on Forest Ecosystem. *Int J Environ Sci Nat Research, 17*(4), 555968.

[55] Ma ZY, Hu C, Huang JL, Li T and Lei JP (2022). Forests and forestry in support of sustainable development goals (SDGs): A bibliometric analysis. *Forests, 13*, 1960.

[56] Melinda GB, Valentina R, Diana B. K and Giovanni NR (2022). Old growth forests and large old trees as critical organisms connecting ecosystems and human health. A review. *Environmental Chemistry Letters,* 20, 1529-1538.

[57] Matilda VDB, María LB, Sarah W, Corina B, Ian H, Mark N, Joan P and Cathryn T (2024) A scoping review of human health co-benefits of forest-based climate change mitigation in Europe, *Environment International*, 186, 108593.

[58] Mandziuk A, Pieniak B, Stangierska MD, Widera K, Bihunova M, Arsenio PMR, Janeczko E, ˙ Zarska B and Parzych S (2025). Attitudes Toward Paying for Recreation in Urban Forests: A Comparison Between Warsawand Lisbon's Young Populations. *Forests, 16,* 188. https://doi.org/ 10.3390/f16010188.

[59] Oldekop JA, Sims KR, Karna BK, Whittingha MJ and Agrawal A (2019). Reductions in deforestation and poverty from decentralized forest management in Nepal. *Nature Sustainability, 2* (5), 421-428.

[60] Orsi FM, Ciolli E, Primmer L and Geneletti D (2020). "Mapping Hotspots and Bundles of Forest Ecosystem Services across the European Union. *Land Use Policy,* 99, 104840.

[61] Paudel U (2018). A Review of Effects of Environmental Change on Human Health. *American Journal of Environmental Sciences,* 14, 95-109.

[62] Pataki D, Alberti M, Cadenasso M, Felson A, McDonnell M, Pincetl S, Pouyat R, Setälä H and Whitlow T (2021) The Benefits and Limits of Urban Tree Planting for Environmental and

Human Health. *Front. Ecol. Evol,* 9, 603757.

[63] Pallabi C (2025) Effects of Climate Change on Forest in Dumka District of Jharkhand. *A multidisciplinary Online Peer Reviewed Journal of Netaji Subhas Open University,* India. *8* (1), 35-40.

[64] Petropoulou P (2025) Environment and Public Health: How the Environment Affects Children's Health and Quality of Life. *Cureus, 17*(1): e78299. DOI 10.7759/cureus.78299.

[65] Qiao S, Zhang C, Cuesta L, Alvarado R, Pinzón S and Bravo BD (2022). Impact of Government Stability and Investment Profile on Forest Area: The Role of Natural Protected Areas. *Sustainability*, 14, 4395.

[66] Raf A, Olivier H and Nieuwenhuyse AV (2018). Biodiversity and human health: mechanisms and evidence of the positive health effects of diversity in nature and green spaces. *British Medical Bulletin*, 127, (1**)**, 5–22.

[67] Raj KK (2024). Importance of Minor Forest Produces in Tribal Livelihood: A Study of Koraput District in Odisha. Proceedings of the NDIEAS-2024 International Symposium on New Dimensions and Ideas in Environmental Anthropology-2024 (NDIEAS 2024).

[68] Rawat A, Dilip K and Bhism SK (2024). A review on climate change impacts, models, and its consequences on different sectors: a systematic approach. *Journal of Water and Climate Change,* 15 (1), 104.

[69] Safen C, Buras A, Zang CS, Rammig A, Seidl R (2020). Excess forest mortality is consistently linked to drought across Europe. *Nature. Communication***,** Article number 116200.

[70] Saurabh S, Sharfa H and Pallavi S (2022) Air pollution and climate change impact on forest ecosystems in Asian region –A Review. *Ecosystem Health and Sustainability,* 8 (1), 2090448.

[71] Shilpa SS, Deepthi D, Harshitha S, Shipra S, Prashanth BN, Suchetha KN, Harishkumar M (2023) Environmental pollutants and their effects on human health, Heliyon, 9 (9**)**, 194-196.

[72] Swetha BS, Prabhakar I and Veeresh S (2023). The Role of Forests in Combating Climate Change and Promoting Sustainable Development: An Integrative Review. *International Journal of Environment and Climate Change,* 13 (11), 3755-61.

[73] Stanikzai K (2025). Impacts of climate change on forest ecosystems. *Journal of Natural Sciences, Kabul*

University, *6*(3),189–196. https://doi.org/10.62810/jns.v6i3.332.

[74] Srivani TR, Mohammad P, Seema N and Singh DK. (2022). Farmer's perception towards Pradhan Mantri Van Dhan Vikas Yojana in East Godavari district of Andhra Pradesh. *Indian Journal of Extension Education*, 58, 165-169. 10.5958/2454-552X.2022.00035.4.

[75] Verkerk DP, Hurmekoski E, Kunttu J, Matthews R, Mäkipaa R, Mosley F, Perugini L, Reyer CPO and Roe PJ (2022). Forest-Based Climate Change Mitigation and Adaptation in Europe. *From Science to Policy,* doi:https://doi.org/10.36333/fs14.

[76] Vijaya C., & Mishra, S.K. (2023). Van Dhan Yojana – A step towards tribal entrepreneurship – Implementation in Odisha – A study. *International Journal of Innovative Research In Technology, 10* (5), 88-95

[77] World Meteorological Organization. (2024). *Climate.* Availableat: https://wmo.int/topics/climate (accessed December 16)

[78] Wang MH, Wang LK and Shammas NK (2020). Glossary of Climate Change, Global Warming and Ozone Layer Protection." In Handbook Of Environment And Waste Management: Acid Rain and Greenhouse Gas Pollution Control. 689–718.

[79] Yu J, Berry P, Guillod BP and Hickler T (2021). Climate Change Impacts on the Future of Forests in Great Britain. *Front. Environ. Science, 9*, 640530. doi: 10.3389/fenvs.2021.640530.

[80] Yuan Z, Ali A, Ruiz−Benito T, Jucker T, Mori AS and Wang S (2020) Above−and below−ground biodiversity jointly regulate temperate forest multifunctionality along a local−scale environmental gradient. *J. Ecol.* 108, 2012–2024. doi: 10.1111/1365-2745.13378