

# **Artificial Intelligence in Forest Conservation**

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#### Abstract

Artificial intelligence is a new science that deals with the automatic presentation, collection and use of information. Artificial intelligence programs attempt to imitate human thought processes such as reasoning, reasoning, language, and image recognition. Artificial intelligence aims to make computers more useful in reasoning, planning, acting, and interacting with humans. The development of AI applications involves the integration of advanced computer science. psychology, and sometimes robotics. Among the areas where artificial intelligence can be exploited, one of the most immediate concerns of forest management concerns expert systems. Expert systems typically involve encoding information from an expert on a particular subject and using that information to mimic their decision-making process. Information is often presented as facts and rules accompanied by symbols, such as English words. At the heart of these systems is a mechanism that automatically finds and groups the facts and rules needed to solve a given problem. Small expert systems can be developed for standard microcomputers using existing, inexpensive commercial expert shells. Shells are

generic expert systems with no information. Users simply need to define the structure of the solution and add the desired information. Larger systems often require integration with existing forest models and databases. Their development requires relatively expensive expert systems development tools or the use of artificial intelligence development languages. Large systems are expensive to develop, require advanced IT skills, and can require years of testing and modifications before they work.

**Keywords:** Artificial intelligence, forest conservation, degradation

The wild forest fires that burn down entire landscapes causing immense damage to the environment, animal life, human lives living in the vicinity and, of course, the climate at large. In the last decade, 36 per cent of India's forest cover has been under the radar of catastrophic forest fires. While the fire is just one part of how forests are shrinking, deforestation, man-animal conflict, poaching, and developing villages and townships in and around the forest area are some of the many other reasons for forests to be in trouble. The world's forests, often referred to as the lungs of the Earth, play a vital role in maintaining ecological balance, preserving biodiversity, and mitigating climate change. As the challenges of forest conservation and management intensify. technology, particularly Artificial Intelligence has emerged as a promising tool. However, while Artificial Intelligence offers tremendous potential, it is not without its own set of challenges and complexities in this context. In this article, we delve into the challenges of using Artificial Intelligence in forest conservation and management, highlighting the need for innovative solutions and responsible practices.

In an era of ever-changing conditions, forest management requires new tools to gain insights and forecast the dynamics and management of forests. One of these tools could be artificial intelligence (AI).

AI encompasses a broad range of approaches and frameworks that date back to the mid-20th century. However, its application to forestry is relatively recent, especially in comparison to its early adoption in other fields like agriculture.

Narrow AI is a type of AI system that has been programmed to perform a specific task. This type of AI is typically used in the forest biometry domain (for example, to analyze the structure of a forest using 3 D point cloud data), but is not widely used in other forest domains.

Currently, AI algorithms can be quickly prototyped thanks to the abundance of open-source databases, libraries and computing platforms.

AI in forest management is primarily used to improve predictions. However, with the potential of AI, there are many opportunities to expand the range of applications, including improving the knowledge of forest processes.

Artificial Intelligence plays a critical role in facilitating conservational efforts, addressing conflicts and alerting landscape changes and illegal activities. It is helping protect species like the humpback whales, koalas and snow leopards by supporting the work of scientists, researchers and rangers in vital tasks, from anti-poaching patrols to monitoring species. AI is able to do the job of hundreds of people, getting faster, cheaper and more effective results. Outside India, it has been extensively used to address various conservation challenges, and the outcome has been quite phenomenal.

Although AI has been leveraged in various projects in India, the intervention has still been very nascent; however, things are moving forward in adopting tech for various studies.

Deforestation is one of the biggest threats to the health of planet Earth. Forests cover almost onethird of the planet's land area. They provide us with cleaner air and fresh water. 80% of the world's land-based population lives in forests. Why are forests important? We don't need to ask ourselves that question, but it seems we must.

The World Bank estimates that between 1990 and 2016 the global forest cover decreased by 502,000 sq km. The recent increase in forest fires in Amazon has made the importance of protecting our forests all over the world even more important.

So, let's talk about the current problem of deforestation, and then let's discuss how AI can help create solutions that help solve this evil problem.

AI can only be a part of a concerted effort, but it needs to be carefully considered.

As a result, poaching has become a full-time job for criminals. They have become tech-savvy and the efforts to curb wildlife crimes need pace and advanced technology. Man-animal conflict is another area causing immense trouble to both animals and humans. Controlling these unforeseen accidents also requires technological intervention. This is where Artificial Intelligence or AI is making a difference.

Forests cover about 30% of earth's land, and are essential to our environment. They remove carbon dioxide from the atmosphere, produce oxygen for us to breathe, and support the plants and animals that inhabit our world. Forests store carbon in a variety of ways, including living things, soil, dead wood, and even litter. The Amazon Rainforest is a prime example of a carbon sink, or a forest that stores more carbon than it releases. The threat of deforestation, however, can release a forest's stored carbon back into the air, polluting our air and damaging our climate. Deforestation is a real threat, and can be caused by illegal logging, mining, and wildfires–especially in tropical areas like the Amazon.

Deforestation and forest degradation contribute a large amount of global carbon emissions. Consequently, they are a point of contention in worldwide climate change negotiations. In order to mitigate the harmful effects of climate change and sequester carbon at a greater rate, planting new forests and restoring old ones are becoming increasingly important. The UN **REDD+** Framework provides financial incentives for developing countries to both protect and sustainably manage their forests. Artificial Intelligence carbon stock monitoring and mapping is essential to our environmental wellbeing. It can assist countries in meeting their goals for reducing emissions under international climate change agreements, and help balance global emissions by accurately tracking carbon sources and sinks. Utilizing this data, we can equip countries to make

judicious, well-informed decisions about the management of their forests.

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Traditionally, local and tribal people, who took pride in caring for the land, were in charge of watching over and supervising woods. But, they haven't been able to anticipate events or keep up with the rapidly changing environment and economy. It is unrealistic to even expect a few individuals to jointly manage and monitor such a vast forest, as even forest authorities and officials have failed to prevent accidents. Humanly speaking, it is not conceivable.

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Artificial Intelligence is one technology which is designed to help human beings. AI-enabled robots/machines can self-perform tasks, self-learn and improvise on the go, allowing human beings to do better and more innovative work. In the forest conservation context, AI is helping humans by making identifications of animals, their movements, and unexpected events easy and prompting the authorities to take action. This reporting happens in near real-time and provides multi-spectral reconnaissance and surveillance of the forest.

Technologies utilised for wildlife conservation worldwide include RFID tags, GPS geolocation for surveillance, infrared cameras, AI-enabled aerial drones, and real-time monitoring systems. Drones and robots with AI are being tested in forests in India and throughout the world to see how they might be used to safeguard animals and the environment in different scenarios.

Integration of technological innovations and AI can bring change in forest management and conservation practices.

Some other relevant use cases can be fighting modern-day threats, including unauthorized deforestation, human encroachment, trespassing, smuggling, wildlife poaching,



# A Treeswift drone on a test run in a New Jersey forest | Credit: Treeswift

mitigating man-animal conflict, tracking animal migration, and wildlife tourism. All these issues can be dealt with AI-powered drones. A drone flying over the area could detect a threat or a breach. So, if a drone alerts authorities about human movement in a certain part of the forest and the forest officials mark that as risky or not a cause for concern, the drone learns that and acts accordingly. If any human intrusion is found in restrictive parts of the forests and those are redflagged, the system learns to identify who is allowed, where, when, what time of the day, and for what kind of activity and prompts the concerned departments.

Technology must be used to stop illicit activity in woods and conflicts between humans and animals. Automated technology can be used to reduce the risk in a variety of ways, from locating regions where animals may pose a hazard to people's safety to delineating danger zones for unlawful activity.

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### Camera-traps-watching-wildlife | Credit: OrissaPost

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AI is essential to making forest conservation easier. Artificial intelligence (AI) has the potential to overcome a wide range of difficult tasks, including resolving conflicts, detecting changes in the environment, and uncovering illicit activity. It can be used to find criminals, their activities, their traps, the causes of animal-village conflict, and even to utilise the anticipated conflict as a starting point for creating the best possible policy. More widespread use of this technology could yield better outcomes with less need for human involvement.

Despite a wealth of statistics about the value of our natural resources, we are essentially flying blind when it comes to their current state and how to best protect them. To fight climate change more effectively, while also feeding a growing population, protecting our ocean and freshwater resources, and stemming a global loss of biodiversity, we must close that information gap, and do so in a hurry.

Agriculture is the world's largest industry, employing more than 1 billion people and generating over \$1.3 trillion worth of food annually. But food production is growing more difficult, as arable land continues to decline, extreme weather wreaks havoc on predictable growing seasons, and climate change lowers the nutritional value from what is harvested. Our other land-based natural resources, such as forests, are in a similar state – forests shoulder the needs of 1.6 billion people, yet reports indicate we are losing 18.7 million acres a year. This represents more than just a loss of natural resources, ecosystems and biodiversity, though that's bad enough. Our current agriculture and land-use decisions are directly contributing to climate change, accounting for nearly 25% of the world's total greenhouse gas emissions. Agriculture is one of the biggest drivers of deforestation, which is one of the top three anthropogenic sources of greenhouse gases – followed closely by agriculture itself.

Managing these resources more effectively improves the well-being of everyone on the planet and also has the potential to improve the planet itself. This presents an incredible opportunity – better management of our ecosystems and land could help feed a growing population, while substantially lowering carbon emissions. However, to act on that opportunity, we need a clearer picture of the current state of the planet's natural systems; how they are changing and what the most effective intervention strategies are. Increasingly, this information gap will be filled by AI-enabled solutions.

Forest management is a good example of how technology-first approaches can quickly deliver results. Conducting a forest inventory hasn't changed much from the statistical sampling approach first introduced in the Nordic countries in the early 1900s. Teams go out into the woods, armed with tape measures, pencils, and a pad of real paper, not a device. They measure the diameter, height and species of each tree in many small "sample plots" to estimate what's in the forest as a whole.

However, there are start-ups devoted to finding better ways to do this inventory. SilviaTerra, an AI for Earth grantee, came up with a software-based approach after becoming frustrated with the status quo while at Yale School of Forestry. Now, their software can assess forests using satellite imagery and machine learning. The algorithm, powered by AI, greatly reduces the amount of fieldwork needed to accurately assess forests and is the vanguard of a new generation of "precision forestry". Their goal is to build a data library and powerful AI tools that can provide an up-to-date map of US forests for the first time in history, with detailed information about each tree. This kind of information enables data-driven environmental management for biodiversity, carbon sequestration, and many other ecosystem services provided by forests.

Work by AI for Earth researchers at Columbia University sheds even more light on why accurate, detailed, and up-to-date information is important. Dr Maria Uriarte, an ecologist, and Dr Tian Zheng, a statistician, have been studying the impact of extreme weather on forests and their re-growth patterns, with an eye towards the impact this has on carbon sequestration abilities - shorter, younger and less dense forests are less effective than older, denser areas. She recently took a team to Puerto Rico to assess the damage to the forests following Hurricane Maria. Uriarte and Zheng, both affiliated with the Data Science Institute at Columbia, will eventually use the collected data, with the remotesensing images and measurements, to come up with a detailed estimate of the loss from the storm. Without current baseline data and a forwardleaning view of what the forest inventory may be in the future, planners may undervalue forests, or countries may over-value sequestration abilities. Conclusion

Conclusion

Artificial Intelligence can be a game-changer because taking actions are easier and more effective – and less vulnerable to politicization – if we know what is happening on Earth, when and where. The speed of innovation is one of the few things keeping pace with climate change. Harnessing the power of AI to monitor the impacts of our current land use practices and to model scenarios means that, perhaps for the first time, we can have the right information at our fingertips to more effectively and sustainably manage our lands, watersheds and ecosystems.Artificial Intelligence holds immense potential in transforming forest conservation and management practices. However, as we have explored, it comes with a unique set of challenges. Overcoming these challenges requires a multidisciplinary approach that involves scientists, conservationists, technologists, policymakers, and local communities.

Efforts should be directed toward improving data accessibility and quality, addressing model bias, minimizing the environmental impact, and upholding ethical standards. Additionally, investing in human-AI collaboration, capacity building, and fostering trust are vital steps toward realizing the full potential of AI in the preservation of our precious forests.

In conclusion, AI is not a silver bullet but a valuable tool that, when wielded responsibly, can contribute significantly to safeguarding the world's forests for future generations. With ongoing research, innovation, and collaboration, we can surmount these challenges and build a more sustainable future for our forests and the planet as a whole.

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