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**Original Article**

## Application of drones for the protection and conservation of forest resources

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**INTRODUCTION**

The greatest gift that nature has given to humanity is its forests, which are among its most valuable and ancient assets. It would have been doubtful if humanity had survived on this planet without the forests. Drones, in particular, are the greatest invention ever made by humans. Unmanned aerial vehicles (UAVs) have made progress and development possible for everyone by providing answers to nearly all societal problems. Drones are unmanned aircraft that are extremely small, use very little energy, are inexpensive to use, and do not endanger human life (Tiberiu *et al.*, 2016).

Drones are UAVS that were first created in the early 20th century. Following the 1950s, the primary use of drones was for military purposes, specifically for surveillance and reconnaissance. Drones of all sizes, shapes, and capacities have proliferated over the past ten years, and interest in using them for civilian purposes (Colomina and Molina, 2014) as well as precision farming, forestry, biodiversity, meteorology, emergency preparedness, wildlife research, land management, traffic monitoring, and many other areas—has grown (Shahbazi *et al.*, 2014).

India forbids hunting and poaching of animals under the Wildlife Protection Act, 1972. UAVS are able to fly all over the forest. They can support the forest officers in tracking the movements of both prey and animals and in keeping an eye out for any poaching activity. In addition, the drones can assist create maps of habitat suitability for each species that lives in a specific forest. It can also be useful in handling conflicts between people and wildlife.

Drones have the capability to create an appropriate geospatial database for the establishment of biosphere reserves, sanctuaries, and national parks. The forest authorities can evaluate the increasing biomass, increasing number of forest covers, and expanding stock with the use of these maps. In addition to all of this, the well-equipped drones also offer services like thematic

mapping of forests, which is crucial for evaluating the amount of forest cover in the vicinity of planned canals and water reservoir projects.

It now only takes a few hours to evaluate the forest covers and calculate the survival rate of plantations or afforestation thanks to the development of intelligent guided drones. In addition, we can determine roughly how much harm natural disasters like massive forest fires have done to the forest coverings. With IG Drones, the use of UAVs in Forestry and wildlife can be incorporated by simply eliminating the traditional ways of using a large number of manual taskforces in the deep forest covers among the not-so-human-friendly species, endangering their lives. A significant change in the use of drones in forestry is imperative given the advancement of technology and society's need for cost-effective and time-saving ways to complete tasks!

### **ADVANTAGES OF DRONES OVER SATELLITES**

By their very nature, satellites have proved incredibly helpful for monitoring and surveillance because they can provide vast amounts of visual content and imagery. Their adaptable skills enable them to capture the many characteristics of several sectors, including forestry. They can provide results conveniently and don't have any limitations on how long they can operate or power outages. Notwithstanding these advantages, satellites have many drawbacks as well, such as a rather pixelated and hazy aerial photo compared to what drones and unmanned aerial vehicles can acquire.

Through its many uses, drone technology has assisted in overcoming the various difficulties and barriers that face the forestry industry. Drone applications have thrust the specialization of topographic surveillance, aerial photography, thermal imagery, mapping, and more to the forefront of forest agriculture, thrusting the abstraction of aerial images and monitoring. Drones' adaptability enables them to record and take real-time, high-resolution video and photos even in humid tropical weather. Drones equipped with artificial intelligence and LiDAR (light detection and ranging) technology can monitor and survey wide regions with targeted coverage, producing more accurate and timely data and findings.

### **APPLICATIONS OF DRONES IN FORESTRY**

Using drones in forestry has become increasingly popular due to their ability to quickly and efficiently gather data over large areas. Here are some key applications and benefits of drone technology in forestry:

#### **1. Forest Health Monitoring:**

- Drones equipped with multispectral or thermal cameras can detect signs of disease, pest infestations, and other health issues in trees.
- They can identify stressed trees before symptoms become visible to the human eye, allowing for early intervention.

#### **2. Forest Inventory and Mapping:**

- Drones can capture high-resolution images and 3D data to create accurate maps of forest areas.

- They provide data on tree height, diameter, and species distribution, which are essential for forest management and planning.

### **3. Carbon Stock Assessment:**

- By analyzing the data collected, drones can estimate the amount of biomass and carbon stored in a forest, which is crucial for carbon trading and climate change mitigation efforts.

### **4. Reforestation and Planting:**

- Drones can be used to disperse seeds in deforested areas, enabling rapid reforestation.
- They ensure even seed distribution and can access remote or difficult terrain.

### **5. Wildlife Monitoring:**

- Drones help in monitoring wildlife populations and their habitats without disturbing the animals.
- They can track movements, nesting sites, and population health.
- Aerial imagery, mapping, and data processing as performed by the AI-powered drones express endangerment alerts, scan for potential threats to wildlife, and so on. Time-critical results help to validate data and provide relief and medication in worsened conditions.

### **6. Life Saving:**

- Drones, as employed for search and rescue missions, draw in the advantages of immediate relief in threatening situations.
- As a means of wildlife monitoring and biodiversity checking, UAVs prove to be highly resourceful at random times of distress and danger, which are frequent occurrences in forest ecosystems.
- Operations and tasks of delivery of emergency medication, surveying for harmful activities, immediate aid to ailing lives, etc., are a few instances of applications of drones in forestry that save time and hence, life.

### **7. Human Interaction:**

- Embodying the features of security and reliability, Unmanned Aerial Vehicles use their abilities to the limits to scan and cover the dense forest areas for potential harm or threats.
- Forest managers and officials may find it handy and skilful to adopt these winged aerial vehicles with their dependable qualities to survey and map regions with improved accuracy.
- This advances the level of efficiency of surveying and inspection and also recovers a fair amount of time, effort, and workforce.

### **8. Fire Management:**

- Drones can be deployed to monitor forest fires, providing real-time data on fire spread and intensity.
- They assist in post-fire assessment by mapping burned areas and assessing damage.

**9. Forestry and land management:** Forestry and land management applications include:

- Biomass analysis
- 3D Mapping
- Mapping diseases
- Classifying species
- Precision forestry
- Fire Management
- Timber evaluation
- Pest Outbreaks
- Large-area Seeding
- Forest governance
- Tracking deforestation

The key benefits of using drones in land management include fewer in-person assessments, which are often required in hard to access regions, as well as reducing resources, energy consumption and data acquisition times, which in turn increase efficiency and reduce costs.

**BENEFITS OF DRONES IN FORESTRY**

Drones have gained popularity in forestry in recent years as a substitute for conventional techniques for measuring, monitoring, and analyzing tree health. Historically, forest management has included time-consuming, resource-draining activities such as people walking on foot or flying in helicopters with heavy equipment to collect pictures and movies. Drones, on the other hand, have completely changed this process by effectively carrying out aerial mapping and surveys, monitoring the detection of diseases and pests, helping to detect and manage fires, providing environmental monitoring, and enabling precision forestry techniques. With significant return on investment, drones provide an economical substitute for time-consuming foot surveys or pricey helicopter leases. Enhanced efficiency through rapid and thorough land evaluations, which reduces the need for ground surveys, is one of the top benefits mentioned.

**1. Efficiency and Cost-Effectiveness:**

- Drones streamline data collection, offering rapid & detailed land assessments in under an hour, a cost-effective alternative to helicopters with potential returns after just a few uses.
- Drones can cover large areas quickly, reducing the time and labor required for ground surveys.
- They lower the costs associated with traditional aerial surveys conducted by manned aircraft.

**2. Safety:**

- Drones reduce the need for personnel to enter hazardous or difficult-to-reach areas, minimizing the risk of accidents.
- They can safely monitor areas during adverse conditions, such as fires or floods.

### 3. Data Accuracy and Resolution:

- Equipped with advanced cameras, drones excel at capturing close-up footage in remote areas with unmatched stability, efficiently surveying areas and providing detailed maps.
- Drones provide high-resolution images and detailed data, improving the accuracy of forest inventories and health assessments.
- They offer real-time or near-real-time data, enabling prompt decision-making.

### 4. Environmental Impact:

- Drones have a lower environmental footprint compared to traditional methods, such as helicopters or ground vehicles.
- They contribute to sustainable forest management by enabling precise and minimal-impact interventions.
- Drones minimise habitat disruption and soil disturbance with their small size and non-intrusiveness. Additionally, they offer an environmentally friendly approach to data collection without heavy machinery or extensive ground surveys.

### 5. Better Accessibility:

- Drones enable comprehensive coverage of forested landscapes, facilitating the monitoring and managing of challenging terrain in remote or difficult-to-reach areas, such as dense forests and high mountains.

## FUTURE PROSPECTS

### 1. Advanced Sensors and AI Integration:

- Future drones will likely be equipped with more advanced sensors, including LiDAR and hyperspectral cameras.
- Integration with AI and machine learning will enhance data analysis capabilities, enabling predictive modeling and more precise forest management.

### 2. Autonomous Operations:

- Advances in autonomy will allow drones to operate with minimal human intervention, conducting routine monitoring and reporting.

### 3. Collaborative Swarms:

- Multiple drones working in coordination could cover vast areas more efficiently, sharing data in real-time for comprehensive forest management.

## CHALLENGES

### 1. Regulatory Issues:

- Drone operations are subject to regulations that vary by country and region, which can limit their use in some areas.

### 2. Technical Limitations:

- Battery life and payload capacity can restrict the duration and range of drone missions.

### **3.Data Management:**

- The large volumes of data collected by drones require robust systems for storage, processing, and analysis.

### **CONCLUSION:**

All things considered, drones are transforming forestry by offering creative answers to age-old problems and improving the effectiveness, precision, and sustainability of forest management techniques. The further advancements in sensor and processing technology are expected to drive drone utilization in forestry applications. Drones are strong instruments for almost all forestry and land management tasks, from tracking exotic plants to spotting fires. Drone technology is redefining the components of forestry and has benefits for the development of forest ecosystems. In this field, drones push the limits of forest management and cultivation, saving species and flora while keeping an eye on dangers to stop tree chopping. Additionally, a few forestry enterprises have started investigating the use of drones throughout their operations to monitor plant health, conduct inspections, and improve safety. Drones are proven to be useful and reasonably priced instruments for managing forests, and as more businesses adopt this technology, the forestry sector has a promising future. The use of drone will allow for unprecedented growth and improvement in the forestry industry.

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