

ROMANIA'S FORESTS PROTECTED WITH THE HELP OF DRONES

*Florentina BURLACU¹
Grațîela Doina GHIOALDĂ²*

Abstract: *Forests are the lungs of the planet and are vital for maintaining life on Earth. Their destruction means the destruction of all the living beings on Earth, be it the creatures that inhabit the forests or the people living in villages and towns. If we want to have a future on this planet we must understand that humans can't breathe money and we must take urgent drastic measures to defend our forests. The solution to this problem can be the usage of drones for patrolling the forests in order to spot and stop illegal logging. Unfortunately foresters are often the victims of the wood thieves and some of them pay with their lives for protecting the forest. All this suffering and loss can be stopped if drones are used for security. Drones are more efficient in covering a vast area of forest and can spot the exact location of the thieves in order to send there the police to arrest them.*

Keywords: *Forests, Romania, Deforestation, Illegal logging, Protection, Drones.*

1. Introduction

We chose this subject because our life depends on the trees and the oxygen that they give through photosynthesis. All the animals and human beings on this planet need the oxygen produced by trees and plants to breathe and stay alive.

Also, forests significantly diminish the amount of water from precipitations that flows to the surface of the soil. This feature, along with the soil stabilization effect due to the roots of the trees, makes the forests our main ally to avoid catastrophic floods that may be caused by heavy rains.

Illegal logging affects the environment, the economy and the society as a whole. The loss or degradation of forests will result eventually in the loss of habitats and biodiversity.

The forests of our country are in extreme danger from legal and illegal logging. Illegal logging is destroying the forests of Romania at an alarming rate. The authorities are overwhelmed and can not take measures or will not take measures.

¹ PhD candidate at The Bucharest University of Economic Studies, Bucharest, Romania, e-mail address: florentina.burlacu@yahoo.com

² PhD candidate at The Bucharest University of Economic Studies, Bucharest, Romania, e-mail address: gratiela101@yahoo.com

The objective of this article is to draw attention to one of the most important problems our country has: the deforestation of the Romanian forests. In order to stop the illegal logging and the legal forest cuttings, which are just as destructive, we must take action - draft laws and legislate in order to protect Romania's forests.

We propose as a solution to this important problem the use of conservation drones. With the help of high technology drones we can keep an eye on our forests and prevent the theft of wood. A drone can survey vast territories and send the information with the exact location where the forester with his crew and the police must intervene to catch wood thieves.

In this article we used mainly the qualitative method in order to obtain the extensive data about the importance of forests in our lives and in our planet's life, and also about the possibility to protect our forests with the help of drones. Quantitative analysis is also used, particularly with regard to statistical data. The techniques used here are: the analysis of the theoretical works in this field and a case study on Romania's forests.

2. Problem Statement

In recent years few environmental issues have attracted as much attention as global deforestation and the effects that it has on the ecological wellbeing of the Planet Earth. According to several estimates forests cover about 10% of the Earth's surface and 20% of the continental surface, excluding Antarctica and Greenland (Bequette 1997, p. 80; Abramovitz 1998, p. 16 in Vajpeyi, 2001, p. 1).

Forests constitute a crucial part of the global ecosystem and the global economy. They provide the largest natural habitat for wildlife. Current estimates indicate that forests host from 50% to 90% of the species of living organisms on the Earth (Schwartzman and Kingston 1997, p. 8 in Vajpeyi, 2001, p. 1).

Forests absorb carbon dioxide (CO₂) from the air and store it in their systems, thus they control and regulate fresh air reserves and their flow. Forests also provide medicinal plants, help in flood control and stop soil erosion, provide timber and wood for energy and fuel for the nearly 1 billion people around the globe (Strada 1999, p. 314 in Vajpeyi, 2001, p. 1).

The contribution of forests to local, national and international economies is significant. The international trade with the 150 nonwood forest products is worth 11.1 billion dollars per year, while the trade in wood products - paper, timber, etc. - generates approximately 142 billion dollars per year (Abramovitz 1998, p. 10 in Vajpeyi, 2001, p. 1).

Buongiorno (2018, pp. 541–551) tried to estimate the accuracy of international forest product statistics. He checked the consistency of the reported consumption of wood and fiber with the production of wood products. For a number of 180

countries Buongiorno approximated the consumption of industrial roundwood and of paper-making fibers nearest to the reported consumption, given the reported production of sawnwood, wood-based panels, pulp and paper and paperboard, and prior estimates of the input–output coefficients. But the results of his study showed that the consumption was under-reported in 57 countries and over reported in 44 countries.

It is stressed the fact that „the main source of the discrepancies was in the production statistics rather than trade. Only in some instances was the presumption of illegal logging consistent with the discrepancy, or lack thereof, between reported and estimated consumption of industrial roundwood” (Buongiorno, 2018, pp. 541–551).

In Romania for the 3-year average 2013, 2014 and 2015 the reported consumption of industrial roundwood was 4762 m³, or 32% less than the estimated. But in the same time we registered positive numbers in the consumption of total paper-making fiber: 52t or 12% and in the consumption of recovered paper: 51t or 16% (Buongiorno, 2018, pp. 541–551).

Our country ranks eighth in the top of the countries with under-reported consumption of industrial roundwood. This inferred under-reported consumption of industrial roundwood in Romania could be linked to illegal logging. The reported production fell short of the estimated in the consumption of industrial roundwood because our country is used for the purchasing of raw materials not finished products.

The benefits that people receive from ecosystems are called Ecosystem services (ES). Sing et al. (2017) emphasize the fact that „understanding the impact of forest management on their supply can inform policy and practice for meeting societal demand.” (Sing et al. 2017, pp. 151–164).

Sing et al. (2017) are convinced that low intensity management is unsuitable for high biomass production, but instead it provides high or moderately high levels of other services. On the other hand a higher intensity management impacts negatively on biodiversity, health and recreation and water supply services. Combined objective forestry provides high or moderately high levels for all services except biomass. The authors state that a diversity of management approaches is needed to maintain multiple ecosystem service provision. The Ecosystem Services framework „offers opportunities to forest management by revealing areas of conflict or co-production and potential trade-offs that may arise from adjusting management intensity” (Sing et al. 2017, pp. 151–164).

Anderson et al. (2018) emphasize the fact that the managers of public forests are required to balance multiple values of forests. The development of policies in order to represent these „can be impeded by uncertainty regarding how to understand and

describe values relevant to forests.” The authors of this study are examining forest values at two levels of abstraction: core values of people (principles that guide in life), and valued attributes of forests (qualities of forests important to people) (Anderson et al. 2018, pp. 629–640).

This paper demonstrated „a broader range of core values relevant to forest management than previously recognized: security (safety and stability of society) and hedonism (pleasure and sensory gratification) were expressed in addition to biospheric, altruistic and egoistic values.” The associations between core values and valued attributes revealed the fact that biospheric values underpin variation in the importance given to production and natural attributes of forests. Also the core value of security underpinned multiple valued attributes. „By revealing a comprehensive yet succinct range of values associated with forests, this research supports development of forest policy congruent with expectations of society” (Anderson et al. 2018, pp. 629–640).

Climate change mitigation strategies have focused on reducing greenhouse gases emissions, especially carbon dioxide (CO₂). A major source of CO₂ emissions is the process of deforestation. Reducing deforestation in order to decrease CO₂ emissions is seen as one of the least costly ways to mitigate climate change (Kindermann et al. 2008, pp.10302-10307 in Gorte and Sheikh, 2010, p. 1).

Researchers have found out that the higher the levels of carbon dioxide and the temperatures the greater is the need to use a larger quantity of water by the plant. The combination of drought and the need for more water could stress forests and cause changes in the ecosystem. Deforestation on large scale reduces evapotranspiration by plants (water loss to the atmosphere), a phenomenon that reduces the formation of clouds and precipitation (Hansen et al. 2001, pp. 765-779 in Gorte and Sheikh, 2010, p. 7).

Deforestation is a complex global issue. This complexity arises from two general factors. First, deforestation introduces a wide range of political actors, from government to international civil society, each entity having a direct or indirect stake in forest use. These actors include: government departments; private profit-making companies, including transnational corporations; UN programs, such as the United Nations Environment Programme (UNEP); intergovernmental organizations, including UN specialized agencies such as the Food and Agriculture Organization (FAO) and intergovernmental organizations operating outside of the UN system; and non-governmental organizations (NGOs) such as conservation groups and research fora, that operate at the international, national and local levels. The structures of local government, community institutions and traditional authorities may also be key political actors at the local level. In addition, various hybrid and ad hoc fora with an interest or a stake in the forests may emerge occasionally. Therefore, there is a diverse range of actors competing frequently,

they are involved in forest politics, although specific actors vary from one area to another (Humphreys, 2014, pp. 1-2).

Second, the complexity of deforestation arises from its connection to other issues. Deforestation is both an outcome and a causal factor. As an outcome deforestation is the end product of an array of political, economic and social dynamics arising at the international and national levels. These dynamics rarely act in isolation, rather they interact in complex ways. As a causal factor, deforestation contributes to other environmental problems, such as global warming, soil erosion and the destruction of biodiversity (Humphreys, 2014, p. 2).

In order to stop deforestation we must find viable and ingenious solutions to this pressing matter. Over the past two decades, science and technology have made significant progress. These solutions must be applicable on vast territories and must diminish the effort of foresters to oversee large areas of forest. Guarding large wooded areas requires a large number of people and related logistics. Patrolling is hard and time consuming, it also has additional costs like car maintenance and gasoline. Human resource are scarce and cannot cover so much ground. Another important and worrisome problem is the fact that in the latest years foresters have been beaten and even killed by the illegal loggers. A solution to this problem would be replacing the patrolling done by humans with the patrolling done by solar energy alimented drones.

Drones have ceased to be synonymous with the flying killing machines used in the „war on terror”, instead they showed their potential in doing good things, helping people and nature. The beneficial new applications for drones cover a wide range: from peacekeeping to humanitarian relief, search and rescue, border control, migration monitoring, environmental and wildlife protection - conservation, agriculture, commercial and other civilian purposes (Sandvik and Jumbert, 2017, pp. 1-2).

Although the word „drone” is used as the term that defines a wide range of unmanned aerial platforms performing a multitude of tasks, the word has a controversial history because both the military and the drone industry insist that other terms should be used. Abbreviations like UAV (unmanned aerial vehicle), RPA (remotely piloted aircraft) and RPV (remotely piloted vehicle) are preferred instead of the term drones (Sandvik and Jumbert, 2017, p. 3).

Drones are used by the military for targeted killing and also for intelligence, surveillance and reconnaissance. UN peacekeeping relies to an increasing extent on the use of drones. Humanitarian actors and organizations use drones for demining, population management and crisis mapping, and are also experimenting with drone use for relief drops and medical logistics (Sandvik and Jumbert, 2017, p. 3).

In order to serve in civil purposes government actors such as firefighters, search-and-rescue crews and police are testing the use of drones to increase the safety and effectiveness of their work (Sandvik and Jumbert, 2017, p. 3).

Civil society actors (environmentalists, conservationists, cultural-heritage advocates, human-rights activists, social-movement organizers, etc.) are delighted with the promising capabilities of the drones especially with their ability to capture and document different situations from above, in support of struggles for sustainability, cultural survival and social justice (Sandvik and Jumbert, 2017, p. 3).

The media sees drones as the new technology that has an immense potential, and with its help the ultramodern „citizen drone” journalists have access to new information. The commercial use of drones is revolutionizing package delivery, precision farming, and, also, is optimizing exploration and productivity in the gas, oil, mining and maritime industries (Sandvik and Jumbert, 2017, p. 3).

The idea of unmanned military airplanes is much older, this type of airplanes was first developed in the early 1900s. The origins of the modern drone technology can be traced back to the First and Second World Wars. During the Vietnam War (1955-1975) the US Army used for the first time drones for military reconnaissance. Israel was a pioneer in the commercial use of drones, also, in the 1980s, the Israeli army began using drones for surveillance. In the 1990s, in Japan, farmers began using drones for agriculture (Sandvik and Jumbert, 2017, p. 4).

After the war on terror faded and the military stopped buying drones, the manufacturers of military drones began to search for new drone clients and new tasks that can be accomplished with the help of drones (Sandvik and Jumbert, 2017, p. 4).

The next step for the drone industry was to convince US and European authorities to open civil airspace to drones. This lobby activity started in 2015 and 2016 generated a large public debate sparked by the fact that drones have the capacity to record every detail of our lives and this can be in the detriment of both our privacy and our security (Sandvik and Jumbert, 2017, p. 4).

In the next section we will try to answer the research questions and to present the aims of the research.

3. Research Questions/Aims of the research

The questions we would like to find answers for are the following:

Can security (patrol) drones be successfully implemented in Romania for guarding the forests?

Are patrol drones an alternative to human foresters?

Can illegal logging be reduced by introducing patrol drones?

Can local or central authorities purchase patrol drones to be used by the Forest Agency (ROMSILVA) and also provide the necessary training for using them properly?

We believe the answer to all the above questions is affirmative.

The objective of this article is to offer some feasible solutions to the problems generated by illegal logging. We want to show that with the help of new technologies, in our case patrol drones, we can save the Romanian forests and the lives of our foresters. These solutions can be implemented with success in Romania because we already have an Intelligent Fire-Detecting Drone invented in 2014 by four Romanian high school students from Eforie Sud, Constanta County. We think that the highly sensitive sensor of the drone can also be used for the detection of the illegal loggers. According to the inventors all the collected information is delivered to the ground in real time, and is automatically downloaded in a computer that analyzes it.

4. Research Methods

In this article we used mainly the qualitative method in order to obtain the extensive data about the real situation of the forests in general and especially in Romania, and also about the beneficial utilization of drones. Quantitative analysis is also used, particularly with regard to statistical data. The techniques used here are: a case study on Romania’s forests, and the analysis of the theoretical works in this field.

5. Findings

Next we will show the real situation of the Romanian forests, and in this sense we present statistics that reflect the existing ecological disaster in our country. The statistical data comes from three sources that have a credibility hard to dispute: National Institute of Statistics (INS), the Romanian Court of Accounts and Greenpeace Romania.

Table 1. Area of forest land fund by land category, forest species

Forestland categories and forest species	Macro-regions, development regions and counties	Years						
		Year 1990	Year 1995	Year 2000	Year 2005	Year 2010	Year 2015	Year 2019
		MU: Thousands hectares						
		Thousands hectares	Thousands hectares	Thousands hectares	Thousands hectares	Thousands hectares	Thousands hectares	Thousands hectares
Total	TOTAL	6371	6368.8	6366.5	6390.6	6515.1	6555.1	6592.2
Forest land area	TOTAL	6252.3	6244.7	6223.1	6233	6353.7	6398.8	6427.3
Coniferous tree forests	TOTAL	1928.8	1902.9	1856.2	1872.7	1940.9	1930.7	1915
Broad-leaved tree forests	TOTAL	4323.5	4341.8	4366.9	4360.3	4412.8	4468.1	4512.3
Other land	TOTAL	118.8	124.1	143.4	157.6	161.4	156.3	164.9

Source: National Institute of Statistics.

Last update: 04 AUG 2020

The National Institute of Statistics defines forest fund as „the total area of forests, lands meant for afforestation, those serving the needs of crops, production or forest administration, of ponds, brooks, as well as of other areas with forest destination and non-productive lands contained in forest arrangements on January 1st, 1990 or included in these later including surface changes according to the fulfilled input-output operations, under the law, no matter of ownership right” (<http://statistici.insse.ro/shop/>).

According to the National Institute of Statistics forest area represents „all lands with an area of at least 0.25 ha covered with trees. Trees must reach a minimum height of 5 m at maturity in normal conditions of vegetation. Area of other lands belonging to the forest fund includes the non-forested lands serving the needs of crops, production or forest administration, land occupied by constructions and related yards, land in regeneration class, ponds, brooks, land meant for afforestation, non-productive land, strip border, land temporarily removed from forest fund and forest lands owned by various physical and legal persons without definitively ownership title and for which there are administratively or in court actions claim in court exists” (<http://statistici.insse.ro/shop/>).

Table 1 presents the evolution of the forest area in Romania starting with 1990 and until 2019. We used the data recorded every five years as the reference period (1990, 1995, 2000, 2005, 2010, 2015), 2019 being the last recorded year.

The analyzed statistical data from the first three years we took as reference (1990, 1995, 2000) shows us that there was a slight decrease in the total number of hectares of forest, the only exception to this trend are the last two categories – “Broad-leaved tree forests” and “Other land”. Then, starting with 2005 – 2010, 2015 and 2019 – the values record an increase in the number of hectares of forest area. Two exceptions to this general trend were registered in the categories “Coniferous tree forests” were there was recorded a decrease starting with 2015 and “Other land” were the numbers fluctuated from year to year.

Table 2. Area of the land submitted to afforestation schemes by forestation category

Afforestation categories (by forest species)	Macro-regions, development regions and counties	Years						
		Year 1990	Year 1995	Year 2000	Year 2005	Year 2010	Year 2015	Year 2019
		MU: Hectares						
		Hectares	Hectares	Hectares	Hectares	Hectares	Hectares	Hectares
Afforestations – total	TOTAL	25489	13117	12701	14389	10106	11846	8443
Coniferous trees	TOTAL	9262	4895	5865	5418	5257	6183	4496
Broad-leaved trees	TOTAL	16227	8222	6836	8971	4849	5663	3947

Source: National Institute of Statistics.

Last update: 04 AUG 2020

The National Institute of Statistics explains that afforestation represents „all works done for planting of seedlings or sowing a land area in order to create new forest trees, both on forest lands that has been exploited mature stand and on lands without forest vegetation” (<http://statistici.insse.ro/shop/>).

Table 2 presents the evolution of the afforestation in Romania starting with 1990 and until 2019. The statistical data shows that initially, after the '90, there was a decrease in the number of hectares submitted to afforestation, then starting with the year 2005 the values record a fluctuation that is maintained until the end of the analyzed period.

According to the data published in The Synthesis of the Audit Report on „The patrimonial situation of the Forest Fund in Romania, during 1990-2012” made by the Romanian Court of Accounts, during 1990-2011 the volume of illegal logging in the forests of Romania was extremely high, yet with some annual fluctuations. The most affected were the state-owned forests (Romanian Court of Accounts, 2013, p. 99).

If we look at the volume of the cuts in 1990-2011 period we can see that there was a peak year 1992 - 281.517 m³ and a minimum of 51.900 m³ in 2008. According to a study by Greenpeace, in Romania are cut over 3 hectares of forest every hour. The data and information from ROMSILVA shows that daily are cut on average 41 hectares of forest, most of which are illegal cuts (Romanian Court of Accounts, 2013, p. 99).

The total volume of illegal logging in state forests and private property during 2005-2011 is 633.500 m³, according to the data provided by the Ministry of Environment and ROMSILVA. Considering the average volume of 217 m³ of wood/ha, in the period under review was illegally cleared a forest area of 291.932 hectares (Romanian Court of Accounts, 2013, pp. 99-100).

If we go back in time until 1990, according to a report made by the Federation for the Protection of Forests, the volume of forest cuts is covering an area of over 366.000 hectares, during 1990-2011 were cut illegally and were used over 80 million cubic meters of wood (Romanian Court of Accounts, 2013, p. 100).

If we do a calculation with the lowest price (70 Euro/cubic meter of firewood) it shows that the value of these cuts is over 5 billion Euro. This figure is far from the real one, since most of the felled trees from the forests of Romania were exported in countries of Europe, North Africa, Asia, etc. at prices much higher than the minimum price set for firewood (Romanian Court of Accounts, 2013, p. 100).

6. Conclusion

This phenomenon of illegal cutting the forests has grown in the last 30 years in Romania to scary proportions. The desire of some for enrichment generated

unimaginable damage to the ecosystem. The mutilation of the forests in large scale generated devastating floods with many life losses and material damages. Unfortunately not even the pandemic stopped the wood thieves. They took advantage of the lockdown and stole even more wood because they knew that the authorities were occupied with COVID -19.

In order to protect the forests we must use all the new technologies in our advantage. Drones have a bad reputation because the military used them for combat, but we must keep in mind that these little gadgets can also be used to do good and to save people and forests.

Using drones can save many foresters lives. These little flying machines are more efficient than humans in patrolling vast forest areas in a short period of time. They can locate with precision the exact spot in which trees are cut and they can even gather evidence for the Court by filming the theft. The forester who controls the drone can have in real time information about the situation in hand.

Because the damage caused to Romanian forests is very high we think it would be necessary to take drastic measures, such as Albania took. Albanian Parliament passed a law banning deforestation for 10 years. It would also help our goal the increasing of penalties for illegal logging.

7. Acknowledgment

First we would like to thank to our supervisor Professor Toma Roman for his guidance, great support and kind advice throughout our PhD research studies. Second, we would like to thank to our families for the continuous support they have given us throughout our PhD studies.

References

- [1] Anderson, N., Ford, R., Bennett, L., Nitschke, C., Williams, K., Core values underpin the attributes of forests that matter to people, *Forestry: An International Journal of Forest Research*, 91(5), 2018.
- [2] Buongiorno, J., On the accuracy of international forest product statistics, *Forestry: An International Journal of Forest Research*, 91(5), 2018.
- [3] Gorte, R. & Sheikh, P., Deforestation and Climate Change, Congressional Research Service, *DIANE Publishing*, Darby USA, 2010.
- [4] Humphreys, D., Forest Politics: The Evolution of International Cooperation, *Routledge*, Abingdon, UK, 2014.
- [5] Sandvik, K.B., Jumbert, M.G., The Good Drone, *Routledge*, Abingdon, UK, 2017.
- [6] Sing, L., Metzger, M., Paterson, J. & Ray, D., A review of the effects of forest management intensity on ecosystem services for northern European temperate

- forests with a focus on the UK, *Forestry: An International Journal of Forest Research*, 91(2), 2017.
- [7] Vajpeyi, D., Deforestation, Environment, and Sustainable Development: A Comparative Analysis, *Greenwood Publishing Group*, Santa Barbara, USA, 2001.
- [8] Romanian Court of Accounts, The Synthesis of the Audit Report on „The patrimonial situation of the Forest Fund in Romania, during 1990-2012”, *the IXth Department*, Bucharest, Romania, 2013.
- [9] National Institute of Statistics <http://statistici.insse.ro/shop/>