

Robots, Drones or Chainsaws? The Future of Logging

by William Arnvik



Harvester felling trees in a Scandinavian forest.

(Photo by Christian Höök and used with permission.)

Outside, the wind howls through the towering pines while snowflakes dance in the glow of the headlights of an excavator-like machine with a long arm ending in a clamp and a chainsaw. Inside the cab of this machine – a so-called harvester, all is calm. With the flick of a joystick, the human operator makes the harvester grab an old, snow-covered pine, which it then fells and slices into shorter logs in mere seconds. A century ago, lumberjacks swinging axes in the freezing cold would have thought this scene was pure science fiction, but it is not. Thousands of these high-tech machines are currently working worldwide, from the steamy rainforests of South America to the frostbitten boreal forests of Scandinavia, providing one of society’s most crucial resources – timber.

Timber Titans – The Countries That Rule the World’s Wood Supply

According to the United Nations, globally, [nearly 2 billion cubic meters \(m³\) of timber, used for industrial purposes, were harvested in 2020](#). When including timber used for

other purposes, such as firewood, the number soars to a staggering 4 billion m³. Of course, the amount of timber harvested varies widely across countries, where a few countries stand out as global leaders in production of industrial timber.

[The five largest producers of industrial timber, in descending order, are the United States, Russia, China, Brazil, and Canada.](#) Sweden, with only a population of 10.5 million, ranks 7th in the world, and harvested 70 million m³ in 2024. In comparison, China, with a population of 1.4 billion, harvested 180 million m³ – only about 2.5 times more than Sweden. To add another layer of perspective, Sweden and Finland combined harvested 120 million m³, nearly a third of what the United States did.

[Forestry plays a big part for the Swedish economy.](#) The Swedish forestry sector employs roughly 140 000 people directly or indirectly. These jobs include, for example, machine contractors, timber and pulpwood factory workers, and forest management planners. Additionally, the forest industry generates a considerable amount of revenue. It accounts for 9–12% of Sweden's industry's total employment, exports, and turnover. Most of the products created are also exported. Roughly 80 % of all products are exported, with a total value of 185 billion SEK.

While timber harvesting continues on a massive scale, global deforestation trends reveal a more complicated reality. [According to the United Nations](#), South America had an annual net forest loss of 2.6 million hectares in 2010–2020. However, the rate of net forest loss is declining. Africa had the largest annual net forest loss between 2010 and 2020, losing about 3.9 million hectares per year. Asia, on the other hand, recorded the highest annual net gain in forest area, with an increase of 1.2 million hectares. Europe has seen slight increases, which were 0.3 million hectares, thanks to reforestation efforts. These patterns show that although technology is improving logging efficiency, sustainable forest management remains critical to balance harvesting with conservation. Of course, the gain or loss of forest area differs between countries across the continents.

Chainsaw Challenges – Where Machines Can't Go

The type of equipment to harvest timber varies as well across countries. In some countries, powerful, high-tech machines dominate harvest operations, whereas in other countries smaller, more agile equipment, such as chainsaws, are still essential. In rugged terrain, even the most powerful machines will struggle, which is why the chainsaw remains an indispensable tool in forestry.

Logging using chainsaws is the predominant method in certain logging operations, particularly in challenging terrain. Harvesting in extreme terrains, such as in mountainous areas, is very dangerous and the use of big, high-tech machines becomes impractical or even impossible. For example, there is a high risk of roll-overs (where a machine tips over on steep or uneven ground) and loss of traction (where the wheels or tracks slip and lose

grip), which can result in costly damages and lethal accidents. Therefore, using skilled manpower with lightweight chainsaws remains one of the best options for these sorts of dangerous missions. Chainsaws are also used in many countries as the conventional method of harvesting because they offer a cost-effective method of felling trees and is easy to transport and can reach areas inaccessible by road. However, this type of logging imposes high risks, where one mistake can result in a missing limb, or even death.

Logging remains a risky business. As Michal Allman, a researcher in forest operations at the Czech University of Life Sciences, notes in a research paper, [*“Forestry continues to be one of the most hazardous industrial sectors in most countries.”*](#) Similarly, the United Nations states that in the United States - one of the world’s largest timber producers - [*logging has been in the top three industries for fatality rates for 30 years.*](#) The risky nature of logging can hardly be overstated, and there is a need to improve safety, which is possible by using high-tech machines.

High-tech Harvesting – Machines in the Forest

Performing logging in a protective, air-conditioned cab, listening to your favorite music, would seem like a dream for lumberjacks a century ago, yet it is now a reality. In several countries, using these machines is the predominant method for logging. In Sweden and Finland, for instance, almost all logging is performed with harvesters in combination with another machine called a forwarder, which I will get back to shortly.

Harvesters are expensive, highly advanced and productive machines suitable for large-scale logging operations. One of their most important features is a powerful hydraulic crane equipped with a harvesting head, which allows them to cut trees and slice them into logs in mere seconds. The crane extends towards a tree, grips the trunk and, with a swift cut, fells it. As the tree is fed through the harvesting head, the branches are stripped away, and the stem is cut into precisely measured logs. In the hands of a skilled operator, it becomes the ultimate timber-producing machine.

When the trees have been felled and logs produced, they are stacked in neat piles on the forest floor. This is where the forwarder takes over. Using its hydraulic crane with a grapple attached to it, the forwarder lifts the logs and places them onto its bunk. With its highly advanced design, it can carry many logs in a single load and traverse rugged terrain without difficulty – climbing over rocks, weaving through dense undergrowth, and maneuvering across muddy terrain, where ordinary vehicles would get stuck.

“These machines have revolutionized the forest industry in ways that were once unimaginable. Not only do they improve efficiency, but also the safety of the operators” says [*Carola Häggström*](#), a researcher in forest technology at the Swedish University of Agricultural Sciences (SLU), whose research focuses on improving working conditions and ergonomics in forestry operations.

Yet, even more advancements regarding logging machines have been made recently. Scientists at the Swedish University of Agricultural Sciences, Luleå University of Technology, and the Cluster of Forest Technology have designed [an unmanned forwarder](#), and by combining computer vision and autonomous navigation, this robotic forwarder can efficiently pick up logs and maneuver through terrain without the supervision of a human.

“What is really amazing is that for the first time ever a forest machine is doing the whole sequence by itself” says [Ola Lindroos](#) – a professor in forest technology at SLU, whose research focuses on evaluating and improving technical innovations to make forestry more efficient while safeguarding working conditions and the environment.

But why limit logging to the ground? These massive machines, powerful as they are, will struggle in mountainous areas thereby restricting their use. The Swedish company [AirForestry](#) have thought about this and have developed a completely new approach: logging with airborne drones. Powerful flying drones that measure slightly more than 6 meters in diameter can cut trees in the most challenging locations where no other type of logging equipment can operate.



Drone developed by AirForestry

(Photo by AirForestry and used with permission.)

AirForestry was founded in 2020 by Olle Gelin and Dr Mauritz Andersson. Olle has a background in hybrid truck development and forest automation. Mauritz, a physicist passionate about electric aviation, shared his vision for sustainable technology. Together they set out to revolutionize forestry by creating electric drones made for harvesting timber.

Not only do the AirForestry drones improve safety, but they also have several additional advantages compared to traditional ground-based timber harvesting. The drones do not cause any ground disturbance or root damage, which is otherwise relatively common

when using larger logging machinery. An additional benefit is that no so-called “strip-roads” need to be created for transporting larger machines. Fewer strip-roads in turn lead to increased timber production while also minimizing the risk for wind and snow damage to the forest. The AirForestry drone technology marks a new era in timber harvesting, combining both efficiency, sustainability and safety.

Tomorrow’s Timber – Dilemmas, AI, and Robots

As technology advances, it is clear that harvesting can be done more efficiently. However, forests are not only a source of timber. Forests are habitats to vast numbers of species and complex ecosystems. Additionally, many people enjoy spending their free time in forests – hiking, biking, and camping. Therefore, when planning the future of timber harvesting, it is important to consider not only how harvesting can be done more efficiently, but also how to preserve the ecological, recreational, and emotional value that forests provide. Modern machines are already extremely productive, and there is a risk that natural resources could be overexploited if proper care is not taken, especially when even more innovative and productive machines are developed in the future.

At the moment it seems like the capacity of the logging machinery of tomorrow is only limited by our imagination. What will the future hold? Perhaps the chainsaw is truly indispensable and will forever remain a popular piece of logging equipment. Or, perhaps, full fleets of autonomous harvesters and forwarders, controlled by AI, will perform all logging operations in the future? Maybe the answer lies in flying drones, where a buzzing swarm of them could effectively collect timber, not limited by the terrain. And who knows – perhaps one day the forest will be filled with chainsaw-limbed cyborg lumberjacks?

One thing is for certain, the evolution of logging will continue, and is far from over.



Born in Gothenburg and now based in Umeå, **William Arnvik** is a PhD student in Forest Technology at the Swedish University of Agricultural Sciences (SLU). His research focuses on the productivity and ergonomics of private forest owners' work efficiency using tractors. William holds a master's degree in forestry (Jägmästare) from SLU. In his spare time, he reads science-fiction books and enjoys the Swedish boreal forest. You can follow William on his [LinkedIn profile](#).