ISSN: 3029-0724

Review Article

Journal of Environmental Science and Agricultural Research

Intelligence for Precision Forestry

Vesa Leppänen, Mikko Saarimaa* and Saara Tracewski

Arbonaut, Finland

***Corresponding author**
Mikko Saarimaa, Arbonaut, Finland.

Received: September 10, 2025; **Accepted:** September 18, 2025; **Published:** September 25, 2025

ABSTRACT

Arbonaut is a leading global geodata company based in Finland that offers innovative geoinformation solutions for a range of applications, including forestry, environmental monitoring, natural disasters, and security. Since 1994, the company has combined forestry expertise with remote sensing technologies and software development to support public and private sector in making responsible decisions across the forestry value chain. Arbonaut provides detailed forest ecosystem inventories, ranging from stand-level assessments to tree-level precision. These inventories provide a detailed and accurate representation of forests and vegetation by combining LiDAR, satellite imagery, and AI-based analysis. The company is also committed to forest resilience. Arbonaut focuses on early detection and mitigation of climate-related threats such as wildfires, bark beetle outbreaks, and providing technical assistance in carbon and REDD+ projects. Such tools help Arbonaut's customers manage forest health and adapt to changing conditions. Arbonaut transitions forest operations planning from field to the office. This includes digital tools and precise information for prioritizing worksites, evaluating forest road and terrain conditions that leads to maximized efficiency, improved resource allocation, cost- and time-savings. With expertise in QGIS, Esri, AI and cloud technologies, Arbonaut develops tailored software solutions and fully custom-built systems for forest management. These platforms empower organizations with accurate forestry data, easy collaboration, and informed decision-making needed to implement well-defined policies and tackle key challenges, including deforestation, restoration, forest clearance, and conservation area management.

Keywords: Intelligent, Precision Forest, Inventory, Operation Management

Introduction

Ditch networks play a crucial role in the infrastructure of mires and forest habitats in water protection. The development of appropriate tools and analyses for mire restoration sites has a significant impact on their functionality, environmental friendliness and long-term cost-effectiveness in identifying restoration potential.

Water Protection is very Important in Today's Daily Forestry Operations

This presentation will highlight how Precision Forestry can be used to assess soil growth potential or protection needs in forest growth, as well as water management and water protection. The analysis is carried out over a large area. As much input data as possible is used. Based on the analysis, accurate information can be obtained even on the smallest features of a large area, which can be used to create the best possible overall picture. The analysis focuses on a smaller entity, whose surface water movements can be examined. The focus is on the fine details of the area. Where water is stored, collected, absorbed or flows. Precise plans for decisions to be made for corrective measures. Key benefits:

- Moving planning work from field into office
- Making planning work more efficient
- Detailed and large-scale picture of potential sites for water protection measures

Citation: Vesa Leppänen, Mikko Saarimaa, Saara Tracewski. Intelligence for Precision Forestry. J Envi Sci Agri Res. 2025. 3(5): 1-3.
DOI: doi.org/10.61440/JESAR.2025.v3.89

Background to Water Management

Forest drainage in Finland has led to significant tree growth and economic benefits. Roughly speaking, the drainage of peatlands has brought about 20% of forestry land, tree volume and annual growth. However, drainage has also had a detrimental effect on the state of water bodies. Unfortunately, organic peat particles have escaped from them into lake waters to accumulate on their bottoms and have also darkened the water bodies. Today, drained peatlands are drying up even further due to climate change. Peatlands have been good water balancers. A peatland is like a" sponge" that absorbs water during the rainy season and slowly releases it into the circulation when the dry season arrives. Peatlands were also drained a bit too much in the hope that the swamps it would become more productive forestry land. Restoring these failed areas would restore the good properties of the peatland as part of water protection structures. Properly targeted water protection structures could effectively improve the state of water bodies. When water protection structures are implemented together with other forest management measures, they can be done cost-effectively

From Ditch Analyses to Water-Flow Management Analyses

Arbonaut's patented ditch analysis has been on the market for over 15 years. This analysis automatically determines the depth of ditches and the need for clearing. However, the old ditch analysis did not provide a picture of how water flows (flow direction and flow speed) from ditch to ditch throughout the entire catchment area.

Drainage Area Analysis

By combining many spatial data sources, a flow network can be created. This can be used to map properties suitable for water protection structures. To locate and dimension the necessary water protection structures (e.g. in addition to drums). The potential sites can be found remotely, so protective structures can be designed and plan alongside to other forestry work.

Figure 1: Drainage Area Analysis

Water Flow Interpretation

The human eye is poor at estimating elevation differences in large, flat areas. Like peatlands generally in Finland are. When elevation differences are several centimetres and the area is hundreds of meters wide, it is visually difficult to determine or imagine the direction or capacity of the water flow.

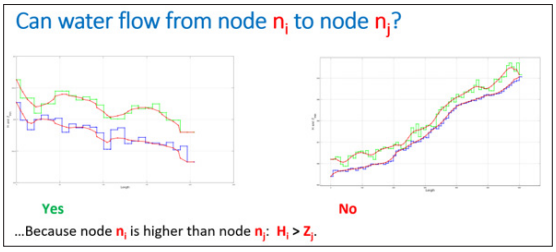

Figure 2: Water Flow interpretation

Water Flow Network

The water will know where to go, but the humans need visualized information. The accuracy of lidar leads to a successful analysis.

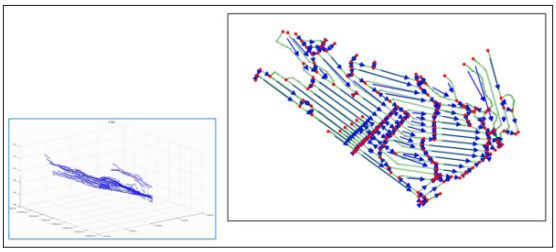

Figure 3: Water Flow Network

Affected Area

The behaviour of water in the area and water management planning using flow networks and data provide information about different types of affected areas. When tree information is added to this and the ability of the soil to grow trees or collect water is analysed, restoration planning can be progressed. When the flow characteristics are known, savings can be made with minimal ditch blockage, with a maximum affected area.

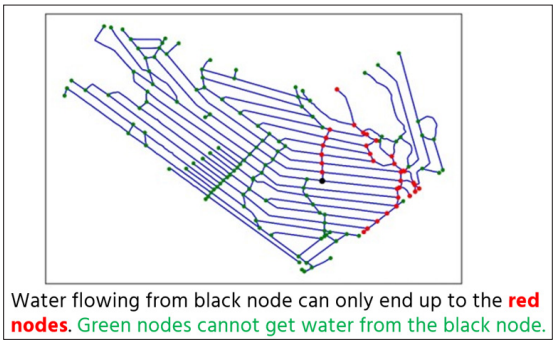

Figure 4: Water Flow Nodes

Example of Analysis

The result of the analysis is the implementation and work plan. Where the blue arrows depict the flow network that restores 35 hectares of sparsely wooded area. (Orange colouring). The violet dashed line indicates the level of the pipe dam, which can be piped, and which causes a delay in the water mass leaving the 112 hectares area (violet colouring), which reduces the amount of organic carbon leaving the area.

A Tool for Applying Drainage Area Analysis

Collaboration between universities and research institutes brings ideas, tests, views, openings, perspectives, like a start-up that can be worked on towards a functional product. Research also creates support and a foundation for the scientific basis of the

idea. There is still a long way to go from this to a product that supports decision-making in the everyday lives of operational actors such as planners. The end user of the product is not a researcher, scientist, analyst, physicist, mathematician, geologist or naturalist. The end user is either a work planner or a person who does practical operational work. The end user's understanding and action is reflected in the workflow management, which should also consider the forest owner's wishes and needs. The workflow is from the contracting service that provides the delivery and the employees involved in the chain.

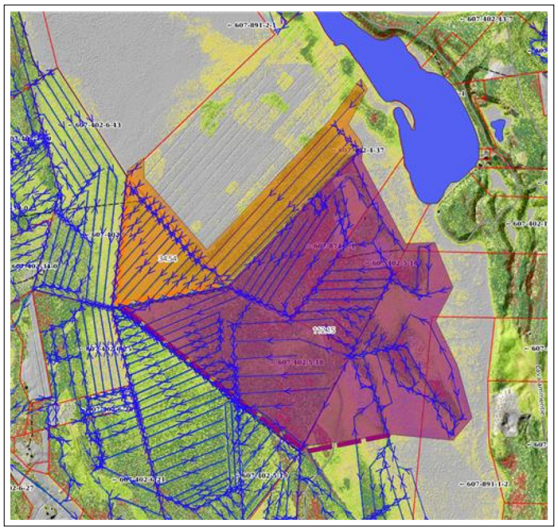

Figure 5: Analysis of Water

- Enables the location, design and cost-effective implementation of the most effective water protection structures in conjunction with other operations
- Provides added value to the forest owner and an additional service to be sold to forest owners
- Provides a comprehensive picture of the need and potential of water protection structures based on information
- Is a practical solution as part of the implementation of a water protection program

Summary of Drainage Area Analysis

Currently, the tool Combines the great features brought out by all the above. Using AI best potential is to produce analytical interpretations to large areas such as Finland. When productizing analysis that combines remote sensing data, scientific research, findings and insights, it is also important to remember that understanding the role of end users is important, maps must be.

- **Instructive:** Assists and guides operational work, such as planners and machine operators, to the best decisions
- **Visual:** Intuitively understandable
- **Teachable:** Minimal need for user training
- **Easy:** Even a simple glance at the map level tells you the necessary information
- **Standardization:** Enn User action and decision-making moves to the next level in operational reliability

Conclusion

The maps will support practical activities and help daily decision making. Water management offers significant potential for nature protection in peat land areas.

??