# Genomic Selection: Towards More Efficient, Financially Viable and Resilient Wood Production (GenoWood)

**Prof. Teemu Teeri University of Helsinki**
Katri Kärkkäinen (Natural Resources Institute Finland Luke)
Fred O. Asiegbu (University of Helsinki)
Outi Savolainen (University of Oulu)

Bioeconomy aims at a society that strongly relies on renewable biological sources, while achieving economic growth efficiently and sustainably. In Finland, forest industry has a key role in bioeconomy. Demand for wood will be increasing, as well as demand for tailor-made trees with specific chemical and physical wood characteristics. In the near future, climate change and associated natural disturbances (pests, pathogens, changing length of growing season and associated frost damage) may negatively affect the productivity of forests. Increased wood production must further be combined with ecological and societal demands for biodiversity and multiple uses of forests. These demands put pressure to radically enhance and speed up forest tree breeding.

Our goal in the project is to utilize novel genomic and phenotyping methods and examine the feasibility of conducting genomic selection in Nordic conifer species. The proposed research makes use of unique resources for Scots pine that have been developed in Finland during decades of research in forest tree genetics, breeding and biotechnology. Our project brings together research groups with complementary skills in molecular biology, population genetics and breeding, forest pathology, and economics.

Tree populations have large variation in many adaptive and economically important characteristics, enabling tree breeding based on natural genetic variation. Changes in the environment and in the use of wood put pressure to include new traits in breeding programs. On one hand, resilience of trees against changing climate and resistance against pests and pathogens must be included in the programs. On the other hand, forest industry demands more uniform and specific chemical and physical characteristics of wood that can be tailored by tree breeding.

Profitability of commercial forestry is strongly influenced by the rate of volume production, which, in turn, can effectively be increased by breeding. Traditional tree breeding is highly profitable (improved material shows up to 24% increase in growth) but is time and resource demanding. As the breeding cycle may take 40 years in Scots pine, methods accelerating breeding are clearly needed. Many new traits are being investigated that could be added to breeding programs and new ones will be investigated as bioeconomy proceeds. In addition to financial gains, the societal impact of breeding is becoming increasingly important.

Genomic tools are increasingly being used for breeding both animals and plants. Genomic selection uses genomewide markers to predict phenotypes. It is an especially useful method for breeding traits with complex, polygenic inheritance. In this project, we will utilize novel genomic and phenotyping methods and examine the feasibility of conducting genomic selection in Scots pine. More specifically, we will study phenotypic and genetic variation of the most relevant traits (growth, growth rhythm, disease and decay resistance, and wood quality), try to discover genes affecting the traits, generate large genotyping resources, conduct association analyses between traits and candidate genes and, finally, examine conducting genomic selection in southern Finnish breeding population.

We will further analyze the economic (financial gains) and societal outcome (carbon balance) of present and future breeding for volume production (growth) and quality (decay resistant timber as an example).

Further details: teemu.teeri@helsinki.fi