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BOOK OF ABSTRACTS

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INTRODUCTION

Forestry plays a crucial role in the ecosystem, maintaining biodiversity, providing habitats, regulating the water cycle, and serving as a carbon sink to mitigate the effects of climate change. The forest resources should be managed according to principles of sustainable and close to nature forest management in order to meet needs of today's and future's generations. These two approaches aim to maximize the benefits of forests and to minimize environmental damages by using modern techniques and technological tools in forestry activities. Particularly, forest operations producing wood-based forest products should abide to the precision forestry approach. In recent decades, advanced small-scale forest operations, which are used in non-industrial and site-specific forestry, provide alternative methods well suited for use with precision forestry concept. Besides, small-scale forestry significantly contributes to the bio-economy through forest-based businesses, rural communities, and provision of multiple ecosystem services in many regions of the world. Small-scale harvesting machines have low initial cost and relatively low operating cost, while at the same time, their potential environmental impacts can be considerably lower than with use of large scale machinery.

5th International Conference of Forest Engineering and Technologies (FETEC 2024): "*Forest operation technologies and systems for small-scale forestry applications*" has been organized on **16-18 September 2024** by University of Ljubljana, Biotechnical Faculty in the city of Ljubljana, Slovenia. The conference co-organizers include **FETEC Platform** and **IUFRO Division 3.01**. The sponsor of FETEC2024 is **Tajfun LLC**.

The aim of the conference is to discuss the most recent scientific and professional research related to forest operation technologies and systems for small-scale forestry applications with attendance of internationally renowned researchers, practitioners, and relevant shareholders.

On behalf of the entire organizing committee, I would like to thank all the participants of the conference and express my best wishes to those who contributed during the preparation and organization stages of the conference.

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ORAL PRESENTATION

Utilizing Decision Trees Models for Machine Selection and Optimal Deployment in Forest Logging Planning

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Abstract

Logging is challenging and renewable for forest areas located in mountainous and variable terrains. Effective planning and sustainable management are crucial for optimizing the economic benefits of these forests. Expanding forest areas offers advantages in terms of time and cost by selecting machinery that is appropriate for the land conditions and utilizing these machines efficiently. However, logging planning is particularly challenging for complex and variable forest areas. These studies have become feasible with the development and application of artificial intelligence tools across nearly every field today. This study utilized the decision trees method to reveal the logging planning of a forest enterprise. The research was conducted in 7 production sections as part of the logging planning for the current year in the Taşlıca Forest Enterprise, which was designated as the study area. Within the scope of the studies, slope, skidding distance, tree type, stand canopy, skidding barrier and living cover were taken into account as land data, and the amount of stamped product was taken into account as forest management plan data. Based on the results obtained from the model created using the Decision Tree method, a logging planning was developed. This plan includes the estimation of the extraction method in the compartments, the completion time of the work in terms of days, and the approximate cost of the wood raw material production work.

Keywords: *Logging, decision making, artificial intelligence, logging planning*

ORAL PRESENTATION

Productivity Calculation of Serial and Parallel Production Systems in Forestry

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Abstract

Forest machines often work in combination and can be used in series or in parallel while harvesting logs. The serial production system needs the longer production time while the parallel system needs the shorter one. Despite the shorter production time, the parallel production system needs more workers at the same time than the serial one. In addition, the parallel production system has the difficulty of synchronizing the operations of two or more machines and their operators. Productivity is an important indicator to evaluate the efficiency of forestry operations. Therefore, in this study, we calculated the productivity of serial and parallel production systems in forest harvesting operations and showed the possibilities and limitations of the existing production systems. We also constructed the production models of forest harvesting systems using the system dynamics and calculated the productivity according to the performance of each forestry machine used in combination. As a result, we accurately determined the productivity according to different operating conditions.

Keywords: *Forest machine, productivity calculation, production system, system dynamics*

ORAL PRESENTATION

Time Consumption and Potential Improvements in Silviculture Practices to Control Invasive Alien Species - American Pokeweed

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Abstract

Invasive alien plant species (IAPS) cause many changes in biocenosis around the world. Many methods are known to suppress IAPS. In the study, we monitored the suppression of pokeweed plants as part of silviculture interventions in the young forest stage, by cutting pokeweed with brushcutters at the ground level. The study aimed to determine the time consumption per area (hectare) and to acquire knowledge in combining silviculture weed control and the IAPS suppression (eradication) process. On average, to cultivate 1 hectare workers spent 18.8 hours of productive time. The non-productive time factor was calculated from our collected data which was approximated to eight hour day shifts with 30-minute lunch breaks included. The calculated non-productive time factor is 1.39, which is lower than the nationally recognized and approved (1.58) for logging. Interpretation of these results requires caution because short-term studies often underestimate the factors of non-productive time. The theoretical calculation, based on linear regression of the data, shows that to cultivate 1 hectare in total, around 22 hours of working time are needed. Despite the already low non-productive time factor, there is still room for optimization of the silviculture process, but for this, long-term time studies are needed.

Keywords: *forestry, invasive alien plant species, silviculture intervention, time study, Phytolacca americana*

ORAL PRESENTATION

Current Situation of Harvesting and Forest Roads in Japan

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Abstract

In order to increase domestic timber supply and mitigate climate change, technology modernization of harvesting and forest roads should be promoted in Japan. On Hokkaido area in a northern island and Tohoku area in a north-eastern part of main island, larger machines, its weight of 20 tons which can be operated in steep slopes with winch-assisted are introduced to increase productivity and reduce costs. On western parts of Japan, Hydraulic yarders and loading grapples are introduced for safe and easy operations on mountainous areas. In order to conduct forestry operations efficiently on a large scale, Forestry Agency of Japan orients aggregating small forests, establishing forest road networks, and promoting mechanization. Then, the establishment of forest road networks combined with strip roads will be accelerated with a subsidy. However, Japan belongs to the Asian monsoon zone and has a hot and rainy climate. Torrential rains occur due to the rainy season in June and the typhoon in Autumn. Therefore, forest road networks with a low-cost alignment plan that is difficult to collapse should be designed using precise topographical data obtained through aerial laser measurements.

Keywords: *Winch-assisted, hydraulic yarder, loading grapple, forest road network, precise topographical data*

ORAL PRESENTATION

Assessing Forest Fire Susceptibility and Potential Severity in the Wildland-Urban Interface (WUI) with Machine Learning and Google Earth Engine: Case of Izmir Regional Directorate

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Abstract

This study presents a method utilizing Machine Learning (ML) and Google Earth Engine (GEE) to evaluate forest fire susceptibility and potential fire severity in the Wildland Urban Interface (WUI) of the Izmir Regional Forest Directorate (RFD) in Turkiye. Precise mapping of WUI areas and assessing fire susceptibility and severity are crucial for advanced forestry, particularly in precision forestry. Initially, WUI areas—both WUI-intermix and WUI-interface—were mapped using a Python-based algorithm in ArcMap. A forest fire susceptibility map was then created by integrating 15 influencing factors with the PyCaret AutoML framework, which compares 14 ML algorithms. For mapping potential fire severity, a GEE-based algorithm was employed, utilizing the Random Forest (RF) method with 19 driving factors. The resultant maps were used to evaluate fire susceptibility and potential fire severity in the WUI areas. Results indicate that 2.5% of the Izmir RFD is classified as WUI-intermix, while 5.1% is WUI-interface. It was observed that 36.0% of WUI-intermix areas could potentially experience moderate to high severity fires, with 21.7% of WUI-interface areas falling into similar categories. Regarding fire susceptibility, 88.6% of WUI-intermix areas were identified as high and very high susceptible, while 82.0% of WUI-interface areas exhibited similar levels. To conclude, mapping WUI areas and assessing their fire susceptibility and potential severity offer invaluable insights for forest managers to combat forest fires and plan operations effectively in high-risk areas.

Keywords: *Forest fire susceptibility, GEE, machine learning, potential fire severity, WUI*

ORAL PRESENTATION

Buffering Effects of the Forest on Particulate Matter and Noise Isolation Arising from Motorway Traffic

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Abstract

Noise and air pollution come in the first place among environmental pollution types that have negative effects on the quality of the environment we live in currently and human health. Particularly, settlements close to motorways are adversely effected from particulate matter (PM) and noise pollution arising from traffic. Determining the type and extent of the buffering effect of the forest cover, which act to isolate the PM and noise pollution, based on the characteristics of the forest cover will constitute the objective of this study. In this way, criteria for isolating the PM and noise pollution, which will have adverse effects on settlements areas and wild life, depending on the characteristics of the forest cover around the highway will be established. Determining these criteria will allow determining the area sufficient to ensure PM and noise pollution based on the leaf type, closure and forest stand age characteristics of the forest cover adjacent to the highway.

Keywords: *Noise pollution, particulate matter, forest cover, highway*

ORAL PRESENTATION

Optimization of Secondary Forest Traffic Infrastructure Network

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Abstract

Optimization of accessibility of secondary forest traffic infrastructure is important issue of planning of forest harvesting operations, because the transport of timber (extraction and long-distance road transport) is considered to be the most expensive phase of its production. The optimization of accessibility of secondary forest traffic infrastructure means quality spatial distribution of skid roads or skid trails that are used for timber extraction by tractors, skidders, forwarders or animals. The quality spatial distribution of secondary forest traffic infrastructure is important for reduction of timber extraction costs from the point of labor cost of transport mean and shortening of extraction distance. The most important indicator of quality of accessibility of secondary forest traffic infrastructure is relative forest accessibility. The aim of the optimization is improving relative forest accessibility of compartment from 60% to 90%. The optimization of secondary forest traffic infrastructure requires using the methods of spatial and statistical analysis of vector and raster data about terrain and stand conditions and state of secondary forest traffic infrastructure by GIS tools.

Keywords: *Roads, trails, extraction, skidding, GIS*

ORAL PRESENTATION

Interaction between Forest Road and Wildfire

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Abstract

Gain a clear understanding of the relationship between wildfires and forest roads it is vitally important in mitigating the strong impact of wildfires in the context of climate change. A number of important issues regarding the use of appropriate road metrics are among the research needs for the scientists. This study is exploring the relationship between the forest road network and the wildfire occurrence in Apulia region (Italy) by adopting different metrics, such as road density, the number of links as well as relative openness. We employed the ordinary least squares (OLS) regression along with the geographically weighted regression (GWR) models to determine the all available links between forest roads and wildfire. A comparison between OLS and GWR prediction models gave a significantly superiority of the GWR models over the OLS regression ones. The approach produced some interesting results that relative openness is achieving a higher value of adjusted R^2 and a lower AICc. Neither the road density nor the links given separately, can explain the correlation between roads and wildfires. However, they become key complement metrics together with relative openness to assess forest road network suitability in relation to wildfires. Our findings demonstrate that forest roads are not one-dimensional and static infrastructure; rather, they are a multi-dimensional and dynamic structure.

Keywords: *Forest road, ordinary least squares, geographically weighted regression, wildfire*

ORAL PRESENTATION

Changes in Topsoil Carbon Stock and Some Hydro Physical Soil Properties and Correlations Among Them After Timber Removal in Broadleaf Mixed Forest

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Abstract

The objectives of this study were to determine the effects of clearcutting on the organic carbon stock (SOC) and selected hydro-physical soil properties of the topsoil and the correlations between these properties with soil temperature, soil moisture, and herbaceous vegetation. The research was conducted in the oak-hornbeam forest. The topsoil was sampled 3 times a year in both control and treatment plots after clear-cut timber removal from the treatment plots. The clearcutting decreased SOC, organic matter (OM), and permeability (HC) values of the soil by 62.87%, 72.35%, and 89.12%, respectively, while increased particle density (PD), pH, bulk density (BD), and dispersion ratio (DR) values by 10.91%, 15.15%, 31.30%, and 104.43%, respectively. Results showed that soil temperature was the main factor affecting SOC and has negative correlations with SOC, OM, EC, field capacity (FC), permanent wilting point (PWP), available water capacity (AWC), HC, saturation capacity (SC), and total porosity (TP) and positive correlations with pH, BD, PD, and DR properties of the soil ($p<0.05$). Moreover, it was determined that soil moisture had a positive correlation with AWC and DR and a negative correlation with HC and TP. Also, vegetation cover had a positive correlation with pH and a negative correlation with SC.

Keywords: *Soil organic carbon, timber removal, vegetation cover, microclimate*

ORAL PRESENTATION

How to Save Timber Products from Wildfires by Improving Forest Road Standards?

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Abstract

Forest fires affect the system elements that form the forest ecosystem, resulting in economic, ecological, and social impacts. In this regard, following factors can be considered: the extinguishing efforts carried out during the fire and the resources spent for this purpose, the assets in the forest that are affected by the fire and constitute economic value, the decrease in the benefits of the forest for people living in or adjacent to the forest, and the decrease in the environmental values produced by the forests and which have economic equivalents. A scientific study assessing the economic losses due to fire can be used to guide fire prevention studies and fire extinguishing policies. In determining the cost of forest fires, the degree of fire impact on the forest product (goods and services) should also be considered in addition to fire extinguishing costs. One of the items affected by the fire is undoubtedly the timber product, which is one of the most important economic outputs of the forest. The loss in timber production can be considered under two main groups: 1) the timber product losses in the trees burned during the fire and 2) timber production losses resulting from the decrease in average increment as a result of early cutting of the stand that has not completed its management period due to fire. In this study, the economic consequences of improving forest road standards were evaluated by considering the economic value of timber products potential saved from the forest fires.

Keywords: *Forest fires, forest roads, network analysis, timber products*

ORAL PRESENTATION

Analysis of Skidder Fuel Consumption by Work Operations During Timber Extraction – Case Study

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Abstract

Research was performed on the skidder Ecotrac 140V during timber extraction in mountainous terrain. The skidder was equipped with a measuring device WIGO-E (Telematic Data collector) gateway with an integrated GPS system, which ensured data were collected from sensors and motor and stored in a computer via CANBUS and data transfer with GSM to Web platforms. In order to precisely measure fuel consumption, a differential fuel consumption meter DFM 100CD was installed on the skidder, which has the ability to measure current fuel consumption and total fuel consumption. The measurement range covers the minimum flow rate of 10 L/h, the maximum flow rate of 100 L/h with an accuracy of ± 3%. Data on fuel consumption (mL), position (traveling route) and detection of winch work were measured with a sampling frequency of 5 s. Furthermore, skidder load volumes per cycles and slopes of skid roads were constantly measured. Based on the results of measuring the fuel consumption of the Ecotrac 140 V skidder when hauling wood at the same worksite for 8 working days), fuel consumption was determined by work components within each cycle and in total on working days.

Keywords: *Skidder, fuel consumption, differential flowmeter, working cycles*

ORAL PRESENTATION

Assessing the Productivity of Timber Extraction with Lewis Winch

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Abstract

Chainsaws are widely favored equipment for timber production in Türkiye. Chainsaws are commonly used in various stages of timber production, including tree felling, tree bucking, and tree debarking. Manpower and cable-based pulling operations with tractors are commonly utilized for timber extraction from compartments in forest operations. In Turkey, where mountainous terrain is predominant, uphill timber extraction poses a significant challenge, especially in areas where forest roads are not planned. In such cases, unplanned temporary forest roads are constructed for timber skidding purposes, leading to damage to the stands. Therefore, this study investigated uphill pulling using the Lewis winch mounted on a chainsaw. The study was conducted in the forests of the Kahramanmaraş Regional Directorate of Forestry in Türkiye. In this study, time measurements were conducted to assess the extraction of small-diameter logs from the stand by uphill pulling from various skidding distances on moderately sloped terrain. Furthermore, efficiency analyses were conducted using the SPSS statistical software. The study results demonstrated that utilizing the Lewis winch could provide an alternative method for extracting small-diameter logs uphill in areas without forest roads. Moreover, it has been suggested that chainsaws, widely employed in Türkiye, can also be utilized for uphill timber pulling in small-scale forestry operations.

Keywords: *Small-scale forestry, chainsaw, Lewis winch, small-diameter timber, productivity*

ORAL PRESENTATION

Productivity and Challenges of Combined Forest Management in Japan A Case Study of Wasabi and Timber Production

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Abstract

As small-scale forestry operations are constrained in their income from timber sales due to the limited area they own, it is crucial to identify alternative sources of revenue. Non-timber forest products are anticipated to enhance the management of forestry households. However, these approaches may potentially diminish the productivity of timber extraction. The objective of this study was to elucidate the advantages and challenges of combined management, as exemplified by a case study of a forest owner engaged in the cultivation of one of Japan's non-timber forest products, wasabi (*Eutrema japonicum*). Data were obtained from interviews with a forest owner who was cultivating wasabi in Hita City, Oita Prefecture. In addition to production cost and sales performance data, labour diaries were used to calculate profitability, income per day, and productivity of thinning. Wasabi is grown on the forest floor and in mountain streams and is a labour-intensive product. Thinning is a management practice that aims to regulate the light environment in forests for wasabi production as well as to sell the timber. Thinning was conducted using a mini forwarder, which is unique to Japan. One challenge was the difficulty of removing large-diameter timber, while another was the low prices.

Keywords*: *Non-timber forest products, wasabi, mini forwarder, spur road, thinning, Japan

ORAL PRESENTATION

Small Scale Technologies and Systems Used for Forest Operations in Urban Forests

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Abstract

Urban forests are networks or systems comprising all woodlands, groups of trees, and individual trees located in urban and peri-urban areas; they include, therefore, forests, street trees, trees in parks and gardens, and trees in derelict corners. Urban forests began to take a decisive role in the improvement of environmental components, and more specifically for the air, but also with a very positive impact in improving the quality of life of the communities in these urban centers. The forestry professionals began to think more sensitively about the operations that take place in urban forestry. It is necessary to define tools and work systems more specific than in traditional forestry. Such operations since planting-where in urban forestry the seedlings have much larger dimensions and are always covered with soil, pruning, formation of crowns, creation of specific green landscapes, applications of arboriculture, removal of rotten wood, diseases, pests etc., should be done in the most environmentally friendly way, the realization of these operations on a small scale and with traditional tools and equipment and with less impact on the environment, but it has relatively higher costs, while the environmental benefits are more important. Thus, urban-forestry oriented small scale technologies and systems should be considered in urban forestry activities. As an example, it is better not to use traditional gas powered chainsaws in urban forests, because when we work in urban areas, they cause acoustic pollution and pollute the air with toxic gases. Instead, it is better to use electric chainsaws, and traditional hand saws, or small chainsaws with the lowest level of noise and gas pollution. The urban forests are relatively small areas, and are frequented by people of different ages, including children, so extra care is needed during the application of operations.

Key words: *Forest operations, urban forests, small scale technology, tree felling*

ORAL PRESENTATION

Silvicultural and Ecological Effects of Machine Use in Forestry

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Abstract

Today, the widespread use of machinery in forestry activities has significant impacts on silvicultural practices and ecosystems. This study aims to examine the impacts of machinery used in the forestry sector on forest management, biodiversity and ecosystem health. The use of machinery increases the efficiency of forestry operations, reduces the need for human labour and reduces costs. However, besides these advantages, there are also various silvicultural and ecological impacts. From a silvicultural point of view, operations such as logging, tillage and planting carried out by machines may cause changes in forest structure and dynamics. This can affect the regeneration process of forests, the composition of tree species and the success of rejuvenation efforts. From an ecological point of view, damage to the forest floor by machinery can lead to problems such as soil compaction and erosion. Furthermore, negative impacts on biodiversity can occur during machining operations. For example, habitat fragmentation, shrinkage of wildlife habitats and decline in the populations of some species may occur. In this study, the silvicultural and ecological effects of the use of machinery in forestry will be discussed in detail together with the existing literature. Furthermore, recommendations for sustainable forestry practices will be presented and strategies for minimising these impacts will be discussed. The aim is to provide a perspective on how to maximise the benefits of machinery use in forestry while minimising its environmental impacts.

Keywords: *Mechanisation in forestry, silvicultural practices, sustainable forestry, ecological and biological effects*

ORAL PRESENTATION

Detection of Temporal Change in Forest Road Construction Areas with Satellite Imaginary- (A Case Study)

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Abstract

Forest roads, which are the basic infrastructure facilities of forestry activities, are used throughout the year for transportation and production vehicles to perform forestry services and, most importantly, to open forests for operation. During the construction of forest roads, the main objective is to plan the road routes closest to nature. However, since the construction of forest roads is a direct intervention in nature, it brings with it inevitable damage to nature. In order to detect these damages, this study aims to detect the changes in forest roads using satellite images. Forest roads within the borders of the Forest Management Directorate of Trabzon Forestry Regional Directorate were selected as the study area. It was tried to determine the degree of change that the identified forest roads had an impact on the forest area over time depending on the years of construction. Controlled classification was performed using SNAP software on Sentinel-2 satellite images of 2016, 2019, 2022 and 2024 to determine the current situation. As a result of this study, the time-dependent change of forest road constructions and their damages to the underlying stands were calculated proportionally. It is thought that the resulting data will show the dynamics of forest road changes and provide a basis for future planning.

Keywords: *Forest roads, satellite images, classification, environmental damages, temporal change*

ORAL PRESENTATION

Effects of Integrating Roundwood Processing in Skidder Operator's Work Cycle

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Abstract

Faced with the lack of forestry workers, entrepreneurs are forced to organize work so that one worker performs several tasks. The research aims to investigate the productivity of roundwood skidding, during which one worker performed all tasks except tree felling and delimbing (skidder driving, outhaul and hook, and assortment bucking at the landing site). The research was conducted using a time and motion study during the thinning of a mixed beech stand in the mountain region of Croatia. Trees were felled and delimbed followed by the skidding of half stems. The study lasted six working days and included 100 cycles with a total of 351.63 m^3 skidded roundwood and an average load of 3.28 m^3. The average productivity was 57.79 m^3/8h (distance 150 m, including the bucking) which is 29.4% less compared to the projected productivity of 81.87 m^3/8h (that could be expected if excluding time for the assortment bucking at the landing site). The information on differences in expected productivity between the two harvesting options and the expected workforce costs in real conditions could provide valuable information for forest contractors in decision making to adapt to the ongoing forestry labour shortage.

Keywords: *Harvesting, time study, load volume*

ORAL PRESENTATION

Determining the Effects of Logging Process on Forest Cover Using Geographic Information Systems and UAV

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Abstract

Today, with the increasing demand for forest products, forest areas are being used more and more intensively. This use also brings environmental damage. In recent years, with people who want to escape from cities turning to natural environments, the prevention and detection of environmental damages of all kinds of activities that interfere with nature has become more important. It is known that the stage with the most interventions in forest management is the logging process. For this reason, in this study, the damages of logging activities in the remaining stand in the area within the boundaries of Borcka Forest Management Directorate of Artvin Regional Forest Directorate were studied. For this purpose, unmanned aerial vehicle (UAV) images, satellite images from the past years and the present were analyzed. Images of the compartment before and after the logging process were obtained with the UAV. Analyses will be made on these images to determine the change of the compartment and its effects on the surrounding stands. Through satellite images, NDVI analysis will be made on the before and after situation and the effects of the logging process on the environment will be determined. As a result of these analyzes, it is aimed to determine the effects of the logging process on forest cover with remote sensing methods.

Keywords: *Logging, stand damage, satellite images, UAV, GIS*

ORAL PRESENTATION

Impact of Bark Thickness on Timber Volume Calculation in Harvester Software

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Abstract

Accuracy of volume calculation provided by a harvester's computer depends on the calibration. However, bark thickness is a crucial factor when obtaining log volume under bark. For that reason, proper bark thickness is a basic parameter when volume calculation is provided, but it is not natural bark thickness due to harvester knives shavings. Therefore, it is important to apply for volume formula bark deduction which is not natural bark thickness, but remaining bark thickness, after shaving by harvester head knives. The aim of this study was to find out how thick is remained bark on 4.0 m long logs after processing, to know how many cm has to be deducted to obtain log volume under bark without errors. The study was carried out on Scots Pine (Pinus Sylvestris L.), 4.0 m long logs, from bottom and middle tree parts. The range of mid diameters of measured logs was ca. 24-28 cm for bottom logs and 21-23 cm for middle logs. Calculation of log volume by harvester computer (Timbermatic H16) was based on measurements of diameter over bark (harvester John Deere 1270G, harvester head John Deere H415) every one cm, and finally mean diameter was used for volume calculation. Bark deduction was based on data installed in the computer, which was bark thickness related to diameter size, but natural thickness of bark without shavings due to harvester knives. After processing, diameters and bark thickness on logs were measured every 20 cm along three strips where bark was shaved and along three strips where bark was not shaved. After measurements, difference in bark thickness was calculated as well as log volume under bark using Huber formula. Finally, volume from harvester computer was taken and compared with volume obtained from manual measurements. Bark thickness after shavings was smaller by 40.30% in average on bottom logs and smaller by 35.83% on middle logs. Log volume from harvester computer was smaller by 9.04% in average for bottom logs, and lower by 2.53% from middle logs. The conclusion is, that to obtain more accurate volume of logs under bark, reduction of natural bark thickness should be used due to fact, that harvester head knives reduce bark on logs during processing.

Keywords: *Harvester, Scots Pine, log volume calculation, bark thickness, bark reduction*

ORAL PRESENTATION

Passing Ability of Medium-Sized Log Trucks in Mountainous Forest Areas in Japan

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Abstract

The size of log transport vehicles has tended to become larger in the world, while it is difficult in mountainous forest areas. There are three types of standard vehicles for both public roads and forest roads in Japan, expressed in terms of payload. These are 4-ton class trucks, 10-ton class trucks, and 20-ton class semitrailers. The corresponding road standards are practically the same as the road width classes expressed in the GIS data: less than 3.0 m, 3.0-5.5 m, and more than 5.5 m. Although officially every public road should be able to accommodate 10-ton class trucks, the steep and complicated terrain in Japan's mountainous forest areas does not allow 10-ton class trucks in a significant portion of the areas. Recently, many carriers have begun to use medium-size trucks, such as 10-ton short-body trucks and 6-ton reinforced trucks, to transport logs in such difficult terrain areas. In this paper, the passing ability of such medium-size log trucks was investigated in terms of the required road width expansion in relation to curve radius and truck body size. The practical passing ability of the medium-sized trucks is discussed using municipal-level GIS data of the road network in mountainous forest areas in Japan.

Keywords: *Log truck, medium-sized trucks, mountainous forest area, passing ability, standard vehicle size*

ORAL PRESENTATION

Decay Assessment in Standing Trees Along Urban-Rural Gradient of Megacity Bengaluru Using Non-Destructive Method: Electrical Resistance Tomograph

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Abstract

Tree health is a critical parameter for evaluating sustainability and urban tree health in an ecosystem. Urban tree is a green infrastructure system that delivers multiple environmental, economic, social and health services in cities. In standing trees wood decay is the major cause of tree failure and accurate measurement of wood decay is very important. Decay of standing trees cannot be detected visually because they appear mostly in the inner zone of tree stems and the trees which are decayed are not safe to society because it is weaker and susceptible to falling down. For this purpose, there are various invasive and non-invasive techniques. One such non-invasive technique is Electrical resistance tomography (ERT) through which the extent of decay can be examined. Analysis of the health status of standing trees along urban-rural gradient was done using Electrical resistance tomography (ERT) device which was further analyzed using PiCUS Tree Tronic PC Software. 2D tomogram image was obtained by measuring resistance at three heights; chest height, 50 cm below the chest height and 50 cm above the chest height. The 2D images so obtained were used to produce 3D images. In our study health status of standing trees in Bangalore was examined by layout of two transects having 23 plots in Northern and 25 plots in Southern transects. Health condition was determined by examining the resistivity pattern from centre point of the cross-section of tree to periphery. Our study aimed at obtaining the number and percentage of unhealthy trees, percentage of infected basal area, volume of infection, percentage of infected tree species and resistance of unhealthy tree species. The results showed, in northern transect the total infected basal area was highest in urban plots with 30686.9 cm2 and in southern transect the rural plots showed highest total infected area with 8331.07 cm2. The volume of infection of unhealthy trees in northern transect was found to be more in urban plots.

Keywords: *Tree health, Decay, ERT, rural-urban gradient, non-destructive technique*

ORAL PRESENTATION

Using Drone Captured Images to Estimate Productivity of a Loading Operation

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Abstract

The loading operation has an important function in the smooth execution of forest operation as it is a transition activity between timber extraction and long-distance timber hauling. Thus, it is crucial to estimate productivity of loading operation and determine the main factors effecting the productivity. The time study analysis is commonly used in productivity estimation of forest operations. Traditional time study analysis, usually done by utilizing time watch, requires two or more personnel who closely observe the logging operation and measure the logs at the landing. However, this field work can be dangerous since several equipment work and move around the operation site. In this study, the productivity of a loader was estimated based on video images which were taken with an "DJI Mavic Pro" model Unmanned Aerial Vehicle (UAV). The study was conducted in a Brutian pine stand located in Muğla Forest Enterprise Chief in the city of Muğla in Turkiye. It was found that the productivity of the loading operation was 25.52 m^3/hour. The results indicated that there was a positive significant relationship between productivity and product diameter and volume.

Key words: *Loading operation, time study, productivity, UAV images*

ORAL PRESENTATION

Swedish Forest Companies' Advice and Services to Non-Industrial Private Forest Owners Regarding Management and Prevention of Forest Damage

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Abstract

Sweden has 310,000 non-industrial private forest owners and a current problem for them is the abundant occurrence of forest damage caused by insects, fungi and animals. Today, many forest owners are unaware about the damage situation in their own forest or feel that they have limited knowledge of how to identify, manage and prevent forest damage. Therefore, the objective of this study was to map what professional advice and services they can currently receive from forest companies. Eleven semi-structured interviews were conducted with representatives of eight different companies, in most cases with timber buyers. The results show that many forest companies have adapted their advice to reduce the risk of damage in the future, e.g. by emphasizing more strongly the importance of choosing the right tree species based on the characteristics of the forest property. Many also expressed an ambition to have more mixed forest stands. Among the forest owners, the damage risks have also led to an increased interest in planting larch instead of pine or spruce, which in the long term can affect the forest companies. The study concludes that despite their differences, the forest companies largely offer their customers similar advice and services.

Keywords: *Family forest owners, pests, forest management, climate change*

ORAL PRESENTATION

Using GIS Techniques to Develop Safe Transportation of Forest Products

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Abstract

Transportation of forest products done by logging trucks is considered as one of the costly and dangerous stage of producing forest products, especially in mountainous regions. In recent decades, large size logging trucks have been preferred during hauling of forest products to minimize the transportation costs. The forest roads with inadequate standards (i.e. road surface, road structures, platform width, curve radius, curve width, etc.) limit the movement and maneuverability of large logging trucks which negatively effects the safety of truck drivers. In this study, it was aimed to use GIS-based network analysis method to develop transportation plan with safety constraint. The study area is located in in the city of Bursa in Turkiye, covering Paşalar, Sarnıç, and Turfal Forest Enterprise Chiefs (FECs). It was found that the total transportation cost increased by 58.23% in the case where safety of the truck drivers was considered. It was found that GIS-based network analysis method can be effectively used to plan transportation of forest products considering safety of logging truck drivers.

Key words: *Forest transportation, logging trucks, operator safety, transportation cost, network analysis*

ORAL PRESENTATION

Tree Diameter Measurement Using a Smartphone with Laser Technology

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Abstract

LiDAR remote sensing technology offers users the ability to make direct measurements and predictions in various areas of forestry. The capacity of this technology to determine and monitor stand characteristics is quite effective. The breast height diameter (DBH) of trees can be determined with high accuracy by correctly processing terrestrial LiDAR data. LiDAR-based point clouds can be divided into a horizontal grid to detect stems. Point clusters at 1.3 meters above the ground are used for DBH calculation. DBH can be determined using shape recognition techniques on these clusters. In recent years, 3D models of objects can be developed using smartphones with LiDAR sensors, and the diameters of trees can be determined in a short time with high accuracy using smartphone applications. In this study, the diameter of 36 Black pine trees (*Pinus nigra*) was measured using an iPhone 14 Pro model smartphone and calculated by the ForestScanner application. In the field applcaiton, diameter measurements of sample trees were also performed with calipers and the results of two techniques were compared using statistical methods. According to the results of the correlation analysis, it was determined that there was a strong positive relationship between LiDAR and caliper measurements with a 99% confidence interval ($p < 0.01$). This result shows that both measurement methods are highly compatible and that LiDAR technology provides consistent results with the data obtained with the caliper.

Key words: *LiDAR, DBH, stand properties, smart-phone applications*

ORAL PRESENTATION

Use of Environmentally Friendly Logging Operations in The Concept of Small Scale Forestry

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Abstract

One of the most important principles of forestry is sustainability which must be taken into consideration during afforestation, regeneration, protection and timber extraction activities carried out in forests. However, since the wood raw material scattered in the forest is extracted under very difficult conditions, logging activities may cause damages on residual stands and impact forest soil. If the environmentally friendly logging techniques are implemented, residual trees and saplings, forest soil and wood-based end products would be protected and the sustainability of the forests can be ensured. Small-scale forestry operations used in non-industrial and site-specific forestry offer alternative methods suitable for environmentally friendly timber extraction activities. In small-scale forestry operations, felling is generally carried out with a chainsaw, and small and medium-sized mechanized equipment and systems are preferred for logging operations. Mechanized logging equipment and systems preferred in small-scale forestry operations, which are mostly used to remove medium and small diameter products from the harvesting units, may include skidding with portable winch, ATV logging, small-scale yarding, and chute system. In this study, these small-scale logging techniques were introduced and their advantages in terms of reduced environmental impact were presented based on the information obtained from the previous studies. As a result, small-scale logging equipment and systems, whose purchase price and operating costs are not very expensive, can be purchased and used at low cost by logging contractors carrying out timber extraction activities. In addition, the systems used in small-scale forestry operations have a much lower impact on the residual trees in the stands and the forest soil.

Key words: *Environmentally friendly logging, stand damage, soil impact, small scale forestry*

ORAL PRESENTATION

The Biodiversity of Georgian Forests and the Current Situation

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Abstract

Georgia is located at the crossroad of Europe and Asia, specifically in the Caucasus, in the northern part of the subtropical climate zone. This location leads to the formation of almost all types of subtropical air, which contributes to the diversity of the plant world. Up to 5,000 species of wild and cultivated plants, including secreted and bare-seeded, as well as up to 8,300 spore plants, grow here. The forest area of Georgia is 3,420,400 hectares, of which 3,100,500 hectares are covered with forest, representing 44.5% of the total territory of the country. The average stock of wood per hectare is 231.8 m³, and the total stock is 528.2 million m³. The current addition of wood is 6 m³/ha, and the annual increase of forests is 13.7 million m³. Eighty-five percent of the forest area is mountainous and located on steep slopes above 1000 meters above sea level (73%). The average annual growth of wood stock is 4.5 million m³. The long-term impact of biotic and abiotic factors, along with climate change, has contributed to the massive proliferation of pests and diseases, which have had a direct negative impact on the forests. Some areas have been destroyed, and some species are threatened with extinction. The goal of our research is to study the current state of this diversity, maintain biodiversity, and establish sustainable, high-yielding groves. We aim to correctly select and implement integrated measures to reduce or eliminate pests and diseases. One of these measures is the cutting and removal of diseased, rotten, and aging trees from the forest.

Key words: *Biotic, abiotic, climate, diversity, pest-diseases, logging*

ORAL PRESENTATION

An Evaluation of Diameter Measurement Techniques: Comparing Calipers, Laser Devices, and the Measure Application

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Abstract

Forest management necessitates precise measurement of stand volume, traditionally achieved through volume tables and direct diameter measurements at breast height (DBH). However, these conventional methods are often time-consuming and costly, particularly in dense vegetation or challenging terrains. This study evaluates the efficacy of smartphone applications as an alternative to traditional methods and laser devices in forest inventory tasks. Measurements were conducted on four tree species (*Pinus nigra*, *Pinus sylvestris*, *Quercus cerris*, and *Fagus orientalis*) within the Bursa Forest District using calipers, laser device, and smartphone application (Measure). Results indicate that smartphone applications offer significant time savings and comparable accuracy to traditional methods, with an average measurement time of 2-3 seconds and minimal deviation. Laser measurements, while accurate, demonstrated longer durations and greater variability. Statistical analyses confirmed significant differences in measurement accuracy and duration based on method and distance. This study concludes that smartphone applications provide a practical, cost-effective, and efficient alternative for forest inventory measurements, promoting broader adoption of digital technologies in forestry practices.

Keywords: *Diameter at breast height, measure application, laser meters, mobile phone, caliper*

ORAL PRESENTATION

Log Volume Measurement Using a LiDAR-Enabled Smartphone

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Abstract

This study aims to evaluate the accuracy and efficiency of log volume measurement in a forest depot using a LiDAR-enabled smartphone. The research was conducted on three log stacks categorized into thin, medium, and thick diameter classes. Diameter ranges were grouped in the following classes: (1) 8.0-19.9 cm; (2) 20.0-35.9 cm; and (3) 36 cm and above. One log stack from each of these classes was selected for measurement. LiDAR scans were performed using the ForestScanner mobile application. Subsequently, noise points were cleaned using CloudCompare software, and volume calculations were completed with Agisoft Metashape software. The data obtained were compared with the official records of the depot and were found to be similar in a paired t-test (p=0.441), demonstrating the reliability and accuracy of the mobile LiDAR system. However, the correlation (r=0.018) was low, which is attributed to the limited number of measured stacks in the depot. Future studies should include a larger sample of stacks. The results indicate that LiDAR technology provides faster and more accurate data for volume measurement compared to traditional methods. Moreover, the applicability of mobile LiDAR systems in various environments and their high accuracy even in areas where GNSS positioning is challenging highlight the technology's significance for forest inventory and management. These findings demonstrate that LiDAR technology holds substantial potential in forestry applications and can significantly contribute to sustainable forestry operations.

Keywords: *Lidar, forest inventory, log volume measurement, mobile application, mean diameters*

ORAL PRESENTATION

The Potential of Mobile Applications in Stand Parameter Estimation and Time Analysis: A Case Study of the Arboreal Application

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Abstract

This study evaluates the effectiveness of the Arboreal application, a digital tool for measuring tree dimensions, by comparing it with traditional manual measurement methods. Conducted within the Bursa Forest Regional Directorate, the research involved four tree species: two broad-leaved (*Fraxinus excelsior* and *Alnus glutinosa*) and two coniferous (*Pinus brutia* and *Abies nordmanniana*). Measurements were taken in 5 sample plots distributed across various locations for each tree species. The sample plots ranged from 400 to 800 square meters, depending on canopy closure. If a sample plot contained fewer than 30 trees, the area was expanded to allow for statistical analysis. In total, 600 trees were measured, and descriptive statistics were provided. Measurements were conducted outdoors during midday to maximize sunlight. The Arboreal application demonstrated significant advantages in both measurement accuracy and efficiency. Diameter measurements showed a standard deviation of 2.42 cm, while height measurements had a standard deviation of 2.32 m. The Root Mean Square Error (RMSE) for measurement times was 3.40 seconds less for diameter and 16.96 seconds less for height compared to traditional methods. Error analysis revealed an RMSE of 8.24% for diameter and 13.89% for height measurements. The percentage RMSE for measurement times was 68.30% for diameter and 60.40% for height. Significant differences were observed in diameter measurements for broad-leaved species and height measurements for coniferous species. These findings indicate that the Arboreal method provides superior accuracy and time efficiency over traditional techniques, making it a preferable choice for field studies to enhance measurement consistency and save time. Detailed analyses by tree species have also facilitated the identification of the most suitable measurement method for each species, contributing significantly to forest management and ecological research.

Keywords: *Forestry technology, forest inventory, arboreal application, Diameter At Breast Height (DBH), tree height*

ORAL PRESENTATION

Assessment of PM10 Exposure in Chainsaw Operators During Tree Felling

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Abstract

One of the most important stages of forestry production is the felling of trees. The use of advanced production machines is difficult in places with rugged terrain such as Turkey. Therefore, chainsaws are generally preferred for these operations. Although chainsaws seem to be easy to use, they have various negative effects. It is an important issue that especially cutting operators are affected by particulate matter (PM10) formed during cutting. This study was carried out in Bursa, Soğukpınar Forest Management Directorate. In the study, 45 trees were felled. Especially PM10 from the use of chainsaws has a significant impact on cutting operators. PM10 was measured from the breathing zone of the chainsaw operator during tree felling. The average PM10 value measured was 361.8 µg/m^3 PM10 per minute. In total, 16280 µg/m^3 PM10 was measured. These values may seem quite small, but operators are affected by the total amount of PM10 during long hours of work. According to the United States Environmental Protection Agency (EPA), air quality is unhealthy when the daily exposure index value is over 150 µg/m^3. Therefore, the values measured during the study are quite high. According to the EPA's air quality index, 361.8 µg/m^3 is in the "Very Unhealthy" group.

Keywords: *Chainsaw, occupational health, particulate matter, tree felling*

ORAL PRESENTATION

Calculation of Log Stack Volume Using Spatial Photos

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Abstract

The logs are stored in depots at the end of the wood production stages in forestry. The logs are stacked in the depot and the diameter, length and volume are noted. Basic tools such as calipers and meters are generally used in these measurements. Nowadays, these operations can be made with phones because of spatial photos. The volume of an object can be calculated by scanning it with photos. These photos are converted into 3D models with some programs. One of these programs is Agisoft Metashape. Many operations can be performed by processing photos with Metashape. In this study, it is aimed to produce a 3D model with Metashape and to calculate the volume information of the model and to compare it with the manual method. In this study, photos were taken around a log stack at Bayramdere Forest Depot in Bursa. These photos were processed in Metashape program. At the last stage, a 3D model was produced, and its volume was calculated. The same log stack were measured manually and volume was calculated. According to the results, the volume calculated by the manual method was 3.468 m^3 and the volume calculated by Metashape was 3.694 m^3.

Keywords: *3D model, Agisoft Metashape, log stack, volume calculation*

ORAL PRESENTATION

Assessing Windthrow Impact in Kastamonu Forests: Environmental Factors and Sentinel-2A Imagery Analysis

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Abstract

In recent years, the frequency of severe storms worldwide has surged due to climate change, causing significant damage to forests and increasing degradation. The most notable impact on forests is windthrow, where trees are uprooted or broken by strong winds. This study at the Kastamonu Forest Regional Directorate in Türkiye from 2017 to 2021 examined the relationship between windthrow sizes and environmental parameters. Using Sentinel-2A satellite imagery, the Normalized Difference Fraction Index (NDFI) was calculated to determine windthrow sizes. The relationships of winthrow sizes with environmental parameters were modeled using regression tree. The Akaike information criterion (AIC) identified the best model, which included site index, maximum wind speed and slope. According to the model results, the widest windthrow sizes were found to occur when the site index was "I" and "II" and the wind speed exceeded 63.93 km/h. The statistical results of the regression tree model in an R^2 of 0.81, MAE of 0.29 and RRMSE of 3.02. To prevent degradation caused by windthrow, area-based conservation efforts should be implemented and silvicultural interventions should consider environmental parameters.

Keywords: *Windthrow, sizes, environmental parameters, remote sensing*

ORAL PRESENTATION

Development of Low-Cost IR Forest Scanner

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Abstract

Forests provide a wide range of essential ecological functions, such as generating oxygen, cycling carbon, absorbing carbon dioxide, and serving as habitats. They also produce eco-friendly goods like wood products and food. Unfortunately, the ability of forests to fulfil these roles, along with their productivity and health, is threatened by factors including insects and disease, drought, forest fires, trade, land use changes, climate change, and forest area loss. Given these ongoing threats and human pressures, the forestry sector must adopt smart, technological approaches. Technological forestry involves measuring, mapping, and assessing forests using infrared (IR) distance meters. By employing IR distance meters to measure the entire forest, an accurate IR point cloud-based digital replica can be created, enabling precise retrieval of forest information such as tree diameter and height. Cost-effective devices can provide high-accuracy information comparable to more expensive alternatives. This research developed a low-cost IR scanner prototype designed for forest scanning. The scanner uses a Sharp-GP2Y0A710K0F sensor, SG90 servo motor, and Atmega328p-PU microcontroller, along with necessary electronic and software improvements like voltage oscillation filtering, noise reduction, and multi-reading averaging for deviation accuracy. The scanner rotates 180 degrees horizontally and 150 degrees vertically, saving distance measurements along with the corresponding angles at each rotation. This prototype generates a dataset that can be used to construct a digital forest replica, thereby enhancing and simplifying forestry analysis.

Keywords: *Forest scanning, IR measurement, point cloud, remote measurement*

ORAL PRESENTATION

Modelling of Gas Dispersion in Forests and Usage of Actual Dispersion Models in Forest Areas: A Software Assisted Study of a Likely Outflow Scenario

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Abstract

Forests are one of the few areas in where most of the risk factors associated with Occupational Health and Safety can be observed. From mechanical and physical risk to biologics and chemicals almost all the factors do have relevance in applied forestry works. Separately, in recent years and the latter half of the past century, one of the biggest hazards for public and environmental safety has been major industrial hazards. These events: characterized as very large industrial fires, explosions or gas dispersion events posed a great threat for civilization and environment in general throughout the world. Some of these hazards came to be realized as real events which showed its effects in disaster proportions like Bhopal (1984) disaster. Gas dispersions like these still pose a great danger as many hazardous chemicals are used in industrial applications. Forestry works, although at first glance seem to be devoid of such large chemical usage and storage, still include such facilities where these chemicals may pose a danger. Aside from risk of fire there is also a risk of gas dispersion from usage of hazardous chemicals like pesticides, fuels, fertilizers etc. Although for open fields and urban areas, dispersion of such chemicals has been studied extensively in the past, there are very few studies that investigate the outcome of a dispersion event in a forest area. For this purpose, several devised chemical outflow and dispersion scenarios were structured and modelled using EPA-NOAA ALOHA software's dispersion modules. The results were correlated as distance to gas concentration outcomes and were graphed accordingly. Also, the results were shown on the scenario area map using Google Earth software with map contours chosen for specific EPA concentration levels such as AEGL1-2-3. When modelling the scenarios one of the most important inputs that would affect the results in forests is the Roughness Ratio number. In this study these numbers were chosen according to most probable and likely ratios present in actual forests of Istanbul – Türkiye. This innovative approach to applied risk assessment in forest dispersion events is thought to be a showcase approach which may shed light to such future studies in the same field.

Keywords: *Occupational health and safety in forestry, gas dispersion, environmental risks in forestry*

ORAL PRESENTATION

Possible Change in Distribution Areas of Scots Pine in Kastamonu due to Global Climate Change

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Abstract

Global climate change is defined as an irreversible problem that could directly or indirectly influence all the organisms and ecosystems and the world must cope with. Especially for the forest trees, the migration mechanism needed should be provided by humans. For this purpose, contrary to the previous studies, detailed studies to be carried out on small areas are needed. In the present study carried out in Kastamonu Regional Directorate of Forestry, which performs the highest level of production in Türkiye, it was aimed to determine the actual distribution areas of the abies and the change in their suitable distribution areas due to Global climate change. In this study, besides the current distribution areas and the potential future distribution areas, also the suitable distribution areas were determined by using SSP 126, SSP 370, and SSP 585 scenarios for the years 2040, 2070, and 2100. The results achieved there showed that, depending on the results of climate change, distribution areas of Scots Pine (*Pinus sylvestris* L.) populations would change in the future and this change would be in form of an increase in general. This species seems incapable of keeping up with such changes without human intervention. Thus, considering the study results, it is recommended to make necessary amendments to the forest management plans.

Keywords: *Global climate change, Scots Pine, SSPs scenarios, Kastamonu*

ORAL PRESENTATION

Determination of the Factors Affecting the Amount of Water Passing Through the Drainage Structures Planned on Forest Roads

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Abstract

In order to fully benefit from forest roads and to plan uninterrupted transportation throughout the year, it is possible to safely remove the water damaging these roads from the road surface and to correctly size the necessary drainage structures. Maintenance and repair operations of incorrectly sized drainage structures can reach or even exceed the costs of their construction. In order to prevent this situation and to avoid unnecessary expenditures, sizing of drainage structures is of great importance. In today's forestry, Talbot formula is used for sizing of drainage structures according to Communiqué No. 292. The selection of at least one of the parameters contained in methods such as State Hydraulic Works synthetic hydrograph method, rational method, HEC-RAS and SCS-CN, which are also used by highways, including Talbot formula, is left to the experience of the planner. In this study, two basins within the borders of Eastern Black Sea Region were taken as test areas in order to create an alternative to decide on the type of drainage structure with the existing data of the area by eliminating personal initiative and experience. By determining the topographical features, vegetation cover, soil type and precipitation amounts that affect the amount of water that can pass through the drainage structure to be planned on a forest road, the parameters affecting the amount of water that can pass through the drainage structure were tried to be determined using ArcMap software. With this method, it is thought that it will be possible to determine how much of the precipitation falling in a basin turns into surface runoff and the parameters affecting it.

Keywords: *Forest roads, drainage structures, basin, geographic information systems, ArcMap*

ORAL PRESENTATION

Performance Analysis in Timber Loading Operations with A Tractor-Mounted Single-Gear Front Loader

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Abstract

One of the most important stages in the efficiency of harvesting operations is the proper planning of loading operations that provide the link between primary and secondary transportation. Modified tractors are the most used in loading operations due to the high cost of advanced mechanization tools. In this study, the performance of loading logs with a tractor-mounted single-gear front was determined in spruce (*Picea orientalis* L. Link) forests in northeastern Türkiye. Within the scope of the study, the diameter and length of the loaded logs were measured, the quantities loaded each time were determined, and their volumes were calculated. The average diameter and length of the loaded logs are 34 cm and 4 m, respectively. The performance of the loading activity was determined by time measurements carried out during the stages of placing the logs into the bucket (f1), moving them to the truck (f2), loading them (f3), and returning to the logs (f4). The productivity of the loading activity was calculated from the volume and time measurements. The relationships between the volume and number of logs loaded at each time and work performance were statistically evaluated.

Keywords: *Forest operations, Biomass harvesting, Time and motion study, Work productivity*

ORAL PRESENTATION

Statodynamic Workloads of a Chainsaw Worker Shown Through the Lens of Motion Capture Technology

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Abstract

Daily motor-manual work activities of felling and wood processing expose chainsaw workers to a wide range of risk factors, which, in addition to frequent injuries at work, can cause the development of occupational diseases in the form of musculoskeletal disorders (MSD). Biomechanical workload of forest workers in such harvesting operations is categorized as "very heavy". Additionally, improper postural and movement habits of the forest worker can lead to the appearance and progression of structural and/or functional changes in the locomotor system of the chainsaw worker, and thus to the occurrence of acute and/or cumulative trauma. Accordingly, the aim of this research is to investigate statodynamic workloads of a chainsaw worker upper body shown through the lens of cutting-edge Xsens MVN Link motion capture technology. Postural-movement habits of a chainsaw worker, for a working element at tree felling operations, were recorded and analyzed through the values of the joint angles of the upper part of the worker's torso. Descriptive and inferential statistical methods were used for the field data analyses. As part of the discussion and conclusion, educational and technical-technological measures are elaborated that can be implemented in the workplace of chainsaw workers with the aim of optimizing statodynamic workloads and mitigating and/or nullifying the development of musculoskeletal disorders.

Keywords: *Forestry, chainsaw worker, motion capture suit, musculoskeletal disorders*

ORAL PRESENTATION

Assessment of Urban Green Areas Using i-Tree Canopy

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Abstract

Assessing urban green areas is crucial for sustainable urban development because they provide fundamentals benefits to the human being such as recreational opportunities and aesthetic value, reducing energy use with cooling effects, improving water and air quality, diverse wildlife habitat, and increasing human health and well-being. Advanced technology such as GIS and Remote Sensing has been applied to monitor, assess, and analyze land use/land cover and the vegetation changes in urban green areas by integrating spatial data. Specifically, i-Tree Canopy is widely used to estimate land use/land cover, especially the vegetation to classify ground cover types. Furthermore, i-Tree is a suite of freely-available software tools designed to assess the benefits and values derived from trees and forests. In this study, the conditions of green areas in the city center of Mogadishu (Somali) were evaluated and suggestions for the protection and development of the urban greenings were presented. "i-Tree" program was used to evaluate the spatio-temporal changes of green areas in the city center of Mogadishu by considering two time periods (2002 and 2023). The results indicated reduction in total green areas (Grass/Herbaceous and Tree/Shrub) from 26.40% to 24.20% over the 21-year period, as indicated by the i-Tree Canopy data, pointed to a gradual loss of green spaces due to urban expansion and infrastructure development.

Key words: *Urban green areas, Socio-economic impact, Environmental sustainability, i-Tree Canopy*

ORAL PRESENTATION

Stump Harvesting Operations: Examples from the Mediterranean Region

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Abstract

The increasing demand for woody biomass has revived tree stump collection. Stump biomass is a viable raw material for the bioenergy sector, and could also be used for extracting valuable chemicals, such as resin. However, the harvesting of stump biomass requires heavy equipment and is a practice that has received much criticism for its potential negative effects on the forest topsoil. Stump harvesting requires specialised tools and equipment, and a similarly specialized supply chain, both of which add a level of complexity to the supply chain. Hence the interest in scoping technology alternatives across the Mediterranean region, and more in general across the globe. Therefore, the aim of this study is to compare the stump harvesting operations, techniques and technologies employed in Türkiye, Italy and generally in other countries. For that purpose, the Authors reviewed the findings of past studies on the subject, obtaining detailed information on the collection process, the equipment used and the results achieved. According to the results of the review, heavy excavators seem particularly effective if fitted with specially manufactured attachments, which minimize soil disturbance compared to the conventional bucket. Of course, stump harvesting is a specific practice limited to plantations on flat terrain and should not be practiced on slopes, unless as part of a general reclamation project. The main challenge with stump harvesting is soil contamination, which can be minimized by mechanical stump cleaning, sieving of the comminuted product or by prolonged open-air storage aimed at weathering the soil off the stumps.

Keywords: *Stump harvest, stump biomass, work technique, excavator based operations*

ORAL PRESENTATION

Key Issues That Need to be Addressed for Successful Biomass Harvesting and Utilization

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Abstract

For ecological and economic reasons, many efforts are being made to harvest and utilize woody biomass resources in traditional or innovative ways. The type, quantity, quality, etc. of usable biomass obtained from various forest management practices are highly variable, depending on many factors. Therefore, woody biomass supply chain logistics have different applications according to forest management objectives and local biomass market conditions. These differences can serve as examples of good practice in sharing innovative practices and providing solutions related to biomass harvesting and utilization in a global scale. The purpose of this study was to summarize the current practices of biomass harvesting and utilization in Türkiye and compare it with the biomass operations in the United States. For this purpose, the situation of the two countries including biomass inventory, biomass supply and utilization, and aspects of good practice examples were summarized. Since forest management practices are taking place in public forestlands in Türkiye, the product range of woody biomass is determined by state-run forest enterprises which emphasize ecological benefits, forest markets, local economy, and best management practices for enhanced biomass harvesting and utilization. We have identified and summarized key issues in biomass harvesting and utilization, including successful marketing woody biomass, enhancing biomass harvesting operations logistics, providing employment opportunities for local communities, and increased utilization of biomass for production of bioenergy and biobased products.

Keywords: *Biomass harvesting, woody biomass, bioenergy, public forest management, biobased products*

ORAL PRESENTATION

An Assessment on the Methods of Unit Price Calculation Procedure for Wood Harvesting

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Abstract

The aim of this study is to criticize the methodology followed to develop the method of calculating harvesting unit prices in Türkiye (TR), which is in the transition period to mechanization in wood harvest operations, in terms of the principles stated in the good practice guidelines. The main issue here is to evaluate the principles on which the method followed is based on how to calculate the cost of production (harvest and transportation) of 1 m^3 of wood raw material in the most realistic way and to the satisfaction of the stakeholders. The unit price method is a function of the unit costs of labor and/or machine power used for the harvest operations and the standard time consumed per unit wood. Because cyclical changes in labor and machine energy inputs used during wood supply chain can cause significant problems in cost calculation and price creation. For example, in Turkish forestry managed by state-run forestry, the unit price calculation method is used for all kinds of wood harvesting and various changes have been observed over time depending on technological developments. Since the increase in mechanization opportunities and technological diversity due to road density, increase in purchasing and investment power, changes both unit costs and standard working hours, there are also updates in determining unit prices. For this calculation method, inputs and outputs in wood harvest operations are measured according to scientific principles, standard working times of various operation techniques are determined, and production unit prices per unit amount of product can be calculated by treating them with flexibly determined unit costs. It is seen that this method, which has been followed in recent years, and the methodology followed during its development have not been evaluated from various aspects. In this study, the background of the unit price calculation method developed for TR forestry by following the good practice guideline prepared for woody biomass production at the worldwide was evaluated from various aspects.

Keywords: *Wood harvesting, unit price, time input, cost calculation, good practice guideline*

ORAL PRESENTATION

Evaluation of GIS Based Landslide Susceptibility Mapping for Determination of New Forest Road Route: A Case Study Tanır Stream Watershed

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Abstract

In mountainous areas, forest road networks are used for forest extraction. Forest areas in Turkey are located in high mountainous areas with steep slopes. In planning road networks in mountainous areas, planning should be done by considering negative and positive cardinal points. Landslides and mass movements are triggered after road construction and can lead to massive earth movements. In this study, a landslide susceptibility map was created using GIS-based logistic regression method. The study area was selected in the Tanır stream watershed, which is 3.918 ha in size and includes forest and rural roads in the Suçatı region of Kahramanmaraş province. The landslide susceptibility map was used to determine the route of a new forest road to be constructed with certain starting and end points. The landslide susceptibility map was produced using ArcGIS and SPSS software. Landslide data were obtained from General Directorate of Mineral Research and Exploration. The parameters of slope, aspect, curvature, land use, lithology, NDVI, distance to road, distance to stream were used to create the landslide susceptibility map. According to the landslide susceptibility map, 9.81, 9.40, 20.19, 26.56 and 34.04 % of the study area is divided into 5 classes as very high, high, medium, low and very low, respectively. According to the ROC analysis of the landslide susceptibility mapping, the AUC (area under curve) value was found to be 79%. GIS-based landslide susceptibility maps offer highly accurate alternatives for determining road routes in sensitive forest watersheds where nature suitability and earth movements are minimized.

Keywords: *Forest road, landslide susceptibility mapping, GIS, logistic regression*

ORAL PRESENTATION

The Use of Satellite Images and Computer Software in the Study and Monitoring of Ratios between Greening - Building in Residential Urban Centers

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Abstract

The future development of inhabited urban centers, from small urban centers to large metropolises, is and remains one of the greatest challenges of the future in all directions of social and economic development, but especially in the environmental aspect. The challenge in the current decades, but also in the coming ones, remains that by designing and building significant, architecturally fascinating, safe, cost-effective objects, they must at the same time be as friendly as possible with the environment. The galloping growth of the population, its extreme increase in urban centers, increased human activity, technologies and the use of resources and products growing by these populations, have caused the environment in these residential centers, but not only, to undergo essential changes in many of its components, which has led to climate changes on a regional and global scale. To soften these influences with negative significance in the environment, for a long time, but especially now, urban greening is seen as a main component in establishing some necessary environmental balances, especially in the direction of air purification. And undoubtedly, keeping under control the relationships between buildings and greenery in residential urban centers is a necessity today and in the future. And this, the condition and monitoring of building-greening ratios, is quite good and very important, it is realized in many countries of the world through the use of satellite imaging and different computer programs, some aspects of which we will present in our paper.

Key Words: *Greening, inhabitant centers, building, monitoring, environment*

ORAL PRESENTATION

Assessment of Mechanization in Timber Harvesting: A Case Study of Çanakkale in Türkiye

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Abstract

To maintain the natural balance and sustainability of the forest ecosystem, careful and strategic use is essential. For this purpose, the proper and effective planning of wood raw material production is required. While wood raw material production in our country is generally carried out manually and partly with machine power, mechanical methods have started to be used more frequently in intensive forestry regions in recent years. In this study, the performance of mechanical production tools (Doosan DX 300lC harvester, Tigercat 635D skidder, Wood Craker C450 feller buncher) used in clear-cutting operations in the Red Pine stand of the Çanakkale Forest Management Directorate was evaluated. Additionally, factors affecting productivity (product sizes, product volume, terrain slope, skidding distance, etc.) were examined. The average productivity of the harvester was determined to be 23.91 m3/hour, the average productivity of the skidder was 104.5 m3/hour, and the average productivity of the feller buncher was 62.43 m3/hour. Showing the effectiveness of mechanical methods to address the productivity and safety issues of traditional practices in Turkiye will help promote the adoption of these methods in forestry operations.

Keywords: *Timber harvesting, mechanization, harvester, skidder, feller buncher*

ORAL PRESENTATION

Identification of Potential Hydraulic Structures on Forest Roads Using ArcGIS® ModelBuilder

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Abstract

Forest roads cause various impacts on the ecosystem during planning and construction activities. Determining the locations of potential hydraulic structures (bridges, culverts, etc.) in the areas crossed by forest roads is of great importance for both infrastructure planning and environmental protection. This study aims to effectively and quickly identify the points where forest roads intersect with stream beds. A model was created using the ModelBuilder tool of ArcGIS Desktop. The model first identifies watershed boundaries and stream beds through watershed analysis. Then, it marks the coincidence points of these stream beds and forest roads as potential art structure locations. The model identified 4 micro watersheds in Maçka Forest Sub-District Directorate. 20 existing and 10 planned forest roads crossed the stream bed 317 times. In the study area, it was determined that an average of 2.01 hydraulic structures can be planned for a 1 km forest road. This model can be used in modeling processes related to forest roads and watersheds. It can provide important data to forest road planners and environmental planners for infrastructure projects planned in the area. The accuracy and usefulness of the developed model is open to be supported and improved by field studies and literature reviews.

Keywords: *Forest roads, hydraulic structures, GIS, ArcGIS, ModelBuilder*

ORAL PRESENTATION

Automatic Detection of Round Timber Logs Using the YOLOv8 Model

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Abstract

This study presents a method utilizing the YOLOv8 model to detect and count stacked round timber logs. The dataset consists of 350 images of stacked round timber logs in a selected forest depot, with image labeling performed using the LabelImg software. The YOLOv8 model was customized with a CSPDarknet53 backbone, C2f module, and SPPF layer for efficient computation. The model was trained using an AdamW optimizer and implemented using Ultralytics YOLOv8.2.49, Python-3.11.7, and torch-2.3.1+cpu on a CPU (Intel Core(TM) i7-5500U 2.40GHz) with CUDA support on an NVIDIA GeForce 840M. Optuna, an open-source library, was integrated into the study to optimize the hyperparameters of the YOLOv8 model. By leveraging Optuna's efficient sampling and pruning algorithms, the study identified the optimal set of hyperparameters, significantly enhancing the model's performance in detecting and counting stacked round timber logs. Model evaluation was conducted using precision, recall, and mean Average Precision at a 50% confidence threshold (mAP50). The YOLOv8 model has proven to be a highly effective tool for automating the counting of stacked round timber logs, providing valuable data to optimize log counting processes and enhance efficiency in the forest industry.

Keywords: *Hyperparameter optimization, image label, optuna, timber log, YOLOv8*

ORAL PRESENTATION

Monitoring Long-term Land Use Land Cover Changes in the coastal wetlands of Louisiana

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Abstract

The coastal wetlands of Louisiana, the seventh largest delta in the world, cover more than 35% of the estuarine herbaceous marshes in the United States. These fragile and valuable coastal wetlands are important not only for diverse ecosystems but also for supporting recreational and agricultural interests and seafood industries. In addition to natural processes, human activities caused alarming annual losses of swamps and wetlands in Louisiana. In particular, Barataria Bay and Wax Lake Delta, two contrasting coastal sites across one of the most dynamic systems of the world, have experienced significant land degradation through the years. Hence, continuous monitoring of these losses is necessary but is difficult and costly. With recent technological advancements, Remote Sensing (RS) technology in conjunction with Geographic Information Systems (GIS) has been effectively used to determine land use landcover (LULC), monitor and analyze the changes in LULC, health condition of the vegetation, biomass, and carbon sequestration. In this study, the LULC changes in Barataria Bay and Wax Lake Delta from 1986 to 2019 were assessed using Landsat images. Also, vegetation health condition in the study areas was evaluated with Landsat image-derived Normalized Difference Vegetation Index (NDVI). The study results showed that the Wax Lake delta experienced increased land gaining and expansion within the study period while there was a significant subsidence and land loss at Barataria Bay. Moreover, based on the NDVI value, vegetation health declined from 1985 to 2019 in Barataria Bay but improved in Wax Lake Delta.

Keywords: *land use land cover change, remote sensing, NDVI, coastal vegetation health*

ORAL PRESENTATION

Assessment of Machine-Based Hazards and Risks in Forestry Transport Works Using HRNS and TOPSIS Methods

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Abstract

While transportation work in forestry is crucial, it also poses major hazards and threats to people and the working environment. Specifically, the hazards and dangers provided by the machines used have severely detrimental consequences. The HRNS (Hazard Rating Number System) technique was utilized in this study to assess the hazards and risks posed by forestry transport machines. The dangers of machines employed in transportation and construction, such as mechanical, electrical, and working without machine protection, were assessed, and the risks associated with these hazards were identified. The five biggest risk criteria identified by HRNS were listed using the TOPSIS (Technique for Order Preference by Similarity to Ideal Solution) technique, and five alternative measures for each were offered. The most relevant one of these measures was selected. The study's goal is to reduce machine-related workplace accidents and improve risk management in the forest sector. As a result, reducing machine-related occupational accidents is crucial for both worker safety and productivity. Machine-related mishaps can result in significant injuries and financial losses. Hazards were discovered using the HRNS approach, and the risks associated with these hazards were assessed. The highest risk criteria were then identified using the TOPSIS technique, and alternative measures were given. As a consequence of the research, feasible and effective strategies were identified to reduce machine-related risks in forestry transport operations, and the most appropriate measure was chosen. This paper is a significant resource for the sector.

Keywords: *Forestry transport, machinery safety, HRNS Method, TOPSIS method, risk assessment, occupational health and safety*

ORAL PRESENTATION

Potential Use of Under-canopy UAV-SfM 3D Models to Determine Forest Stand Parameter

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Abstract

The SfM workflow allows foresters to collect remote sensing data of varying resolution and accuracy suited to their specific needs, providing various spatial products from a single sensor. This study emphasizes the potential use of consumer-grade cameras integrated into drones for determining forest stand parameters. Additionally, it presents key practical considerations for collecting high-quality aerial photographs for forestry applications using SfM software. The applications of UAV and SfM technologies in forestry are examined, focusing on the data collection process and how these data can be optimized for photogrammetric surveys. The study highlights the advantages of UAVs, such as safety, speed, and accuracy, while also offering a comparative analysis with traditional ground-based measurement methods. The two most critical forest stand parameters, Breast Height Diameter (DBH) and Stem Volume (SV), are addressed. DBH and SV estimates are compared with ground truth measurements, accepted as reference, along with general error statistics. The results show that the forest stand parameters obtained from UAV-SfM 3D models have an acceptable mean square error (0.42-0.72 cm for DBH and 0.005-0.0015 m^3 for SV). The findings suggest that UAVs and consumer-grade cameras can enhance efficiency, expedite data collection processes, and improve safety in forestry operations. Moreover, the accessibility of SfM software for a broad audience enables even non-expert users to perform high-quality photogrammetric analyses. Promoting the use of innovative and accessible technologies in forestry and increasing knowledge in this field is crucial.

Keywords: *3D remote sensing, Diameter at Breast Height, Stem Volume, UAS*

ORAL PRESENTATION

Log Tracking Information Systems: Barcode Application in Turkish Forestry

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Abstract

Forests provide a wide range of services to humans, such as wood products, recreation, health, food, and shelter. In particular, harvested wood products, about half of which are used for fuel wood worldwide and the rest for industrial purposes, are the main components of national and international trade. Hence, it is important to have efficient, practical, and economic log-tracking mechanisms because tracking logs can add value to the wood product by providing an information system aimed at identifying and locating legal wood and wood products. They do not only prevent and control illegal logging but also contribute to developing sustainable forest management worldwide. There are various log tracking systems in the wood trade sector, ranging from simple stamping and painting of the logs to innovative digital tracing information mechanisms for recognition, log tracking, and monitoring. In this study, we will present and discuss the current log tracking system in Turkish forestry, particularly the integration of digital and innovative technologies (barcode application), which was developed to prevent deforestation and forest degradation under the Regulation of the European Parliament and the Council. This study will also provide a better insight into the log traceability methods used in Turkish forestry practices in terms of digital forestry.

Keywords: *Information systems, log tracking, traceability, supply chain, sustainable forest management*

ORAL PRESENTATION

Determination of Soil Deformation with Unmanned Aerial Vehicles in Logging Activities with Agricultural Tractors

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Abstract

Mechanical timber extraction system provides higher quality products and safer working environment than traditional timber extraction system (Manpower and Animal power). However, if the logging work is not planned properly, mechanical production tools cause damage to the trees and saplings left in the stand, and heavy logging equipment with rubber wheels and pallets can damage the physical properties of the forest soil. The products skidded on the ground during the extraction work carried out using mechanical tools cause various deformations on the forest soil. Some of these damages are soil compaction, rut depth, losses in soil fertility and nutrient content, erosion due to surface runoff, and destruction of the humus layer. Rut depths, which are an important soil deformation indicator, can be effectively determined by using digital surface models produced with the help of UAV. This study was carried out in Yeniköy Forest Management Directorate to determine the soil deformation that occurred during removal from the compartment with an agricultural tractor using UAV. In the study, four autonomous flights (Control, 10th, 20th, 30th) were made with the UAV, and rut depths and soil volume losses were determined from the high-resolution images obtained using Agisoft PhotoScan software. In addition, local rut depths of the study area were measured with a manual method (ruler method) at 10 meter intervals. The rut depths measured by UAV and the rut depths measured by the manual method were compared with the Paired Sample T-Test in the SPSS 20 program. As a result, it was determined in the study that rut depths increased as the number of trips increased and soil deformation increased similarly.

Keywords: *Skidding, UAV, soil deformation, wheel rut depth*

ORAL PRESENTATION

Analysis of Production, Utilization and Material Sources of Small and Medium-Sized Chippers in Slovenia

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Abstract

This study presents a comprehensive analysis of the production, utilization and material sources of small and medium-sized chippers in Slovenia based on the 2024 survey. This study aims to examine the role of chippers in woodchip production, focusing on production volume, geographical distribution and raw material types. The survey included 202 small and medium-sized chippers with nominal capacities under 100 nm^3/h. The results show that they are essential for the sustainable management of wood resources in small-scale forestry, with a total annual production volume of almost 700,000 cubic meters (23 % of total registered wood chip production in Slovenia, produced by 262 chippers). Mobile chippers dominate the market (92 %) and are used in forestry operations and other production sites, making them particularly effective in cost-efficient woodchip production from logging residues directly on forest roads. Primary raw materials include sawmill (41 %) and forestry residues, with coniferous wood accounting for 69 % of total production. Most woodchips are sold on the domestic market (52 %) with the majority (88 %) being used for energy purposes. The study underlines the crucial importance of small and medium-sized chippers for sustainable forestry and provides valuable data for improving efficiency and sustainability in forestry.

Keywords: *small chippers, medium chippers, wood chip production, sustainable forestry, Slovenia*

ORAL PRESENTATION

Redesigning Administrative Measures on Wildlife: Case Study of Deer Management in Kumamoto Prefecture, Japan

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Abstract

While damage caused by deer (*Cervus nippon*) is serious in Japan, the administrative division of roles in deer control is unclear. There are two plans for deer at the prefecture and municipal levels, which presents a challenge in ensuring consistency and coordination between them. Furthermore, many plans mention information and communication technology (ICT), yet the details are often omitted. It is unclear whether ICT has facilitated coordination between actors. The objectives of this study are twofold: to organize the division of administrative roles and clarify staff attitudes towards deer control; and to determine the status of the introduction of ICT technology for deer control and its effectiveness. The survey was conducted in the Kumamoto prefecture, one of the leading forestry prefectures in Japan. The websites of each organization (prefecture and 45 municipalities) were browsed to analyze the information on deer measures. A questionnaire was conducted among the organizations (prefecture and municipalities) to clarify what kind of awareness and issues the staff felt about deer control measures and the role they anticipated in the rural communities. It was discovered that information on deer was disseminated across various departments. It is necessary to integrate forest and wildlife management with new technology.

Keywords: *Wildlife management, deer, forest management, rural communities, Japan*

ORAL PRESENTATION

UAV-Based Temporal Change Detections in an Open-pit Mine Using Python

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Abstract

The practice of open-pit mining significantly contributes to the disruption of natural landscapes, pollution of the environment, and irreversible deformations, particularly deforestation. This cost-effective mining method conflicts with approaches to forest and nature conservation. Consequently, environmental groups and nature advocates have called for the restriction of open-pit mining operations and stricter regulation of mining permits. The aim of this study is to calculate temporal changes in an open pit mine using UAV photogrammetry data processed with Python. The study area is located within the borders of Burdur province in Southwestern Turkey. This region has numerous new mining permit areas and many active open-pit mines. Python software was used to process point cloud and digital terrain model data produced by two different times UAV flights to ascertain the topographic changes. In recent years, the number of permits granted for open-pit mining activities in forest areas in Turkey has increased significantly. Furthermore, the expansion demands of mines continue to pose a significant threat to natural ecosystems. The General Directorate of Forestry places great importance on determining whether mining operations comply with the permit areas and monitoring temporal changes within these permitted areas. According to the findings of this study, suggestions have been put forward regarding the essential software and hardware infrastructure required to implement an automated mining monitoring system.

Keywords: *UAV, python, digital terrain model,* o*pen-cast mining, change detection*

ORAL PRESENTATION

Comparing Manual and Numerical Methods for Forest Road Design

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Abstract

Forest roads are linear infrastructure projects that must be affordable, practical, safe, and aesthetically pleasing. Precise fine-scale spatial analysis between the start and finish locations of the road segment is necessary for project design during the planning, design, application, and construction phases of road construction. The route is created in accordance with the goals and limitations of the forest road on a two-dimensional topographic map, in accordance with the traditional methods now in use in forest road design. Projects can be drawn autonomously or semi-autonomously using computer-aided design techniques, also referred to as modern approaches. Computer-aided methods are more successful than the classical method, according to existing practices and literature. The extent to which the computer-aided methods differs from the classical method as well as the points at which these differences become apparent during the project design process, have become a research subject. This study aims to identify these discrepancies and conduct a thorough analysis and evaluation from multiple angles. As a result, 35 distinct forest road projects that had previously been created by classical method were redesigned by computer-aided method setting for the same start and finish locations, and statistical tests were used to assess and interpret the outcomes. The outcomes demonstrate that, as predicted, the computer-aided design of forest roads produces accurate and timely results.

Keywords: *Design of forest roads, route by road, volumetric excavation and filling, cost estimation and management, computer-aided design*

ORAL PRESENTATION

Substantiation of Wood Skidding Equipment Taking into Account the Natural and Production Conditions of Ukraine

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Abstract

Sustainable forest management, particularly through selective logging methods, demands improvements in existing wood skidding practices. This necessitates the development of modern wood skidding equipment tailored to the complex natural and production conditions of Ukraine's forest fund. A new technology and equipment are proposed, which involves using a winch mounted on the boom of a forestry crane. It is anticipated that this approach will reduce the likelihood of soil erosion, minimize damage to undergrowth and growing trees, and enhance work efficiency. Materials and methods of the research included a comprehensive analysis of forest growing conditions in Ukraine, taking into account forestry, production, geographical-climatic, and ecological features. The research employed both field experiments and simulation models to assess the effectiveness of the proposed equipment in various scenarios. A comparative analysis was conducted that utilizing a winch mounted on a crane significantly reduces soil erosion and tree damage, thereby promoting sustainable forest management practices. The technology and skidding equipment demonstrate excellent timber harvesting efficiency, particularly in areas with complex terrain, achieving a significant reduction in harvesting time and costs compared to traditional methods.

Keywords: *Wood skidding, forestry crane, winch, soil erosion, efficiency*

ORAL PRESENTATION

Dynamic Modelling and Optimisation of Forestry Machines

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Abstract

The conducted researches of the dynamics and optimisation of the operating modes of forestry machinery and technological equipment is necessitated by the need to improve their reliability, durability, productivity and safety. The study examines the dynamic processes that occur in the mechanisms of skidding winches, cranes and grab grippers used in forestry. A three-mass model was developed to analyze the dynamics of movement, revealing that loads in the mainline and guyline ropes surpass steady-state values by a factor of 2 to 3. This reduces their service life and increases the risk of injury to the operator. Using the methods of the calculus of variations, the optimal laws of motion reduced the peak dynamic loads in the ropes, ensuring a smooth change in the angular speed of the drum and eliminating oscillations of the load. Experimental studies conducted confirmed the results of theoretical calculations. The results obtained indicate that the application of optimal operating modes can significantly increase the efficiency of forestry machinery, reduce the energy intensity of technological processes, extend the service life of equipment and create safer working conditions.

Keywords: *Logging, forest machinery, operating mode optimization, dynamics of machines, calculus of variations*

ORAL PRESENTATION

Social benefits of a forest road network in fire-prone and protective forests

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Abstract

The forest road network has not only an important productive value, but also a social value, especially in protective and fire-prone forests: (1) it enables adapted forest management that reduces the risk of fire in fire-prone forests; (2) it enables adapted forest management of protective forests that ensures a more stable and vital forest, guarding settlements and infrastructure from water and snow erosion; (3) it enables access into the forests to response units in case of a wildfire or other natural disaster; (4) it enables access for construction mechanization to torrential streams with the purpose of building or maintaining torrent protection infrastructure or cleaning natural streams; (5) it facilitates regular monitoring of protective forests, torrential streams and fire-prone forests; (6) it accelerates restoration after any natural disaster event; and nevertheless (7) sufficiently maintained roads can also serve as a fuel brake. In Slovenia, there are few opportunities to obtain funds for the construction or maintenance of the road network in protective or fire-prone forests. The biggest luck of funding can be seen in areas, opened mainly by tractor roads. Further efforts should be made to fund the maintenance of tractor roads in protective or fire-prone forests in order to achieve the social benefit objectives.

Keywords: *Forest road network, wildfire, erosion, protective forest, social benefits, funding*

ORAL PRESENTATION

Estimating Sediment Yield from a Road Network by Using a GIS-Based Sediment Prediction Model

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Abstract

A significant part of the fresh water resources available on earth are provided by forest basins. Especially the upper parts of the basins provide quality and sustainable water production as well as services such as erosion and flood control, soil protection, landslide, avalanche and rockfall prevention. However, forestry activities are also carried out in these basins, and the execution of these activities can be efficient through planned roads in forest areas. Forest roads cause compaction on the soil surface, surface runoff formation, increase in stream peak flows and temperature, sediment transport, erosion and thus deterioration of water quality. In this study, the SEDMODL method, a GIS-based sediment prediction model, was used to calculate the sediment production from the road network in a sample study area. Gürgen Creek Basin, which was chosen as the study area, is a sub-basin of the Doğancı Dam, located on the Bursa-Osmangazi borders in the Marmara Region and built on the Nilüfer Stream. The altitude above sea level in the basin varies between 530 m and 1093 m. 80.51% of the total basin area is forest, 13.27% is agricultural and 6.22% is pasture area. The results indicated that the sediment yield from road sections highly depends on several erosion factors. Even though their effects on sediment yield vary based on the road types (i.e. secondary or county-maintained roads), the most important attribute to consider in predicting sediment yield are road use, slope, and cut-slope heights.

Keywords: *Erosion, sediment yield, forest road, GIS*

ORAL PRESENTATION

Evaluation for Planning Optimal Forest Road Routes Using Landslide Susceptibility Maps

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Abstract

Landslides are among the most significant disasters affecting human life due to the impacts of climate change and irregularities in global/regional rainfall patterns. Regions experiencing increased instantaneous rainfall, high clay content in soil structures, and steep terrain slopes witness a rise in landslide occurrences. With these increases, landslide events that start in the upper basins create a chain of disasters that trigger each other, causing economic and, more importantly, loss of life in the lower basins. Consequently, the protection of forest resources in upper basins is increasingly crucial. In this context, the use of landslide susceptibility maps produced using machine learning/artificial intelligence, depending on regional characteristics and developing technology, has become quite widespread recently. These maps are employed during the pre-urbanization phase, road/bridge/tunnel planning, establishment of new settlements, and construction of strategic and critical infrastructure. Within the scope of activities in forest areas; it is observed that forest roads constructed for afforestation, production, transportation, firefighting, maintenance and protection purposes can trigger landslide events during and after the construction process if appropriate techniques are not applied. Since forest roads are the basic facilities for carrying out forestry activities, forest road construction activities must continue despite the mentioned damages. At this point, minimizing damage and establishing an optimal forest road network through rational planning are imperative. Based on previous studies on the subject, this article evaluates the parameters that should be considered in the design and construction of forest roads, especially in landslide susceptible areas, and the capabilities of using machine learning and remote sensing techniques.

Keywords: *Forest road planning, landslide, machine learning, optimal forest road route, remote sensing*

ORAL PRESENTATION

Analysis of Climate Change Variability Over Amasya Merzifon Forest Areas

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Abstract

Global climate change has widespread effects on forest ecosystems. This study aims to examine how climate change and changes in topography affect forest areas in the Amasya Merzifon region. The analysis covers changes in precipitation, surface temperature, vegetation condition, soil moisture, and drought indices from 2002 to 2021. The results indicate that average precipitation decreased by 49.21 mm over the 20-year period, while surface temperature increased by 9.01 ºC. The northern region was found to be the most affected, with these changes also being significantly felt in Merzifon, located in northeastern Amasya. Fluctuations in green area and moisture were predominantly noticeable in the northern regions. The SPEI values, based on the Google Earth Engine (GEE) platform, increased by -0.119. LST-based hot spot areas were observed in the southern and western parts of the region. The study revealed that reduced precipitation and high-temperature fluctuations could affect crop production, moisture loss, and lead to floods and droughts in the western regions.

Keywords: *Temperature, precipitation, vegetation scenarios, SPEI, moisture content*

ORAL PRESENTATION

Assessment of Soil Contamination in Urban Forest Areas of Samsun City

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Abstract

The Urban expansion and population growth have led to increased residential development, significantly affecting the quality of urban environments. One notable consequence of this expansion is the rise in soil contamination, which is attributed to both anthropogenic and industrial activities. Among the various pollutants, heavy metals in soil are of particular concern due to their industrial origins and potential health risks. Despite the wealth of research on heavy metal remediation, effective prevention and management of soil contamination remain critical due to the high costs and complexities associated with remediation processes. Urban green spaces, which serve as important recreational areas in cities, are especially vulnerable to soil contamination. This study focuses on assessing soil contamination in urban green spaces within Samsun City, with a particular emphasis on heavy metals like cadmium (Cd), lead (Pb), and phosphorus (P). Soil samples were collected from nine distinct locations across the urban area. Laboratory analyses determined the concentrations of these metals, and the data were subjected to statistical evaluations. Kriging interpolation techniques were employed to create detailed maps depicting the spatial distribution of heavy metal concentrations. The results highlight the pressing need for ongoing monitoring and management of soil contamination in urban green spaces to protect public health and minimize exposure to harmful pollutants.

Keywords: *Urban forest area, soil contamination, Geographic Information Systems (GIS), heavy metals, statistical analysis*

ORAL PRESENTATION

Performance a Daily Traffic Load –DTV at the Main Forest Road Entrances at a Suburban Forest

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Abstract

In Greece small scale forest owners are small portion and owned by Monasteries, municipalities or private citizens. Suburban forest of Thessaloniki is an ecosystem bordering like a crown of the city of Thessaloniki and some of the important roles are: a) a protection from severe weather phenomena (floods, soil runoffs, etc), b) reduction of pollutant emissions, c) the production of oxygen, water etc., d) to improve the quality of life and the health of residents and visitors. e) sports activities in a natural environment. The research aim is to measure vehicles passing through the forest areas. Daily Traffic Load (DTV)* performed at the main entrances of the Suburban forest of Thessaloniki at regular time intervals with use, on the forest road axis. The research process is simplified by encouraging the use of the method in the forestry practice. Through the calculation of the traffic load, immediate conclusions are drawn about the users and the traffic in the peri-urban forest. The traffic load measurement device of the company Metro Count – Vehicle Classifier System (v.5.0) is using pressure measuring of passing vehicles on them. Through the analysis of the traffic load data, the study aims to highlight results regarding the entrances chosen by visitors to the site as well as its managers. A model of visitors controlled guidance is proposed and the aim of the model is to strengthen the recreation areas of the forest, which receive the majority of visitors, and at the same time to temporarily remove them from parts that need protection. The implementation of such a model over time, will give the opportunity to all parts of the forest a gentle regeneration and be able to support the number of visitors, offering them quality and safe development of sports and leisure activities. In the Forestry Service DTV measurements can be a decision making tool by pointing out the frequency of maintenance of the forest road network based on the intensity of its use over time.

Keywords: *Forest Road, real time measurements of traffic load, Daily Traffic Load-DTV, forest protection, suburban forest visitors*

POSTER PRESENTATION

Investigation of Mechanization Machines Used in Wood Production Studies in Türkiye

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Abstract

Wood production activities in Türkiye have increased greatly in recent years. Especially in parallel with the increase in population, the need for wood raw material has also increased. Different vehicles are used in wood production in Türkiye. These are agricultural tractor, skidder, harvester, portable hand winch, mobile tower yarder and skyline. The rate of mechanization in wood production in our country is very high. Agricultural tractors play a major role in production work. Mobile tower yarders and long-distance skylines are used in mountainous regions. In this study, the studies on the use of machines in wood production studies in Türkiye are examined. Data such as the efficiency, fuel consumption and operating costs of tractors, skidders, yarders, skylines, hand winch are presented. In addition, the study also provides up-to-date information such as the increasing amount of wood raw material in our country in recent years and the numerical status of production machines. In the light of this study, various recommendations were made on the effectiveness of the use of machinery in wood production in Türkiye.

Keywords: *Mobile tower yarder, tractor, skidder, productivity, hand winch*

POSTER PRESENTATION

Determination of Drainage Structure Excavation Areas by Close Range Photogrammetry

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Abstract

Long-term service of forest roads is a very important phenomenon. In addition to good planning on forest roads, it is very important to make drainage structures for these roads to be durable. In the construction of drainage structures, excavation areas must be determined accurately. Determining the amount of excavation and filling is of great importance in terms of cost. This study was carried out in Yalıköy Forest Management Department, which is affiliated to the Istanbul Regional Directorate of Forestry. In the study, six steel culverts of different sizes were constructed. The excavation areas of the drainage structures were determined in two different ways. First, the approximate amount of excavation was calculated according to the size of the culvert before the excavation was carried out. Secondly, after excavation for drainage structures, the amount of excavation areas was determined by close range photogrammetry. Because of this study, it was determined that the use of close range photogrammetry during excavation and filling works of drainage areas affects the cost. Because of the study, it was found that there was a difference of approximately 15% between the first excavation quantity and the close range photogrammetry. Accurate determination of the amount of excavation is important in terms of labor costs, machine operating costs and environmental damages.

Keywords: *Forest road, culvert, cutting, drainage, photogrammetry*

POSTER PRESENTATION

Analysis of Cut and Fill Calculation Methods in Forest Road Design

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Abstract

Road design and construction is a time-consuming, multi-variable and complex process. One of the most important steps in this process is the estimation of earthwork. The accuracy of earthwork estimation has an important role in all aspects of engineering works. It represents the largest cost component, especially in low-volume forest road projects constructed in mountainous terrain. In this study, it was aimed to compare the volumes calculated by traditional methods used in the estimation of cut-fill volumes on forest roads with the volumes calculated by computer-aided methods. A section of 420-meter road located in IUC Faculty of Forestry Research and Application Forest was selected as study area. Traditional methods such as Average and Area method, Prismoidal method, Simplified Applicable Lengths method and Pappus theorem were used for volume calculations. In the same study area, cut-fill volumes were calculated in Autodesk Civil 3D software, control values were determined and compared with the volumes calculated by traditional volume methods. According to the obtained results, it was determined that it is important to comply with the cross-sectional dimensions standards determined in forest road works, and it is not sufficient to pay attention only to cross-sectional spacing in volume calculations. In computer-aided volume calculations, it was determined that cross-sections with 5 m intervals, which take the horizontal and vertical geometry of the road into account, are sufficient.

Keywords: *Forest roads, earthwork, computer aided volume calculation, civil 3D*

POSTER PRESENTATION

Assessment of Timber Forwarding Efficiency in Small-Scale Forestry

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Abstract

The efficiency of the use of transport vehicles depend primarily performance indicators, operating costs and consumption of energy resources. However, to evaluate the effectiveness of a forest machine in small-scale forestry, it is important to consider its impact on the environment too. The purpose of the work is to substantiate the type and technical and operational parameters of machines for the primary wood transportation, as well as to develop recommendations aimed at increasing the level of their operational excellence. The presented calculation model allowed you to determine the depth of the rut, which is formed under the influence of the wheels, taking into account the properties of the soil, the parameters of the drive, the carrying capacity of the machine and the number of passes. As a result of the timekeeping observations, specific time expenditures on the major technological operations implementation in the process of timber primary transportation have been determined. According to the results of the study, practical recommendations for choosing the type and technical and operational parameters of the machines for the timber primary transport in small-scale forestry have been developed.

Keywords: *Timber forwarding, machine performance, impact on the environment, machine technical and operational parameters*