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The Current Status of Forest Residues and Disposal Machinery in Turkiye

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Abstract

The term "cutting residue" is a widely used term in Turkey, which refers to the leftover pieces of logs in the forest after cutting, except for the logs. As of yet, there is no specific expression and explanation for the term "slash" in Turkish forestry. Turkey carries out intensive forestry activities based on industrial wood production, primarily in mature stands and damaged after disasters such as fire or storm fall. Products that do not carry industrial woodiness in the stand, such as branches, roots, and tips that are not suitable for industrial production, are considered firewood and used for energy production or left in the stand. As a result, it is observed that the collected cutting residues from the fields that are sufficient in terms of benefit and cost is burned to generate electricity in electricity generation stations. Due to the demand for forest-based wood raw materials in recent years, some domestic companies have begun converting thick branches into industrial products such as paper and chipboard production. Additionally, some studies have been conducted to reduce transportation costs in bringing cutting residues to the economy, focusing on the storage and processing of forest cutting residues on the landing sites. In this regard, small-scale chipping machines have been produced by the domestic industry. Therefore, slash disposal and mechanization have a very limited place in Turkish forestry. Decision makers need to prepare action plans in this regard and provide support to joint research projects with academic units.

Keywords: Energy, Forest biomass, Logging residue, Production, Feasibility, Turkiye

1. Introduction

The annual average volume of trees cut from the forests is 28 million m^3 in Turkiye and approximately 25% of the harvested trees (7 million m^3) consists of branches, trunk bark and end pieces left after cutting, as felling residues, remain in the forest (Karayılmazlar et al., 2011). A large proportion of this residuals is left to rot in the forest because it is not economically feasible to extract them from forests (Saraçoğlu, 2006). In recent years, forest biomass related studies have increased regarding within the measures to reduce carbon emissions within the scope of combating climate change. In Turkiye, there have been developments related to energy production from forest biomass. Within the scope of these developments, support was given for the establishment and development of biomass energy production facilities. These facilities cover not only the use of forest biomass but also the use of other biomass resources (Kaygusuz and Türker, 2002; IRENE, 2020; Balcioglu et al., 2023; Gülci et al., 2023).

Forest bioenergy potentials can be converted into alternative biofuels. This process involves physical processes, thermochemical processes, chemical processes and biological processes. However, biophotolysis processes have gradually become widespread among conversion methods in recent years. Physical presses include grinding, drying, pelletizing and briquetting. The main thermochemical processes are combustion, pyrolysis (torrefaction, slow pyrolysis and fast pyrolysis), gasification and hydrothermal processes. Pyrolysis, gasification, fermentation and anaerobic digestion methods, which are among the biomass-to-energy conversion technologies, are used to convert forest-derived biomass into energy (Sarıkoç, 2020; Jha et al., 2022).

Forestry residues, such as branches, twigs, leaves, and stumps, are generated as derivations of forestry activities, such as logging and thinning (Moskalik and Gendek, 2019). These residues can be used for various purposes such as bioenergy production, soil improvement, and animal feed. However, if not managed properly, forestry residues can cause environmental problems including soil degradation, erosion, and greenhouse gas emissions. Therefore, effective and sustainable operation of forestry residues is crucial for both environmental and economic reasons (Janeiro et al.,

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2015; Pergola et al., 2022). In Turkiye, particularly, the demand for effective and sustainable timber residue operation is crucial due to increasing demand for renewable energy, the need for soil improvement, and public awareness of environmental issues (Eker, 2011; Kutlu and Koçar, 2017; Turk and Yildiz, 2019; Demir et al., 2020).

In Turkiye, the forest industry generates significant amounts of forest residues, such as branches, stumps, and tree tops during logging and timber processing operations (Eker, 2011; 2014; Çoban and Eker, 2014; Saracoglu, 2015). The management and disposal of forest residues is a critical issue for sustainable forest management, as these residues can cause soil degradation, forest fire hazards, and hinder natural regeneration (Marchi et al., 2018). However, the current status of timber residue and disposal machinery in Turkish forestry is not sufficient to meet this demand (Bilgen et al., 2015; Demirci et al., 2018).

The machinery, including chippers, grinders, slashers, and balers, have been used to collect, shred, and bale the agriculture and forest residues for easier transportation and utilization. However, the machines used for forestry activities, such as logging and thinning, is not suitable for the efficient and sustainable management of forestry residues. Due to the lack of clear regulations and incentives for the production and use of bioenergy from forest residues, it is difficult for the industry to attract investment and develop sustainable business models (Toksoy et al., 2020). Therefore, there is a need for increased investment in research and development of new and efficient forest waste/residue management and disposal machinery, as well as standardization and certification programs to ensure the safety and quality disposal machinery.

2. Recent Literature Related to Forest Residue Recovery in Turkiye

“Potential of forest biomass in Turkiye" conducted by Sarıkoç (2020) analyzed the potentials of forest biomass for energy production in Turkiye, considering forest residues and slash. The study identified the amount and quality of forest biomass in different regions of Turkiye and evaluated the feasibility of using forest biomass for energy production. In another study, “Energy production from forest residues in Turkiye", Saraçoğlu (2015) evaluated the utilization of forest residues for bioenergy production in Turkiye. Other similar studies analyzed the characteristics of forest residues, including slash, and evaluated the technical and economic feasibility of using forest residues for bioenergy production in Turkiye (Ateş et al. 2007; Eker, 2011; Eker et al., 2017).

The researchers also assessed the availability of logging residues, including slash, to meet the demand of industry for producing bioenergy in Turkiye (Alkan et al. 2014; Kurt, 2020). These studies evaluated the amount and characteristics of logging residues in different regions of Turkiye and analyzed the technical, political and economic feasibility of using logging residues for bioenergy production. Thus, logging residues and energy recovery potential in Turkish forestry sector was investigated by researchers regarding with the alternative use of logging residues in the Turkish forestry sector.

The main concept of logging residues in Turkiye is still subject to many challenges, thus, it is essential to analyze the current status and opportunities related to the sustainable management of logging residues, including slash, in Turkiye. The future may also evaluate the existing policies and regulations related to logging residues and analyze the potential of using logging residues for erosion and material production. For example, in previous studies conducted by Akay et al. (2007), Turk (2018) and Turk and Yildiz (2019), the effectiveness of wood chip and slash treatments in reducing soil compaction was evaluated during forest harvesting operations.

3. Forest Machinery in Turkiye

Forest harvesting by tractors is considered to be an effective method in Turkiye, especially in small-scale operations. Akay, (2005) conducted a study on the use of tractors in small-scale timber harvesting operations in Turkiye and reported that the use of tractors can significantly reduce the logging costs and improve the efficiency of the harvesting process. Similarly, Öztürk et al. (2019) and Çağlar, (2020) evaluated the productivity and costs of a tractor-based logging system in a Turkish forestry and found that it was cost-effective and could compete with other traditional logging methods.

In recent decades, the use of forest machinery has been increasing to improve the efficiency of forestry operations in Turkiye (Demir and Bilici, 2010). According to a study by Bilici and Akay (2021), the use of modern forest machinery has increased in recent years, and this has led to significant improvements in forest management practices. Hence, mechanized logging and transportation operations have been shown to reduce labor costs and increase productivity in Turkish forestry. In industrial forest stands, modern forestry machinery such as harvester, feller-buncher, and skidder have been used for activities such as tree felling, extraction, and skidding in Turkiye (Acar et al., 2018).

In particular, chippers and grinders have been used to convert slash into smaller, more manageable pieces that can be used for various purposes such as energy production, composting, and soil improvement. An example of a portable wood chipper operation from chipping of forest residues in Turkiye is given in Figure 1. However, it should be noted that the use of disposal machines is still relatively limited in forest operations in Turkiye due to factors such as high costs, limited availability, and lack of awareness among practitioners.

Figure 1. Landing site of a forest residue disposal operation (Erdoğan, 2021)

In general, tree-based cutting residues obtained from parks and gardens are grinded by some municipalities in Turkiye. Grinded cutting residues have been used for fertilizer purposes in parks and gardens (Figure 2). Thus, these small-scale operations also prevent environmental pollution and contribute to the ecological balance in urban areas.

Figure 2. Studies on the grinding of wood cutting residues with a gasoline-powered grinder (Karabaglar, 2021).

4. Recommendations and Conclusion

Considering literature review, there have been several studies conducted on the potential of forest waste/residue, slash, and disposal machinery in Turkiye. The studies show that there is a significant potential for using forest residue and slash for energy and material production in Turkiye. However, the current status of disposal machinery is not sufficient to meet the demand for efficient and sustainable forest residue management (Eksi and Karaosmanoglu, 2017; Kurt, 2020). The studies highlight the need for policy support and investment in research and development of disposal machinery. Thus, further efforts are required in Turkiye to enhance the utilization and conversion of forest biomass into energy.

Various biomass conversion technologies can be generated through the utilization of different comminution machines, particularly when segregating stem wood from forest residues piles during logging or thinning activities (Waste to Wisdom, 2018). The utilization of forest biomass requires the testing of various methods in production and calculations. However, ensuring the inclusion of relevant variables, such as small, medium, and large wood pieces, in the calculations will enhance the effectiveness of the sampling method and overall success of the study (Kizha and Han, 2015).

Furthermore, it is important to enhance the ecosystem services derived from forests. By considering the economic, social and ecological aspects, a long-term sustainable utilization of forest biomass can be achieved while maintaining a balance of benefits (Nicholls et al., 2022). Harvesting woody biomass for different purposes, such as biochar production, can contribute to the overall health and sustainability of forests by reducing stress and vulnerability to insects, pathogens, and wildfires. Briefly, utilization of forest residues aims to maximize the ecological value of forest residues by transforming them into goods that promote sustainability and contribute to environmental conservation. For instance, biochar serves as both a valuable energy source derived from wood and a product that enhances soil fertility, resembling the effects of wildfire regimes (Scott and Page-Dumroese, 2016).

Due to several factors, the current state of equipment for managing forest residues in Turkiye is inadequate to meet the demand for effective and long-term forest residue management. Firstly, the existing technology is largely incapable of handling the volume and diversity of residue generated by modern forestry practices. The machinery in use is not equipped to efficiently process and utilize the wide range of residue materials. Secondly, limited financial resources and a lack of official support have resulted in a shortage of investments in modern and innovative machinery. The forestry sector faces challenges in acquiring advanced equipment that can enhance residue management practices.

Moreover, the scarcity of skilled workers in the forestry industry contributes to the underutilization and suboptimal operation of available machinery. The lack of qualified personnel proficient in operating and maintaining specialized equipment hinders the effective utilization of forest residue management strategies.

Lastly, the absence of a comprehensive and coordinated national policy for forest residue management decelerates the situation. The lack of a comprehensive strategy and guidelines on managing forest residues at the national level further impedes progress in this area.

Until significant improvements are made and scientific approaches are implemented in these key areas, Turkiye may continue to face challenges in effectively managing forest residues. It is crucial to address the limitations in equipment, increase investments, develop skilled workforce, marketing and establish a comprehensive policy framework to enhance forest residue management practices.

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