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Energy Infrastructure-Based Fire Risk: The Impact of Electric Transmission Lines on Forest Ecosystems and Social Policy with Prevention Strategies

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Abstract – In recent years, the rising frequency and intensity of forest fires globally have been driven not only by climate change-related natural factors but also by human-induced infrastructure vulnerabilities. Among the most at-risk areas are forested and rural regions intersected by power transmission lines. In arid, windy, and low-humidity environments, technical issues such as poor maintenance, equipment failure, inadequate insulation, or collapsed poles can generate sparks that ignite fires. These fires endanger ecosystems and also disrupt livelihoods, essential services, and social well-being in affected communities. This study investigates the relationship between energy transmission infrastructure and forest fires from an integrated perspective encompassing engineering, environmental safety, and social policy. Numerous international incidents, particularly in countries like the USA and Australia, highlight faulty power infrastructure as a critical cause of large-scale fires. Accordingly, such fires should be regarded not only as environmental disasters but also as technological and social crises. To mitigate these risks, the study proposes several technical strategies: routine and autonomous inspection of power lines via unmanned aerial vehicles (UAVs); early fault detection using thermal imaging technologies at cables and connectors; creation of protective zones of at least 10 meters along power line routes; and deployment of AI-powered spark detection sensors and smart grids equipped with fast-acting circuit breakers. The study also explores the broader impacts of power outages during wildfires. These outages can severely hinder emergency response capabilities, disrupt communication systems and healthcare services, and destabilize supply chains for food and basic needs. Such disruptions tend to exacerbate social inequalities, particularly in rural areas marked by high vulnerability. In conclusion, forest fires represent a complex interplay between environmental risks, infrastructure safety, and social resilience. Managing these risks effectively requires a multidisciplinary approach that incorporates disaster risk reduction, rural development, and climate justice-oriented social policies. Key priorities should include continuous monitoring of energy infrastructure, legal enforcement of maintenance responsibilities, and targeted infrastructure investment in socially disadvantaged regions to ensure sustainable disaster preparedness and response.

Keywords – Forest Fires, Electricity Transmission Lines, Energy Infrastructure, Social Policy, Disaster Management.