Analysis and Countermeasures for Common Issues in the Acceptance of Biological Firebreak Forest Belts in Huiyang Forest Area

Huaying QIU, Ren CHEN, Boyang CHEN, Yan TAN
Guangdong Tamping Ecological Environment Co., Ltd., Huizhou 516100, China

Abstract Based on a comprehensive inspection and acceptance evaluation of the biological firebreak forest belt construction project in Huiyang Forest Area, this study systematically analyzes common issues encountered during the acceptance process. The findings indicate that primary challenges include low seedling survival rates, incongruities between tree species selection and site conditions, structural deficiencies within the forest belts, insufficient post-planting maintenance and management, and irregularities in documentation. To address these problems, the study proposes targeted countermeasures, such as optimizing tree species selection, enhancing supervision of planting techniques, and establishing a long-term ecological compensation-based management model. These recommendations are framed within the contexts of scientific planning, precise implementation, strengthened oversight, and innovative management mechanisms. The research aims to improve the construction quality and long-term fire prevention efficacy of biological firebreak forest belts, thereby providing practical guidance for analogous firebreak forest belt construction and acceptance initiatives in forest areas of South China.

Key words Huiyang Forest Area, Biological firebreak forest belt, Acceptance inspection, Issue, Countermeasure

1 Introduction

The establishment of biological firebreak forest belts is a strategically significant and systematic initiative in forest fire prevention. This approach serves as a fundamental measure to prevent and control the occurrence and propagation of forest fires, thereby mitigating the risk of major and catastrophic fire events. Moreover, it is a critical indicator of modernization in forest fire prevention practices. Biological firebreak forest belts serve as effective barrier networks for controlling large-scale forest fires and constitute fundamental preventive and control projects within the development of forest fire prevention systems. To guarantee the efficacy of these engineering constructions, it is typically necessary to organize and conduct comprehensive verification and acceptance procedures. Acceptance involves not only the verification of the project's quantitative aspects but also a comprehensive evaluation of construction quality, ecological functions, and the long-term fire prevention effectiveness of the forest belt. The acceptance process revealed several common issues that require urgent attention, particularly in areas such as tree species selection, planting techniques, and management and protection measures.

2 Overview and methods of acceptance work

The acceptance process for the biological firebreak forest belt in Huiyang District strictly complies with pertinent regulations, standards, and requirements, including the *Measures for the Inspection and Acceptance of Afforestation in Guangdong Province (Interim)* and the 2018 *Key Forestry Ecological Project Inspection Implementation Rules in Guangdong Province*. This process employs a method that integrates on-site investigation, sampling measurement, and internal investigation. Field investigations primarily concentrate on indicators including afforestation density, average tree height, ground diameter, and seedling survival rate within newly established forest belts. Additionally, they assess the quality of maintenance in tending forest belts, the growth status of forestry, and other relevant conditions. Internal investigations focus on reviewing the completeness and standardization of documentation, such as operation designs, construction contracts, quarantine certificates for seedlings, and completion drawings. Based on the comprehensive results of both field and internal investigations, a systematic assessment is conducted to evaluate the quantity, quality, and fire prevention effectiveness of forest belt construction.

3 Major issues identified during acceptance inspection

3.1 Low seedling survival rates hinder the early establishment of forest belts The acceptance inspection revealed that the average survival rate of certain newly established forest belts was approximately 85%, which did not fully satisfy the design requirement of exceeding 90%. Plots exhibiting low survival rates are predominantly located on ridges and steep slopes characterized by poor soil quality and limited water retention capacity. Several factors contribute to this phenomenon. First, the quality of certain seedlings fails to meet established standards, with some exhibiting weakness or disease. Second, inadequate planting techniques are employed, including insufficient soil compaction, limited root expansion, and the absence of water-retaining agents. Third, post-planting care is often neglected, particularly the lack of timely drought-resistant irrigation and other nurturing interventions during the hot and dry summer months, resulting in seedling mortality due to water stress. The low survival rate may cause early gaps and forest openings within the forest belt, thereby disrupting its

Received: August 18, 2025 Accepted: October 10, 2025
Huaying QIU, bachelor's degree, forestry technician, research fields: implementation of forestry engineering projects.

structural continuity.

3.2 Tree species configuration is not highly compatible with the site conditions The acceptance inspection revealed that, in certain plots, a uniform approach was applied to the selection of tree species, with insufficient adherence to the principle of "matching tree species to appropriate site conditions". Planting fertile and moisture-demanding species on dry and infertile soils results in suboptimal growth. Currently, the construction predominantly emphasizes monoculture forests, thereby underutilizing the multifaceted benefits of mixed forests, including enhanced fire prevention, fire resistance, and ecological functions.

3.3 There are structural gaps in the forest belt Structural gaps represent a significant issue identified during the acceptance process. These gaps primarily arise from three factors: first, interruptions in the forest belt caused by engineering constructions (*e.g.*, patrol roads and cable lines) or human activities (*e.g.*, sporadic land reclamation); second, gaps resulting from the mortality of local trees due to geological disasters, pests, and diseases; and third, the lack of fully coherent planning and design during the afforestation process, which failed to avoid extreme areas such as exposed rock formations. These structural gaps constitute vulnerabilities within the forest fire barrier network, thereby compromising its overall fire prevention effectiveness.

3.4 There is an absence of adequate post-planting care and management practices, resulting in insufficient long-term sustainability The phenomenon of "prioritizing afforestation over subsequent management" persists. In newly afforested areas, essential nurturing practices—such as drought resistance measures, fertilization, and replanting—have not been consistently implemented. In forest belts designated for tending, activities predominantly involve shrub cutting and weeding, while more intensive management techniques, including singling, pruning, and thinning—critical for the healthy development of trees—are inadequately applied. Furthermore, the responsibility for long-term management and maintenance following project completion remains unclear, funding channels are insufficiently established, and a sustainable guarantee mechanism is lacking.

3.5 Management of project archives and materials is not standardized During the internal investigation, several deficiencies were identified in the archive management of certain projects, including inconsistencies between construction records and operational designs, incomplete change management procedures, absence of quarantine certificates for seedlings, and discrepancies between as-built drawings and the actual construction. The lack of standardization in archival materials adversely impacts the efficiency of acceptance processes and poses challenges for future auditing, traceability, and project evaluation.

4 Optimization countermeasures and suggestions

4.1 Adhering to scientific planning and optimizing the selection and configuration of tree species During the project planning and design phase, a comprehensive investigation and classification of site conditions should be conducted. Based on this analysis, the selection of tree species should be optimized to move away from a monoculture model. In addition to the primary planted species, such as *Schima superba* and *Michelia macclurei*, native fire-resistant species with greater adaptability, such as *Pinus massoniana*, *Castanopsis hystrix*, and *Castanopsis fissa*, should be selected in accordance with local environmental conditions. The promotion of mixed coniferous and broad-leaved, evergreen and deciduous forest belt models is strongly recommended. For example, configurations such as *S. superba* combined with *C. hystrix*, and *M. macclurei* combined with fir, can be employed to establish multi-layered forest stands that exhibit enhanced fire resistance and greater ecosystem stability. This approach structurally improves the fire resistance capacity of forest belts.

4.2 Implementing precise construction and strengthening the supervision of the entire process of planting techniques The quality of seedlings must be rigorously controlled at the source, with strict implementation of "two certificates and one signature" system for seedlings. Throughout the construction process, supervision of planting techniques should be intensified to provide technical guidance and on-site oversight for each stage, including land preparation, fertilization, planting, and watering, ensuring that all technical measures are properly executed. Particular emphasis should be placed on standardizing planting practices to guarantee that the root system is well spread and the soil cover is firm. Additionally, the application of water-retaining agents, root growth powders, and other drought-resistant and life-preserving technologies should be promoted. For plots that do not meet the required survival rate standards, a detailed record should be established, and post-cultivation care and supplementary planting must be completed within a specified timeframe.

4.3 Enhancing supervision and inspection and ensuring that engineering construction is conducted in a standardized and orderly manner A comprehensive supervision mechanism encompassing the entire process from design and construction to acceptance should be established and continuously improved. It is imperative to enhance daily inspections and periodic evaluations, focusing on project progress and critical quality control points. Concurrently, the management of project archives should be standardized, mandating construction units to systematically and uniformly organize all technical documents and records. This ensures that all archives and materials related to design, construction, and acceptance are complete, accurate, and properly finalized, thereby facilitating traceable project management.

4.4 Innovating the management and maintenance mechanism and implementing a long-term ecological compensation management and maintenance model A long-term ecological compensation management and protection model has been established, which integrates the ongoing management and protection of biological firebreak forest belts within the framework of ecological public welfare forest compensation or specialized forest tending subsidies. Through the formalization of management and protection contracts, responsibilities can be explicitly assigned to local administrative units such as towns and villages, forest rangers, or professional cooperatives, thereby operationalizing the principle of "those who manage and protect shall benefit". This approach not only enforces accountability for management and protection but also incentivizes engagement at the grassroots level and among forest farmers. Consequently, it facilitates a balanced approach between construction and management, ensuring that biological firebreak forest belts consistently deliver their ecological and fire prevention functions over the long term.

5 Conclusions

The establishment of biological firebreak forest belts is a vital ecological security barrier project. Through the evaluation process, the system identifies significant issues related to seedling survival, tree species composition, structural integrity, subsequent management and maintenance, as well as archives management. Addressing these challenges necessitates systematic optimization across three dimensions: concepts, technologies, and mechanisms. Only through rigorous scientific planning, precise construction, stringent supervision, and the innovative establishment of a long-term management and protection mechanism can each kilometer of forest belt be transformed into a robust and reliable green firewall. Ultimately, this approach will facilitate the development of an efficient, stable, and sustainable forest fire prevention system, thereby providing a solid foundation for safeguarding regional forest resources and the accomplishments of ecological construction.

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4 Conclusions and discussion

During the experiment, the investigation of certain indicators was slightly delayed due to weather conditions, which had some impact on the test results. However, the effect of different herbicide concentration combinations on various weed species was not significantly affected. The variations in herbicide concentrations across treatments did not result in significant differences in the emergence rates or safety indicators of corn and soybeans compared to the control. This suggests that the herbicide concentrations used in each treatment were relatively safe for the growth of both crops. As the concentration of herbicides increased in each treatment, the effect of weed control in soybean fields exhibited an upward trend. Treatments D and E demonstrated the most effective results. Specifically, 40 d after application, the plant control effect and fresh weight control effect were 97.25% and 98.03% for treatment D, and 97.25% and 98.24% for treatment E, respectively. No significant difference was observed between treatments D and E. Furthermore, the yields of soybeans and corn treated with herbicides were higher than those of the control group. This difference can be attributed to the absence of herbicide application in the control group, where weeds competed with the crops for essential resources such as nutrients, light, and water, thereby creating an environment that was detrimental to crop growth[4]. In this study, as the concentration of herbicides increased, the highest converted yields of soybeans and corn were observed in treatments D and E. Specifically, the soybean yields in treatments D and E were 84.15 and 84.12 kg/667 m^2, respectively. The corn yields for treatments D and E were 1 071.79 and 1 073.35 kg/667 m^2, respectively, with no significant differences observed between the two treatments. Considering the overall input and output, this region can identify treatment D as the optimal combination of herbicide concentrations for weed management in the soybean and corn strip intercropping system. This treatment significantly improves weed control effect and crop yield in the soybean and corn strip intercropping system, effectively addressing the prevalent issue of "incomplete weed suppression" in soybean and corn strip intercropping production in Zhongwei City.

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