

GREEN LOGISTICS FOR COOPERATIVE NETWORK EXCHANGE OF AGRICULTURAL PRODUCTS: A COMPARATIVE ANALYSIS OF RAIL AND ROAD IN THAILAND'S NORTH-SOUTH SUPPLY CHAIN

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ABSTRACT

Thailand's inter-cooperative agricultural distribution system relies almost entirely on uncontrolled-temperature road haulage and rarely plans for return-trip (backhaul) loads, driving logistics cost as high as 10-20% of farm-gate price, exposing perishable produce to avoidable spoilage, and generating disproportionate greenhouse-gas emissions relative to volume moved. This study develops and evaluates a rail-based cooperative network for exchanging agricultural products between northern and southern Thailand, combining in-depth interviews with five agricultural cooperatives, transport operators, and State Railway of Thailand officials with a comparative Life Cycle Cost (LCC), Life Cycle Assessment (LCA), and lead-time evaluation of road versus rail (20-ft and 40-ft refrigerated container) transport between Chiang Mai and Surat Thani. Although road haulage has the lowest cost per trip (19,000-24,000 baht), its limited payload (about 3,000 kg) yields a high unit cost of 6.33-8.00 baht/kg and a carbon footprint of 440.82-583.88 tCO₂e per tonne. Rail transport reduces unit cost to as low as 1.13-1.19 baht/kg under theoretical maximum payload, or 1.48-1.55 baht/kg once practical stacking constraints are accounted for, and cuts emissions intensity by 4.5 to more than tenfold depending on container size and packing configuration, while temperature-controlled containers virtually eliminate spoilage. Rail lead time, however, is longer and less predictable (about 25 planned hours, with possible delay to 87-98 hours) than road (about 20-22 hours, highly predictable). We conclude that rail-based cooperative networks are economically and environmentally superior for large-volume, long-distance produce exchange under both optimistic and physically conservative loading assumptions, provided that backhaul utilization, stackable packaging, and information-sharing platforms are institutionalized, and translate these findings into public policy recommendations covering rail-freight incentives, cold-chain infrastructure investment, packaging standardization, and inter-agency coordination.

Keywords: Agricultural Cooperatives, Life Cycle Assessment, Life Cycle Costing, Rail Freight Logistics, Cold-Chain Transport, Public Policy

CITATION INFORMATION: Chitchaiman, P., Boonsothonsatit, G., & Khumboon, R. (2026). Green Logistics for Cooperative Network Exchange of Agricultural Products: A Comparative Analysis of Rail and Road in Thailand's North-South Supply Chain. *Procedia of Multidisciplinary Research*, 4(8), 10.

Data Availability Statement: The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

Conflicts of Interest: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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