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Forest Road Operations in the Tropics

With 57 Figures and 25 Tables

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Preface

Forest road operations include all the activities to plan, design, construct, and maintain the infrastructure needed to move forest products from the roadside to the mill or port destination. Poor road management can jeopardize the economics of the forestry enterprise and can impact water quality and wildlife habitat.

Sustainable forest management is concerned with management of the transportation infrastructure in such a way that efficient transportation is provided while controlling adverse environmental impacts.

Much of the direct impact of forest roads can be reduced through proper planning and control of road location, design, construction, and maintenance using principles, systems, and techniques common to temperate forests. However, many areas of the tropics pose unique operating conditions: prolonged wet periods, high-intensity precipitation, swamps, and lack of rock for suitable road surfacing.

The purpose of this book is to bring together information on road planning, location, design, construction, and maintenance to support environmentally acceptable operations in tropical forests. It highlights the challenges of road operations in the tropics, includes techniques that have been shown to be successful, and discusses newer technologies. It is intended as a reference book for the forest engineer and others interested in the planning and management of tropical forests. Numerical examples, where appropriate, are included to provide clarity for interpreting graphs, procedures, and formulas. The book is divided into 11 chapters which cover the various facets of road management from design objectives through practices to control environmental impacts.

Chapter 1 summarizes the issues surrounding road development, the purpose of forest roads, including concepts of the design vehicle, design objectives, an overview of environmental effects, and best management practices.

Chapter 2 covers road standards suitable for forest road operations in the tropics, including geometric design for heavy vehicle use and safety.

Chapter 3 discusses the economic basis for forest road construction and identifies the cost components in road construction and maintenance,

and procedures for identifying the road spacing and the most economical road standard.

Chapter 4 presents the elements of route selection from preliminary examination of documents, field reconnaissance, in-field road design, to staking the alignment on the ground, and construction staking.

Chapter 5 discusses the selection and use of road building materials in the tropics, including design of the road structure, location and improvement of road building materials, and opportunities for recycling of road aggregate. The importance of proper road structure design and the tradeoff between axle loading, vehicle tire pressure, and road surface thickness is examined.

Chapter 6 focuses on road construction techniques on gentle and steep terrain by tractor and excavator. The importance of adequate road drainage structures is emphasized, including design for high-intensity rainfall events. Simple retaining walls for special slope stability problems are discussed.

Chapter 7 focuses on special road structures for the tropics suitable for crossing swamps and wetspots. The design of buried corduroy and use of geotextiles is presented.

Chapter 8 addresses a range of stream crossing options from culverts to log stringer and portable bridges. Flow-estimating procedures are presented with examples. The advantages of various options are discussed. The elements of bridge location are presented. The importance of appropriate choice of log stringers for log plank decking and laterite decking is discussed.

Chapter 9 discusses elements of road maintenance needed to protect the road structure and permit safe and efficient road use. Elements of road maintenance include the importance of maintaining road drainage, protection of cut and fill slopes, dust abatement, erosion protection, safe sight distances, bridge condition monitoring, and economic determination of road surface maintenance frequency.

Chapter 10 provides an overview of road construction and maintenance equipment with consideration of special conditions in the tropics.

Chapter 11 summarizes relatively inexpensive actions that can contribute to environmental protection during the design, construction, and maintenance of forest roads if done in a consistent and disciplined manner.

The Appendix summarizes analog tools and digital tools available for road measurements in the tropics and their accuracies.

This book represents a compilation of available literature and the professional experiences of the authors. In particular we would like to recognize the long-term contributions of the Food and Agriculture Organization for promoting improved management of world forests, and their funding and documentation of many studies in tropical forest management and conservation.

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