



Fast Growing Plantation Development and Industrial Wood Demand in China's Guangxi Zhuang Autonomous Region

A Report Prepared
for
Guangxi Forestry Bureau
and
The World Bank

With Partial Funding from the
European Commission's Asia Pro Eco Programme

Christian Cossalter and Christopher Barr
Center for International Forestry Research (CIFOR)

Bogor, Indonesia
December 22, 2005

Fast Growing Plantation Development and Industrial Wood Demand in China's Guangxi Zhuang Autonomous Region

**A Report Prepared
for
Guangxi Forestry Bureau
and
The World Bank**

**With Partial Funding from the
European Commission's Asia Pro Eco Programme**

**Christian Cossalter and Christopher Barr
Center for International Forestry Research (CIFOR)**

**Bogor, Indonesia
December 22, 2005**

Cover design by Ahmad Yusuf
Layout by Rosita Go
Photographs by Christian Cossalter

Prepared by
Center for International Forestry Research (CIFOR)
Mailing address: P.O. Box 6596 JKPWB, Jakarta 10065, Indonesia
Office address: Jl.CIFOR, Situ Gede, Sindang Barang
Bogor Barat 16880, Indonesia
Tel:+62 (0251) 622622 *Fax:*+62 (0251) 622100
E-mail: cifor@cgiar.org
Website: <http://www.cifor.cgiar.org>

Table of Contents

Acknowledgements	i
Author Contacts	ii
Units and Abbreviations	iii
List of Tables	iv
List of Figures	vi
List of Maps	vii
Chapter 1: Introduction to the Study	1
Chapter 2: Overview of Guangxi's Existing Forest Resource Base	
2.1 Introduction	3
2.2 Overview of Guangxi forest inventory system	3
2.3 Data sources and definitions	4
2.4 Main land-use types	5
2.5 Forest resources distribution	6
2.6 Age class structure	8
2.7 Commercial forests	9
2.8 Annual Allowable Cut	9
2.9 2004 Plantations with fast-growing species	10
2.10 Potential lands for future plantations	10
Chapter 3: Overview of Guangxi's Wood Processing Sector	
3.1 Introduction	45
3.2 Structure of Guangxi's wood processing sector	45
3.2.1 Sawnwood	45
3.2.2 Wood panels	46
3.2.3 Pulp and paper	48
3.2.4 Wood chips	49
3.2.5 Geographic concentration	49
3.2.6 Ownership	50
3.3 Medium and high density fiberboard	51
3.3.1 Recent trends in China	51
3.3.2 Industry structure in Guangxi	52
3.3.3 Products and markets	53
3.3.4 Prices and cost structures	54
3.3.5 Wood consumption	56

3.4	Plywood and veneer	60
3.4.1	Recent trends in China	60
3.4.2	Industry structure in Guangxi	61
3.4.3	Products and markets	61
3.4.4	Prices and cost structures	62
3.4.5	Wood consumption	63
3.5	Particleboard	65
3.5.1	Recent trends in China	65
3.5.2	Industry structure in Guangxi	66
3.5.3	Products and markets	67
3.5.4	Prices and cost structures	67
3.5.5	Wood consumption	68
3.6	Wood-based pulp production	71
3.6.1	Recent trends in China	71
3.6.2	Industry structure in Guangxi	72
3.6.3	Wood consumption	72
3.6.4	Nanning Phoenix Pulp & Paper Co.	76
3.6.5	Guangxi Liujiang Paper Mill	76
3.6.6	Guangxi Rong County Wanli Paper Mill	77
3.7	Wood Chips	79
3.7.1	Recent trends in China	79
3.7.2	Industry structure in Guangxi	79
3.7.3	Prices and cost structures	80
3.7.4	Wood consumption	83

Chapter 4: Economic Competitiveness of Guangxi's Plantation Sector

4.1	Introduction	85
4.2	Conversion factors	86
4.3	Data sources	86
4.4	Costs associated with wood production	87
4.4.1	Land rental	87
4.4.2	Fixed assets and infrastructure	88
4.4.3	Plantation establishment and management	90
4.4.3.1	Labor-intensive, short-rotation plantations on hills	90
4.4.3.2	Semi-mechanized, short-rotation plantations on flat land	91
4.4.4	Wood harvest, extraction and loading	92
4.4.5	Transport	94
4.4.6	Taxes and fees at harvest	95
4.4.7	Overhead costs	96
4.5	Compounded cost analysis	96
4.5.1	Stumpage cost	96
4.5.2	Costs of delivered wood	100
4.6	Wood grades and prices	103

4.6.1	Reconstituted panel industry	103
4.6.2	Wood pulp industry	104
4.6.3	Plywood	105
4.6.4	Future pulpwood prices	105
4.7	Profitability and competitiveness	106

Chapter 5: Assessment of Guangxi's Medium-Term Wood Fiber Demand

5.1	Introduction	113
5.2	Wood panels	114
5.2.1	Projected growth in wood panel production	114
5.2.2	Factors driving capacity expansion	115
5.2.3	Challenges and potential limiting factors	118
5.2.4	Implications for wood fiber demand	120
5.2.4.1	Effective wood demand at current capacity levels	121
5.2.4.2	Wood panel scenario #1	121
5.2.4.3	Wood panel scenario #2	122
5.3	Wood-based pulp	
5.3.1	Projected growth in wood-based pulp production	123
5.3.1.1	Construction of a greenfield pulp and paper mill in Qinzhou Prefecture	123
5.3.1.2	Construction of a greenfield pulp and paper mill in Beihai Prefecture	123
5.3.1.3	Capacity expansion at Liujiang Paper Mill in Liuzhou Prefecture	124
5.3.1.4	Capacity expansion at Nanning Phoenix Papermaking Co. in Nanning Prefecture	124
5.3.1.5	Capacity expansion at Heda Papermaking Co. in Hezhou Prefecture	124
5.3.1.6	Capacity expansion and construction of an integrated pulp and paper mill in western Guangxi	125
5.3.2	Factors driving capacity expansion	125
5.3.3	Challenges and potential limiting factors	127
5.3.3.1	Competition for wood fiber	127
5.3.3.2	Developing effective company-community partnerships	128
5.3.3.3	Delivered wood cost	128
5.3.4	Implications for wood fiber demand	129
5.3.4.1	Effective wood demand at current capacity levels	129
5.3.4.2	Wood pulp scenario #1	130
5.3.4.3	Wood pulp scenario #2	130
5.3.4.4	Wood pulp scenario #3	131

Chapter 6: Guangxi's Current and Projected Wood Supply-Demand Balance to 2010

6.1	Introduction	141
6.2	Source and relevance of the data provided to the study	141
6.3	Trends in timber supply based on Guangxi Forestry Bureau data	143
6.4	Trends in green residue supply based on Guangxi Forestry Bureau data and 2010 supply forecast	145
6.5	CIFOR's 2010 supply forecast for timber and green residue	146
6.5.1	Method	146
6.5.2	Chinese fir, slash pine and Yunnan pine	147
6.5.3	Eucalypts	149
6.5.3	Masson pine, 'other softwoods' and 'other hardwoods'	151
6.5.5	Summary of CIFOR's 2010 wood supply forecast	153
6.6	Guangxi's current wood demand by prefecture	157
6.7	Projection of supply-demand balance to 2010	161
6.7.1	Wood supply-demand balance under Demand Scenario #1	161
6.7.2	Wood supply-demand balance under Demand Scenario #2	164
6.7.3	Wood supply-demand balance under Demand Scenario #3	166

Chapter 7: Assessment of Strengths, Weaknesses, Opportunities and Threats (SWOT) for Guangxi's Forestry Sector

7.1	Introduction	169
7.2	Strengths	169
7.3	Weaknesses	171
7.4	Opportunities	174
7.5	Threats	175

Sources Cited	179
----------------------	-----

Appendix A: Sensitivity of Stumpage Costs to Discount Rate (DR), Mean Annual Increment (M.A.I) and Increases in Land Rental Prices	181
---	-----

Appendix B: Wood Production Performances - Review of Seven Plantation Profiles	189
---	-----

Appendix C: Questionnaire for Tree Plantation Enterprises and Individual Tree Growers in Guangxi Province	199
--	-----

Appendix D:	Lists of Wood-based Enterprises in Guangxi Province by Industry, 2003-2004	209
Appendix E:	Estimated 2004 Wood Demand by Industry for Each of Guangxi's 14 Prefectures	221

Acknowledgements

This study has been funded by the World Bank and by the European Commission's Asia Pro Eco Programme. We would like to express our gratitude for the support that each of these institutions has provided. The contents of the report, however, are the sole responsibility of CIFOR and in no way should be taken to reflect the views of either the World Bank or the European Commission. We would particularly like to acknowledge our appreciation for the preparatory work and guidance provided by Liu Jin of the World Bank.

We would also like to express our sincere appreciation to the very substantial assistance and support provided by the Guangxi Provincial Forestry Bureau and the Guangxi Forestry Survey and Design Institute. We would especially like to thank Mr. Wang Zhigao, Deputy General Director of the Guangxi Forestry Bureau, for the guidance and support that he provided for this study, and for making his very capable staff available to provide assistance during our visits to Guangxi.

This report draws on the work of many partners and collaborators in Guangxi and elsewhere. A number of people have contributed with official data and documents, while others have provided valuable information and insights through interviews and consultancy services. We would like to express our gratitude to the following individuals (noted here in alphabetical order): Deng Xiang Zhen (Center for Chinese Agricultural Policy), He Dequan (consultant), He Sanzhong (Guangxi Forestry Bureau), Hoffman (interpreter), Huang Yong (Guangxi Forestry Survey & Design Institute), Huang Yong Ping (independent expert), Jiang Ying Hong (Guangxi Forestry Bureau), Jiang Xiu Kui (Guangxi Forestry Bureau), Josef Ernstberger (World Bank), Kari Tuomela (Stora Enso), Lei Fujuan (Guangxi Forestry Survey & Design Institute), Li Fu Fu (Guangxi Forestry Bureau), Li Ke Fu (Guangxi Forestry Bureau), Li Xiang Xing (Guangxi Development and Reform Commission), Marilyn Beach (consultant), Pan Wen Feng (Guangxi Development and Reform Commission), Peng Jin Zhao (Gaofeng Group), Risto Vuokko (Stora Enso), Sun Ding Qiang (Center for Chinese Agricultural Policy), Wan Ye Jing (Guangxi Forestry Bureau), Wang Li (consultant), Wei Qizhong (Guangxi Forestry Survey & Design Institute), Xiang Dong Yun (Guangxi Forestry Research Institute), Yang Chao Ren (Asia Pulp & Paper).

We would like also to express our personal thanks to He Sanzhong, who has been our focal point at the Guangxi Forestry Bureau, and to Qin Jian Ning, who has been our focal point at the Guangxi Forestry Survey & Design Institute. Both have helped us greatly by facilitating our visits to Guangxi, assisting with survey design and distribution, coordinating synthesis and management of data, and assisting with interpreter and translation services. Finally, we would like to gratefully acknowledge the administrative support provided by Rosita Go and Ambar Liano at CIFOR.

*Christian Cossalter and Christopher Barr
Bogor, 22 December 2005*

Author contacts

Christian Cossalter (C.Cossalter@cgiar.org) is a Senior Plantation Scientist with CIFOR's Environmental Services and Sustainable Use of Forests Program, based in Bogor, Indonesia.

Christopher Barr (C.Barr@cgiar.org) is a Senior Policy Scientist with CIFOR's Forests and Governance Program, based in Bogor, Indonesia.

Units and Abbreviations

A.A.C	Annual Allowable Cut
Adt	Air-dried tonne
APP	Asia Pulp & Paper
ASEAN	Association of South East Asian Nations
BDMT	Bone dry metric tonne (= 2,204.6 pounds)
BHKP	Bleached hardwood kraft pulp
BSKP	Bleached softwood kraft pulp
cm	centimeter
CTMP	Chemical thermo-mechanical pulp
DR	Discount Rate
F.F.	Forest Farms
FGHY	Fast-growing, high yielding (plantations)
G.F.B.	Guangxi Forestry Bureau
Ha	hectare
HDF	High density fiberboard
IRR	Internal rate of return
km	kilometer
M.A.I.	Mean Annual Increment
MDF	Medium density fiberboard
m ³	cubic meter
mu	0.15 hectare
RMB	Renminbi, Chinese currency (equivalent to Yuan)
S.F.A	State Forestry Administration of China
TMP	Thermo-mechanical pulp
tons	refers to metric tons unless indicated differently
UKP	Unbleached kraft pulp
yr	year

List of Tables

Table 2.1	Main land uses categories in Guangxi Province
Table 2.2	Main features of Guangxi's forest resource base
Table 2.3	Guangxi's averages by type of tenure for commercial and public use forests
Table 2.4	Distribution of forestry land by main types of land tenure
Table 2.5	Commercial forests: Total area and area breakdown for 5 age classes
Table 2.6	Forests for environmental services: Total area and breakdown for 5 age classes
Table 2.7	Commercial forests: Total volume with breakdown for 5 age classes
Table 2.8	Forests for environmental services: Total volume with breakdown for 5 age classes
Table 2.9	Annual Allowable Cut in 2001 and 2003
Table 2.10	Assessment of land areas potentially suitable and available for future plantations
Table 3.1	Sawnwood capacity by prefecture in Guangxi, 2005
Table 3.2	Structure of Guangxi's panel industry, 2003
Table 3.3	Geographic distribution of Guangxi's panel industry by provincial sub-region, 2003
Table 3.4	Wood chip capacity by prefecture in Guangxi, 2005
Table 3.5	Ownership of panel mills in Guangxi province, 2003
Table 3.6	Estimated volume of fiber required by Guangxi's MDF and HDF mills to produce 1,925,000 m ³ of panels
Table 3.7	Estimated volume of fiber required by Guangxi's plywood mills to produce 315,000 m ³ of panels, according to 2003 industry structure
Table 3.8	Estimated volume of fiber required by Guangxi's wood-based particleboard mills to produce 156,000 m ³ of panels
Table 3.9	Current capacity of wood pulp producers in Guangxi Province, 2005
Table 3.10	Effective wood demand from wood pulp mills with > 20,000 Adt/yr capacity, 2005
Table 3.11	Hardwood chip prices by species/destination country, 1995-2004 (US\$ per BDMT FOB)
Table 3.12	Derived fiber demand from Guangxi's wood chip mills, 2005
Table 3.A-	MDF, HDF, and wet-process fiberboard producers in Guangxi Province, 2003
Table 3.A-2	Plywood producers in Guangxi Province, 2003
Table 3.A-3	Particleboard producers in Guangxi Province, 2003
Table 3.A-4	Blockboard producers in Guangxi Province, 2003
Table 3.A-5	Partial list of pulp and paper companies in Guangxi Province, 2004
Table 3.A-6	Partial list of wood chip mills in Guangxi, by location and capacity, 2004
Table 4.1	Conversion from cubic meter per mu to cubic meter per hectare
Table 4.2	Average costs for infrastructure development in Guangxi plantation
Table 4.3	Range of variation of operational costs for a 6-year planted rotation in Guangxi
Table 4.4	Average operational costs for a 5-year coppice rotation in Guangxi

Table 4.5	Average operational costs for a 7-year planted rotation in Guangxi
Table 4.6	Average operational costs for a 6 -year coppice rotation in Guangxi
Table 4.7	Average operational costs for harvesting short rotation plantation in Guangxi
Table 4.8	Average operational costs for small-diameter wood extraction in Guangxi
Table 4.9	Taxes and fees for fast-growing, high yielding plantations in Guangxi
Table 4.10	Stumpage costs of first rotation
Table 4.11	Stumpage costs (compounded at 7% DR) of first and second rotations in hills
Table 4.12	Stumpage costs (compounded at 13% DR) of first and second rotations in hills
Table 4.13	Stumpage costs (compounded at 7% DR) of first and second rotations in flats
Table 4.14	Stumpage costs (compounded at 13% DR) of first and second rotations in flats
Table 4.15	Wood costs at point of delivery compounded at 7 % DR
Table 4.16	Wood costs at point of delivery compounded at 13 % DR
Table 4.17	Estimated internal rate of return for 7 plantation profiles
Table 4.18	China's imports of hardwood woodchips in 2004
Table 5.1	Planned structure of Guangxi's wood panel industry by 2010, as of 2003
Table 5.2	Estimated total investment cost for MDF mills according to type of press and production capacity (in RMB)
Table 5.3	Estimated wood panel capacity in Guangxi, as of end-2004
Table D-1:	MDF, HDF, and Wet-Process Fiberboard Producers in Guangxi Province, 2003
Table D-2:	Plywood Producers in Guangxi Province, 2003
Table D-3:	Particleboard Producers in Guangxi Province, 2003
Table D-4:	Blockboard Producers in Guangxi Province, 2003
Table D-5:	Partial List of Pulp and Paper Companies in Guangxi Province, 2004
Table D-6:	Partial List of Wood Chip Mills in Guangxi, by Location and Capacity, 2004
Table E-1:	Estimated Wood Demand by Industry for Beihai Prefecture, 2004
Table E-2:	Estimated Wood Demand by Industry for Guigang Prefecture, 2004
Table E-3:	Estimated Wood Demand by Industry for Hezhou Prefecture, 2004
Table E-4:	Estimated Wood Demand by Industry for Wuzhou Prefecture, 2004
Table E-5:	Estimated Wood Demand by Industry for Yulin Prefecture, 2004
Table E-6:	Estimated Wood Demand by Industry for Chongzuo Prefecture, 2004
Table E-7:	Estimated Wood Demand by Industry for Fangchenggang Prefecture, 2004
Table E-8:	Estimated Wood Demand by Industry for Nanning Prefecture, 2004
Table E-9:	Estimated Wood Demand by Industry for Qinzhou Prefecture, 2004
Table E-10:	Estimated Wood Demand by Industry for Guilin Prefecture, 2004
Table E-11:	Estimated Wood Demand by Industry for Laibin Prefecture, 2004
Table E-12:	Estimated Wood Demand by Industry for Liuzhou Prefecture, 2004
Table E-13:	Estimated Wood Demand by Industry for Baise Prefecture, 2004
Table E-14:	Estimated Wood Demand by Industry for Hechi Prefecture, 2004

List of Figures

- Figure 3.1 China's MDF production, imports, and capacity, 1994-2005
- Figure 3.2 Indicative direct costs per cubic meter of MDF and HDF
- Figure 3.3 China's plywood production and trade, 1990-2003e
- Figure 3.4 Indicative direct cost per cubic meter of irregular hardwood plywood (< 6 mm)
- Figure 3.5 China's particleboard production, imports, and capacity, 1994-2005e
- Figure 3.6 Indicative direct costs per cubic meter of particleboard
- Figure 3.7 China's wood chip exports by destination market, 1993-2005 (projected)
- Figure 4.1 Delivered wood cost structure (Costs compounded at 7% DR)
- Figure 4.2 Inverse correlation between stumpage costs and internal rates of return
- Figure 4.3 Costs involved in the production of one MBDT of chips with domestic wood
- Figure 4.4 Domestic hardwood woodchips costs compared to imports from Thailand
- Figure 4.5 Domestic hardwood woodchips costs compared to imports from Vietnam
- Figure 4.6 Domestic hardwood woodchips costs compared to imports from Australia
- Figure 4.7 Domestic hardwood woodchips costs compared to imports from Malaysia

List of Maps

Map 2.1	Coverage of farming land
Map 2.2	Coverage of land partially or totally unused
Map 2.3	Chinese fir (<i>Cunninghamii lanceolata</i>), area (in ha)
Map 2.4	Chinese fir (<i>Cunninghamii lanceolata</i>), standing volume (in m ³)
Map 2.5	Masson pine (<i>Pinus massoniana</i>), area (in ha)
Map 2.6	Masson pine (<i>Pinus massoniana</i>), standing volume (in m ³)
Map 2.7	Eucalypts, area (in ha)
Map 2.8	Eucalypts, standing volume (in m ³)
Map 2.9	Slash Pine, standing area (in ha)
Map 2.10	Slash Pine, standing volume (in m ³)
Map 2.11	P.yunnanensis, standing area(in ha)
Map 2.12	P.yunnanensis, standing volume (in m ³)
Map 2.13	Acacia, standing area (in ha)
Map 2.14	Acacia, standing volume (in m ³)
Map 2.15	Forest stands - Collective forests -
Map 2.16	Forest stands - State-owned forests -
Map 2.17	Commercial forests, standing area (in ha)
Map 2.18	Commercial forests, standing volume (in m ³)
Map 2.19	Forestry land under commercial management - Collective forests -
Map 2.20	Forestry land under commercial management - State-owned forests -
Map 2.21	2001 and 2003 Timber harvests
Map 2.22	2004 Plantations with fast-growing tree species: total area
Map 2.23	2004 Plantations with fast-growing tree species: plantation on wastelands
Map 2.24	2004 Plantations with fast-growing tree species: re-plantation after harvest
Map 2.25	2004 Plantations with fast-growing tree species: conversion of low-yield forests
Map 2.26	Forested and non-forested lands in provincial forest farms

Chapter 1: Introduction to the Study

This study assesses the current condition of the industrial wood production base and both current and projected wood demand levels in China's Guangxi Zhuang Autonomous Region. The analysis was commissioned by the World Bank as part of the appraisal process for a proposed Guangxi Integrated Forest Development and Conservation Project. The study builds upon research initiated by the Center for International Forestry Research (CIFOR) under a grant from the European Commission's Asia Pro Eco Programme.

The findings presented in this report are the product of cooperation between CIFOR and the Guangxi Provincial Forestry Bureau (G.F.B) and the Guangxi Forestry Survey and Design Institute. In November 2004, these institutions collaborated on the design of survey questionnaires which were distributed to a representative sample of plantation companies and wood processing industries within Guangxi. The Guangxi Forestry Bureau and the Forest Survey and Design Institute were responsible for disseminating the questionnaires, and for ensuring that they were completed and returned. They were also responsible for helping to secure government statistics, industry data, and secondary information on plantation development and wood processing industries in Guangxi, as well as facilitating meetings with key informants in Guangxi province and providing logistical support during the course of the study.

The study is organized into six analytical chapters, structured as follows:

Chapter 2 provides a concise analysis of Guangxi's existing forest resource base, summarizing available data on management category, species, age class, standing volumes, annual harvest levels, and geographic distribution.

Chapter 3 examines the structure of the wood processing sector in Guangxi as well as the current demand for wood within the province. This includes an analysis of the recent production trends for major grades of wood panels, wood-based pulp, and wood chips; and their implications for wood consumption by each industry segment. The analysis focuses largely on demand for small-diameter wood fiber, with relatively less attention given to larger diameter roundwood used for structural purposes.

Chapter 4 analyzes the commercial competitiveness of Guangxi's fast-growing plantations, particularly those developed to produce wood fiber as compared to imports of wood chips from other countries in the region. This includes information on species use; growth rates and productivity levels; site management practices; cost structures; institutional and management arrangements through which plantations are being developed.

Chapter 5 analyzes future demand for plantation wood from Guangxi by assessing likely market trends and by analyzing the wood supply strategies of leading forest industries in the region. Potential growth in wood fiber demand through 2010 is

assessed by examining various scenarios for capacity expansions in both wood panel industries and wood-based pulp production.

Chapter 6 assesses the volumes of commercial timber and green residue which could, theoretically, become available in 2010 in each of Guangxi's prefectures. It then provides a forecast of the projected wood demand by prefecture, based on projections of likely growth in capacity within each segment of the wood processing sector under various wood demand scenarios. These figures are then used to obtain preliminary estimates of both the current and future wood supply-demand balance within each prefecture, as well on a regional and provincial scale.

Chapter 7 contains an analysis of strengths, weaknesses, opportunities, and threats (SWOT) of the province's existing program for commercial plantation establishment and wood industry development. The SWOT analysis can be used as a platform for identifying risk factors and formulating recommendations that will need to be considered to ensure that forestry sector development in Guangxi is conducted in a manner that is both cost-competitive and socially and environmentally sustainable over the long-term.

Chapter 2: Overview of Guangxi's Existing Forest Resource Base

2.1 Introduction

This chapter analyses and summarizes official Forestry Bureau data about Guangxi forestry land and timber resources. It gives an overview of the forest inventory system in place in the province and summarizes available data on management category, species, geographic distribution, age class structure, standing volumes and annual harvest levels. It describes some of the main features of the recently launched Fast-Growing, High-Yielding Plantation Programme. In this chapter, we have also attempted to assess, at prefecture level, the area of land which could be made available for future plantations.

2.2 Overview of Guangxi forest inventory system

In China, Provincial Forestry Departments are implementing forest inventories often referred to as 'second level inventories'. The National Forest Inventory which is being coordinated by the State Forestry Administration provides 'first level' forest inventory data for the entire country. Provincial forest inventories are being organized for planning and management purposes. The data that they generate are being used to determine logging quota (annual allowable cut). For this purpose data are aggregated at county levels.

Like elsewhere in China, Guangxi forest resources fall under two land ownership categories: State-owned land and collectively-owned land. State-owned lands are being managed through a network of State-owned forest farms. These State-owned forest farms have different status depending on the hierarchical level of the government body which manages them (County, Prefecture, Province, Central Government Ministry or Agency). Currently Guangxi Province has 151 State-owned forest farms whose cumulated area and standing wood volume represent respectively 9% and 12% of the provincial totals. There are approximately 10,000 village collective forest farms and in the order of 20,000 family-run forest farms in Guangxi province.

Guangxi Forestry Bureau (G.F.B) has a Forest Monitoring Center within its Planning and Financial Division. The Forest Monitoring Center organizes/coordinates forest inventory activities and manages forest inventory data. G.F.B provides up to 30% of the direct costs of forest inventory operations while the remaining is supported by county governments.

Guangxi Survey & Design Institute designs the overall inventory technical package, including the forms which are being used to collect data during field surveys. It also trains field staff and processes inventory data.

Guangxi province implemented its first inventory in 1990. Since then this assessment has been repeated at regular time intervals: 5 years in State-owned forest farms and 10 years in areas under other types of land tenure.

State-owned forest farms update their data on forest resource on a yearly basis during the interval between two consecutive provincial surveys. However these intermediary yearly updates are not passed on at the upper level/not stored in a prefecture or provincial database. Still many county forestry bureaus lack the resource and capacity to maintain adequate forest resources database.

All data are collected through ground survey using a temporary sample plot system.

Second level forest inventories go systematically through all forest stands with an area above 0.1 hectares (1.5 mu). Stand boundaries are measured, geo-referenced and mapped - at the scale 1: 10,000 - on maps produced by the National Geophysical Information Center. Since 2000, the Forest Survey & Design Institute digitizes stand boundaries on scanned versions of maps produced by the National Geophysical Information Center. These maps have 5 or 10 m elevation contour lines, depending on locations. Digitizing stand boundaries is being done in 11 out of the 14 prefectures of Guangxi. In Hechi, Guilin and Liuzhou prefectures, the Central-South Institute of Forest Inventory managed by SFA is testing an alternative approach - using remote sensing technology (Landsat 7 images). The Forest Survey & Design Institute expects a complete switch to remote sensing technology by 2010, for the entire province.

The latest inventory of Guangxi forest resources was carried out in 2004. At the time this report was prepared the corresponding data were still being processed and therefore could not be made available.

2.3 Data sources and definitions

All data related to Guangxi forest resources which are reported in this chapter are the official Guangxi Forestry Bureau data of the 1999 provincial forest inventory. The data collection took place in 1999. Data were processed in 2000.

Data on Annual Allowable Cut for 2001 and 2003 were provided by Guangxi Forestry Bureau's Forest Monitoring Center

Forest stand is the forest land category where trees have canopy coverage over 20% (category called 'closed forest stand' in the maps shown at the end of this chapter). In China forest stands include stands of forest trees (both natural forests and plantations) as well as 'economic forest' (essentially tree orchards) and bamboo groves. In other words a forest stand can be a natural forest where conifers and broadleaved trees are mixed, a plantation made of a single tree species, a tree orchard or a bamboo grove.

Stands made of forest trees are present in both areas under commercial management and areas for environmental services. **Commercial forests** are forest stands (either natural or planted) located on forestry land under commercial management and consisting of forest trees (conifers and broadleaved). **Forests for environmental services** are forest stands (either natural or planted) located on forestry land for environmental services and consisting of forest trees (conifers and broadleaved).

The forest land category where trees have canopy coverage below 20% is called **Sparsely-stocked forest stand**.

The category called **‘Unstocked forest land’** includes areas which have been harvested and not yet replanted, areas where land preparation prior afforestation is being carried out, areas covered with young natural regeneration and areas which have been accidentally burnt.

We have called This section analyses the structure of a sub-set of forest stands: those made of forest trees (either natural or planted, single-species stands or mixed stands). ‘Economic forest’ and bamboo grove are not discussed here. Stands made of forest trees are present in both areas under commercial management and areas for environmental services.

2.4 Main land-use types

Table 2.1 gives an overview of the distribution among the main land types found in the 14 prefectures of Guangxi province. The provincial breakdown per main land type is as follows:

▪ Forestry land:	57.45%
▪ Farming land:	29.66%
▪ Degraded land:	6.96%
▪ Waste land:	0.91%
▪ Inland water:	1.85%
▪ Urban & other types of land:	3.17%

The central part of Guangxi has the highest density/coverage of farming land as shown in Map 2.1. On the other hand, Map 2.2 shows that Hechi prefecture, South-West of Liuzhou, North-East of Guilin, South of Baise, North of Chongzuo and North-East of Nanning have relatively higher density of totally and partially unused land, in comparison to the rest of the Province.

The land category called ‘partially or totally unused land’ was composed by pooling together the area of sparsely stocked forest stands, the shrub area, the waste land area and the degraded land area (mostly bare land). The coverage of ‘partially or totally unused land’ shown in Map 2.2 is expressed in percent of dry land area (total land area excluding areas of inland water)

2.5 Forest resources distribution

Table 2.2 summarizes the main features of Guangxi forest resources as reported in the 1999 Provincial Forest Inventory. Data are given for the 14 prefectures and a network of 15 State-owned forest farms under the direct authority of Guangxi Forestry Bureau.

Two different figures are given for the percentage of forest cover. These two figures are generated by two different calculation methods:

In both cases, the forest cover is expressed in percent of the total land area (dry land + inland water). G.F.B counts as forest cover the cumulated areas of forest stands and shrubs. We have used an approach more in line with the international standards by which only the area of forest stands is taken into account.

Difference in forest cover figures due to difference in method of calculation remains minimal for 3 prefectures with relatively abundant forest resources, namely Whuzhou, Yulin and Guigang as well as for Quinzhou and Beihai, two prefectures of the coastal region where plantation development has been particularly important during the last decade.

8 prefectures as well as the State-owned forest farms managed by G.F.B have a forest cover (forest stand cover only) above 40%. These are namely: Wuzhou, Hezhou, Guilin, Yulin and Liuzhou in the Eastern and North-East regions, Quinzhou and Fangchenggang on the coast, and Baise in the West.

Masson pine, Slash pine and Chinese fir are important elements of the overall forest cover in the Eastern and North-East regions (see Maps 2.3 to 2.6, 2.9 and 2.10). Chinese fir covers also important areas in the North and the West. *Pinus yunnanensis* is a common species in Baise prefecture (see Maps 2.11 and 2.12). Eucalyptus dominates the forest cover in the two coastal prefectures of Quinzhou and Fangchenggang (see Maps 2.7 and 2.8).

On the other hand, Beihai and Chongzuo prefectures have relatively low (below 25%) forest cover (forest stand cover only).

Guangxi's forestry land is divided up into two categories: forestry land for environmental services and forestry land under commercial management. Both types contain forest stands, sparsely-stocked forest stands, shrub land, land recently afforested, land occupied by nurseries and un-stocked forest land. There is approximately 35% more forestry land under commercial management than forestry land for environmental services

Maps 2.19 and 2.20 show that in all prefectures, except Fangchenggang and Chongzuo, at least 80% of the area of forestry land under commercial management is made of stands with canopy coverage over 20% (category called 'closed forest stand' in the map captions). Shrubs alone accounts for 21.2% of forestry land under

commercial management in Fangchenggang prefecture and 21% in Chongzuo prefecture

Guangxi's forestry land is to a very large extent on collectively-owned land. The mode of tenure remains the same, whatever the forest function - environmental services or commercial use - as shown in Table 2.3

Table 2.3: Guangxi's averages per type of forestry land and mode of tenure

	Forestry Land under Commercial Management	Forestry Land for Environmental Services
Collectively-owned land	90.96%	90.24%
State-owned land	8.47%	8.29%
Land with other types of ownership	0.57%	1.47%

Data source: 1999 Guangxi Forest Inventory

Table 2.4 gives further data, at prefecture level, on the distribution shown here above in Table 2.3

Maps 2.15 and 2.16 show the structure of forest stands under both collective and public tenure. In China forest stands include stands of forest trees (both natural forest and plantations) as well as economic forest (essentially tree orchards) and bamboo groves.

Forest stands under collective tenure: Map 2.15 shows a net dominance of coniferous forest types in nearly 3/4 of the provincial territory. Baise is the only prefectures where broadleaves dominate. Bamboo occupies a relatively larger share in the North - East: Guilin, Liuzhou and Hezhou prefectures.

State-owned forest stands: Coniferous forest remains important in most prefectures. Baise still shows a dominance of broadleaves. Broadleaves (plantations of eucalypts) dominate also the forest landscape in Fangchenggang and Beihai prefectures (see Map 2.16)

Tables 2.5 to 2.8 analyses the structure of a sub-set of forest stands: those made of forest trees (either natural or planted, single-species stands or mixed stands). Stands made of forest trees (forest-type stands) account for 70.8% of the forestry land under commercial management while they cover only 48.4% of the forestry land devoted to environmental services. This makes that Guangxi province has twice more area of natural forests and forest plantations under commercial management than for environmental services.

2.6 Age classes structure

This section analyses the structure of a sub-set of forest stands: those made of forest trees (either natural or planted, single-species stands or mixed stands). ‘Economic forest’ and bamboo grove are not discussed here. Stands made of forest trees are present in both areas under commercial management and areas for environmental services. For both types, the 1999 Provincial Forest Inventory gives the total areas and standing volumes as well as areas and standing volumes of five age-classes. The age-classes used here are those currently used in the Chinese forest statistics system, namely: Young, Middle age, Nearly mature, Mature and Over mature. Tables 2.5 to 2.8 give the provincial totals, the total figures at prefecture level and for the network of provincial forest farms.

Commercial forests: Forest resources are expanding both in area and volume in 10 prefectures as well as in the network of provincial forest farms. Behai, Hechi and Baise are the 3 prefectures where commercial forests have displayed the most spectacular expansion. Growth in commercial forest area and standing volume has also been very important in Qinzhou, Laibin and Liuzhou prefectures. Age-class distribution in Nanning, Yulin and Guigang prefectures should support a more moderate increase in timber demand during the 10 to 15 years to come. The long-term trend in Hezhou prefecture and in the network of provincial forest farms will also be an increase in timber outputs. In these two later cases, the plantations which have been established since 2001 under the FGHY should be able to maintain future production at current level and compensate for the gap in area and volume of the ‘Nearly-mature’ age-class of the 1999 forest inventory.

Similarly, the new plantations established in Chongzhuo , Fangchenggang and Wuzhou prefectures under the FGHY programme should allow to offset the temporary trend of stagnation or decline in production which could be predicted from the sole observation of the age-class structure of the 1999 provincial forest inventory.

Finally, commercial forests of Guilin prefecture should be able to sustain their current production still for a number of years and then reduce their outputs by at least half the current level at the time the ‘Young’ age-class of the 1999 provincial forest inventory will reach maturity.

Forests for environmental services: All prefectures have recently expanded their forests for environmental services in a spectacular way - both in area and volume -. This statement also applies to the network of provincial forest farms. However, provincial forest farms remain very much oriented towards commercial forestry with an area of commercial forest 2.8 times larger than the area of forests for environmental services, a ratio which is well above the provincial average of 2 for 1.

2.7 Commercial Forests

Maps 2.17 and 2.18 show that the East, South-East and Northern fringe of Guangxi's province have a higher coverage of commercial forests as well as larger volumes of commercial standing timber. Regions with higher rate of commercial forest cover approximately 60% of the provincial territory.

Behai and Yulin prefectures in the South - with the exception of Bobai and Rongxian counties - have relatively modest coverage of commercial forests. This is also the case for the Central-West region and particularly Laibin prefecture, the northern half of Nanning prefecture, the Southern half of Hechi prefecture, the southern half of Baise prefecture and the northern half of Chongzuo prefecture.

Provincial Forest Inventory data which were made available to the study do not distinguish between natural forest, slow-growing plantations and fast-growing plantations. However, they provide a breakdown for the main timber species as shown in Maps 2.3 to 2.14.

2.8 Annual Allowable Cut

Table 2.9 and Map 2.21 shows the official cumulated volumes of timber harvested in collective and state-owned forests for years 2001 and 2003. Trends are of three types:

- i. A relatively substantial increase in timber outputs in Nanning, Yulin, Guigang, and Beihai prefectures. This is in line with the analysis of the age-classes structure of commercial forests made in section 2.6. We believe that most of the additional timber outputs has consisted in outputs of fast growing plantations since these four prefectures have been among the most active ones in the development of the Fast-Growing, High-Yielding plantations programme;
- ii. A relatively slight increase in timber outputs in Hezhou, Baise, Hechi, Qinzhou, Chongzuo and Fangchenggang prefectures. Trends observed in the first four prefectures match our analysis of age-classes structure of commercial forests (see section 2.6). Timber output has continued to increase in Chongzuo and Fangchenggang prefectures in spite of a slightly defavorable age-class structure of their commercial forests. This might be an indication that harvests in forests for environmental services have contributed to fulfill the expected gap.
- iii. A relatively slight decrease in timber outputs in Liuzhou, Laibin, Wuzhou and Guilin prefectures, as well as in the provincial forest farms. In the case of Wuzhou, Guilin and the provincial forest farms such a trend was predictable (see section 2.6).

2.9 2004 Plantations with fast-growing species

A total of 134, 545 ha was established in 2004. Three broad categories of sites - characterized by their previous land use - were utilized. The following gives the average area contribution of each type of site to the 2004 FGHY Plantation Programme.

- Waste land: 72,2%
- Mature plantations planned for clear-cutting: 22.1%
- Low-yield forests: 5.7%

Map 2.22 shows that Guilin prefecture and - to a lesser extent - Hezhou and Wuzhou prefectures have only contributed very marginally to this programme. The same holds true in the Western part of the province for the North-West and South-West regions of Baise prefecture and the Western part of Chongzuo prefecture. Nanning, Guigang, Laibin, Yulin, Qinzhou, Beihai and Fangchenggang are the prefectures which have been the most involved in this programme.

Maps 2.23, 2.24 and 2.25 show that replanting fast-growing species after harvest of existing plantations has occurred mainly in the central and southern part of the province while conversion of low-yield forests has been relatively more frequent in Guigang, the Eastern part of Chongzuo, Beihai and Fangchenggang.

2.10 Potential lands for future plantations

An attempt was made to assess the amount of land which could be made available for future plantations by pooling together the following four categories of land:

- Sparsely-stocked forest land
- Forest land covered with shrubs
- Unstocked forest land
- Waste land outside the forestry estate

Table 2.10 gives the separate amount for each type of land as well as the total amount for the province.

Table 2.10: An assessment of land areas potentially suitable and available for future plantations (in hectares)

		Total	Collective tenure	State tenure	Other tenures
Forest land	Sparsely-stocked	60,696	56,910	3,758	288
	Shrub	2,689,645	2,569,850	108,358	11,037
	Unstocked	694,412	559,531	129,526	5,355
Non-Forest Land	Waste land	214,450	194,775	15,897	3,778
Total		3,659,203	3,381,066	257,539	20,458

Data source: 1999 Guangxi Forest Inventory

Map 2.2 shows the distribution - among prefectures - of the land which is 'partially or totally unused'. This category was composed by pooling together the area of sparsely stocked forest stands, the shrub area, the waste land area and the degraded land area (mostly bare land). Coverage of 'partially or totally unused land' is expressed in percent of dry land area (total land area excluding areas of inland water).

Maps 2.19 and 2.20 show the distribution - at prefecture level - of: (i) sparsely-stocked forest lands; (ii) forest lands covered with shrubs; and (iii) un-stocked forest lands.

Map 2.26 shows the relative share of natural forests, plantations and land with no tree cover in the 15 forest farms under Guangxi Forestry Bureau. This analysis shows that in the Southern region, out of a total number of nine provincial forest farms, the seven holding the largest areas of land have still substantial shares of land not covered with trees. The same hold true for three other farms located in Laibin, Liuzhou and Baise prefectures.

Table 2.1: Main land uses categories in Guangxi Province (in hectares)

	Total Land Area (including areas of inland water)	Area of inland water	Total Land Area (excluding areas of inland water)	Total Forestry Land	Waste Land	Total Farming Land	Degraded land (mostly bare land)	Other types of land
Total for the Province	23,645,849	436,988	23,208,861	13,584,824	214,451	7,012,219	1,646,594	750,773
Nan Ning	2,110,783	60,441	2,050,342	879,259	2,718	934,197	136,886	97,282
Chong Zuo	1,631,391	23,325	1,608,066	764,089	8,862	626,541	151,883	56,692
Bei Hai	357,102	15,386	341,717	95,837	1,055	174,639	32,125	38,061
Qin Zhou	1,021,132	29,751	991,380	564,987	709	358,003	15,108	52,573
Fang Cheng Gang	600,445	23,920	576,525	371,253	1,203	157,676	28,424	17,969
Yu Lin	1,232,593	26,773	1,205,820	729,288	3,085	388,799	5,155	79,493
Gui Gang	1,061,072	38,221	1,022,851	468,116	7,852	459,107	22,786	64,990
Liu Zhou	1,810,670	33,450	1,777,220	1,147,290	12,841	510,973	60,291	45,825
Lai Bin	1,302,169	27,923	1,274,246	591,075	18,789	524,325	100,776	39,281
Wu Zhou	1,251,238	23,573	1,227,664	942,700	7,875	253,879	837	22,373
He Zhou	1,150,313	20,507	1,129,806	816,745	1,483	240,259	43,829	27,489
Gui Lin	2,739,532	38,350	2,701,182	1,885,430	75,867	549,931	135,319	54,634
He Chi	3,350,146	37,329	3,312,817	1,850,505	41,965	805,196	571,443	43,709
Bai Se	3,545,701	33,516	3,512,185	2,117,614	25,749	971,545	335,713	61,565

Data source: 1999 Guangxi Forest Inventory

Table 2.2: Main features of Guangxi Forest Resources (in hectares)

	Total Land Area (including areas of inland water)	Total Forestry Land	Forest Stands				Sparsely Stocked Forest Stands	Shrub Land	Unstocked Forest Land	Nursery Land	% of forest cover (includes shrub cover)	% of forest cover (forest stand only)
			Total Forest Stands	Coniferous + Broadleaves + mixed	Economic Forest	Bamboo Grove						
Total for the Province	23,645,849	13,584,824	10,138,968	8,326,449	1,557,395	255,124	60,957	2,689,245	694,412	1,242	54.25%	42.88%
Nan Ning	2,110,783	879,259	612,883	503,186	95,162	14,535	5,489	195,788	65,014	86	38.31%	29.04%
Chong Zuo	1,631,391	764,089	373,314	306,483	64,191	2,639	6,653	346,404	37,671	48	44.12%	22.88%
Bei Hai	357,102	95,837	78,802	68,427	8,765	1,610	690	3,638	12,549	159	23.09%	22.07%
Qin Zhou	1,021,132	564,987	484,401	365,194	112,798	6,410	3,736	17,722	59,009	119	49.17%	47.44%
Fang Cheng Gang	600,445	371,253	274,825	207,879	65,873	1,074	2,827	75,147	18,442	13	58.29%	45.77%
Yu Lin	1,232,593	729,288	641,799	477,632	150,279	13,888	3,412	38,679	45,301	96	55.21%	52.07%
Gui Gang	1,061,072	468,116	403,079	338,282	58,726	6,071	1,879	39,438	23,713	7	41.70%	37.99%
Liu Zhou	1,810,670	1,147,290	910,474	738,151	135,961	36,361	6,763	180,699	49,154	200	60.26%	50.28%
Lai Bin	1,302,169	591,075	397,974	339,061	48,562	10,352	4,282	157,781	30,995	43	42.68%	30.56%
Wu Zhou	1,251,238	942,700	863,230	743,784	106,699	12,747	4,300	35,530	39,599	41	71.83%	68.99%
He Zhou	1,150,313	816,745	666,183	573,238	74,639	18,306	1,679	94,813	54,045	25	66.16%	57.91%
Gui Lin	2,739,532	1,885,430	1,567,315	1,321,146	154,564	91,606	6,145	293,635	18,234	101	67.93%	57.21%
He Chi	3,350,146	1,850,505	1,021,026	874,406	137,976	8,645	7,206	796,223	26,028	22	54.24%	30.48%
Bai Se	3,545,701	2,117,614	1,582,950	1,237,572	318,511	26,868	4,491	370,803	159,300	69	55.10%	44.64%
Forest Farms under Provincial F.B.	481,562	360,635	260,712	232,009	24,689	4,015	1,405	42,945	55,358	214	63.06%	54.14%

Data source: 1999 Guangxi Forest Inventory

Table 2.4: Distribution of forestry land by main types of land tenure (in hectares)

	Forestry Land under Commercial Management (1)				Forestry Land for Environmental services (1)			
	Total	Collective	State-owned	Others	Total	Collective	State-owned	Others
Total for the province	7,806,684	7,100,810	661,555	44,319	5,778,140	5,214,357	479,057	84,726
Nanning	545,534	514,695	26,640	4,199	333,725	313,920	12,789	7,016
Chongzuo	377,259	337,502	37,003	2,754	386,831	368,946	16,036	1,849
Beihai	62,375	56,555	3,895	1,925	33,462	28,098	2,487	2,877
Qinzhou	393,503	374,386	19,117	0	171,485	167,142	4,336	7
Fangchenggang	239,288	213,396	24,319	1,572	131,966	84,465	42,429	5,071
Yulin	477,828	460,213	13,526	4,090	251,460	230,282	19,052	2,126
Guigang	310,610	294,293	15,849	468	157,506	142,568	13,652	1,286
Liuzhou	722,165	681,872	35,329	4,963	425,126	393,017	28,723	3,386
Laibin	258,162	223,954	32,436	1,773	332,913	300,768	29,626	2,519
Wuzhou	617,688	604,422	13,041	225	325,012	318,878	6,053	82
Hezhou	481,351	454,100	26,329	922	335,394	297,508	28,568	9,318
Guilin	1,023,041	975,868	45,500	1,674	862,389	764,076	67,823	30,490
Hechi	863,887	796,282	66,938	668	986,618	960,086	16,064	10,468
Baise	1,194,368	1,103,840	72,898	17,630	923,246	842,447	72,848	7,951
Guangxi Forest Farms	239,625	9,433	228,734	1,458	121,010	2,157	118,573	280

Data source: 1999 Guangxi Forest Inventory

1/ Includes: Forest Stands, Sparsely-Stocked Forest Stands, Shrub Land, Land Recently Afforested, Land Occupied by Nurseries and Un-Stocked Forest Land.

Table 2.5: Commercial forests: Total area and area breakdown for 5 age classes (in hectares)

	Total Area	Young	Middle-age	Near-mature	Mature	Over-mature
Total Guangxi	5,529,410	1,881,073	1,595,671	1,026,711	896,096	129,859
Nan Ning	368,438	113,594	130,417	68,323	51,016	5,088
Chong Zuo	217,838	85,356	47,900	20,466	59,043	5,073
Bei Hai	49,736	35,033	9,907	3,992	701	103
Qin Zou	269,908	99,324	84,723	48,988	34,360	2,513
Fang Cheng Gang	136,876	37,249	27,981	30,959	37,482	3,205
Yu Lin	317,940	97,219	99,068	61,381	54,677	5,594
Gui Gang	242,046	75,665	79,137	42,490	41,235	3,520
Liu Zhou	536,511	192,596	185,687	94,471	55,107	8,651
Lai Bin	186,875	71,648	64,288	33,212	14,016	3,711
Wu Zhou	500,353	132,237	99,780	102,450	148,690	17,196
He Zhou	341,086	86,426	95,504	62,061	69,192	27,903
Gui Lin	782,473	115,368	207,954	231,946	209,423	17,781
He Chi	674,320	317,506	208,333	103,927	37,937	6,616
Bai Se	734,626	356,964	215,571	99,221	55,821	7,050
State Forest Farms	170,387	64,887	39,422	22,825	27,397	15,856

Table 2.6: 'Forests for environmental services: Total area and breakdown for 5 age classes (in hectares)

	Total Area	Young	Middle-age	Near-mature	Mature	Over-mature
Total Guangxi	2,797,039	1,665,826	890,167	138,789	62,453	39,804
Nan Ning	134,748	89,955	38,627	5,359	771	36
Chong Zuo	88,645	57,362	24,058	6,210	952	64
Bei Hai	18,692	15,944	2,163	532	38	16
Qin Zhou	95,286	62,266	27,115	5,047	766	92
Fang Cheng Gang	71,003	31,397	37,302	1,784	515	6
Yu Lin	159,693	97,131	52,028	8,212	2,139	184
Gui Gang	96,236	62,078	28,543	4,004	1,489	122
Liu Zhou	201,641	121,655	53,135	17,331	6,323	3,197
Lai Bin	152,185	84,495	42,874	10,412	13,660	745
Wu Zhou	243,431	150,813	76,634	11,478	4,153	353
He Zhou	232,152	127,539	80,804	12,576	10,364	869
Gui Lin	538,673	219,789	247,083	32,915	9,922	28,965
He Chi	200,087	141,384	50,934	6,300	1,415	54
Bai Se	502,946	368,604	110,478	12,981	6,157	4,725
State Forest Farm	61,623	35,415	18,392	3,648	3,791	378

Data source for above 2 Tables: 1999 Guangxi Forest Inventory

Table 2.7: Commercial forests: Total volume with breakdown for 5 age classes (in m3)

	Total Volume incl. trees outside forest	Young	Middle-age	Near- mature	Mature	Over- mature
Total Guangxi	212,201,524	32,113,992	61,385,739	48,902,233	56,746,585	12,343,339
Nan Ning	12,268,187	1,160,280	4,293,517	3,267,571	3,007,837	502,075
Chong Zuo	10,792,750	1,265,305	2,276,281	1,321,569	5,279,986	559,705
Bei Hai	1,000,097	431,219	395,782	135,041	30,424	4,879
Qin Zhou	8,040,790	1,289,705	2,626,265	2,042,700	1,875,517	175,029
Fang Cheng Gang	5,530,416	378,367	878,518	1,412,828	2,489,617	339,250
Yu Lin	11,372,648	1,639,383	3,466,342	2,802,793	2,990,605	447,489
Gui Gang	9,342,378	1,311,414	3,253,037	2,028,271	2,377,084	363,740
Liu Zhou	18,860,601	2,561,910	6,302,839	4,797,129	4,187,337	941,170
Lai Bin	6,572,799	1,038,706	2,289,032	1,678,874	1,176,231	350,500
Wu Zhou	19,899,416	2,358,557	2,866,478	4,219,784	8,682,164	1,637,256
He Zhou	16,273,766	1,068,889	3,818,909	3,705,084	5,320,240	2,344,148
Gui Lin	28,209,551	1,931,465	7,212,105	9,065,588	9,073,209	880,964
He Chi	20,725,868	4,756,987	7,361,837	4,473,572	2,916,793	1,122,998
Bai Se	32,202,549	9,120,549	11,705,998	6,175,690	4,517,274	628,681
State Forest Farms	11,109,708	1,801,256	2,638,799	1,775,739	2,822,267	2,045,455

Table 2.8: Forests for environmental services: Total volume with breakdown for 5 age classes (in m3)

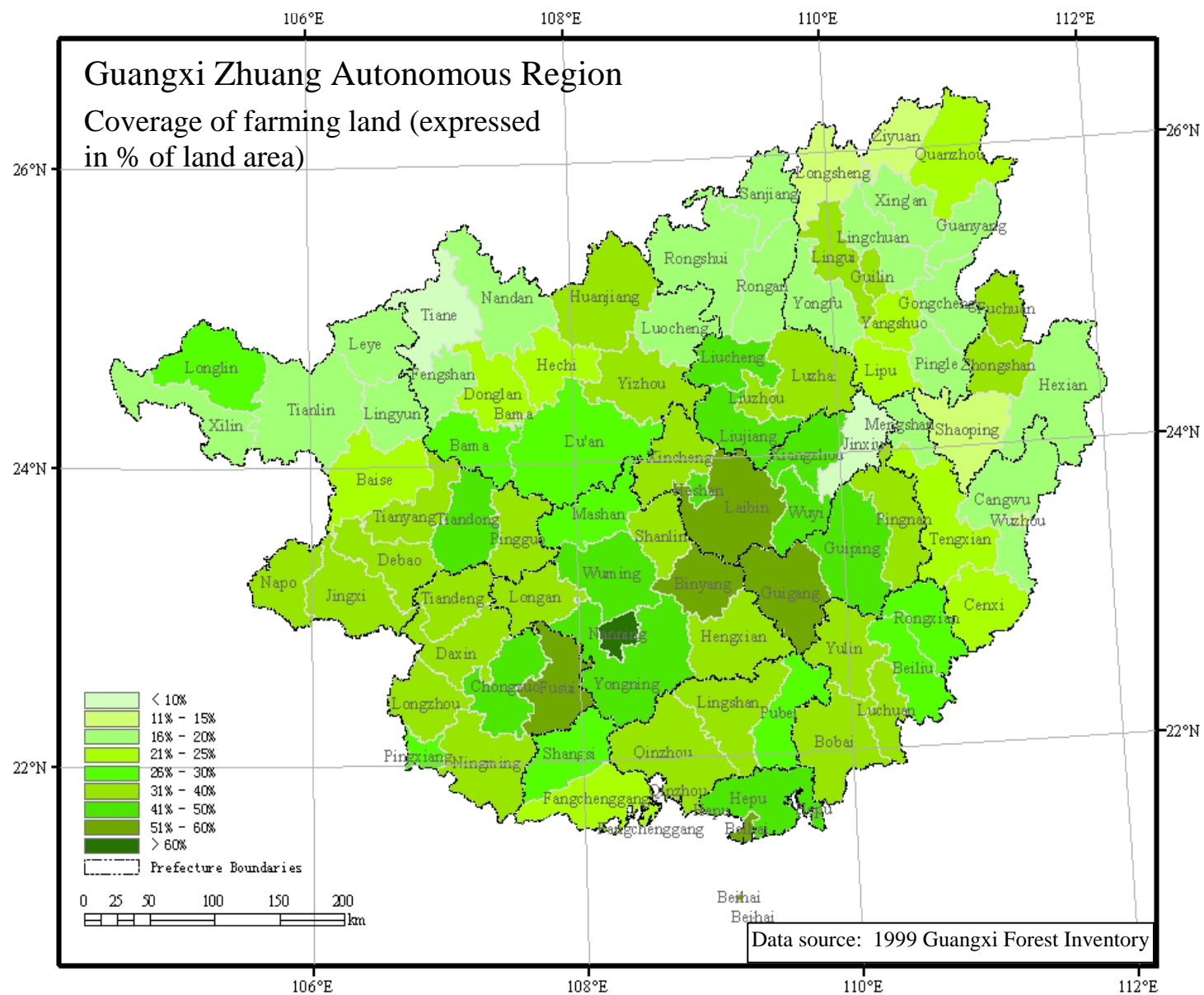
	Total Volume incl. trees outside forest	Young	Middle-age	Near- mature	Mature	Over- mature
Total Guangxi	107,905,374	42,576,238	45,827,586	9,868,156	5,032,137	4,331,024
Nan Ning	4,312,541	1,927,384	1,904,713	417,676	45,431	2,135
Chong Zuo	3,656,781	1,491,599	1,471,536	546,003	92,309	4,833
Bei Hai	380,195	267,270	91,429	18,353	2,081	10
Qin Zhou	2,643,959	1,206,239	1,128,247	250,670	44,576	4,743
Fang Cheng Gang	3,309,878	1,033,840	2,105,609	129,536	38,790	196
Yu Lin	5,816,745	2,500,316	2,655,225	481,620	150,504	17,042
Gui Gang	3,685,488	1,769,383	1,545,627	249,056	103,339	10,538
Liu Zhou	9,309,806	3,372,963	3,126,169	1,850,488	625,211	316,582
Lai Bin	5,949,197	1,617,613	2,288,792	701,068	1,269,160	57,747
Wu Zhou	7,265,838	2,842,331	3,325,294	712,863	332,845	19,164
He Zhou	10,577,582	3,494,452	5,010,928	1,016,119	862,301	185,704
Gui Lin	22,190,759	6,588,366	10,855,110	1,586,938	461,377	2,661,369
He Chi	4,884,072	2,163,366	2,001,256	533,737	173,022	2,652
Bai Se	20,554,782	11,105,140	6,965,954	1,055,833	426,813	981,406
State Forest Farm	3,367,751	1,195,976	1,351,697	318,196	404,378	66,903

Table 2.9: Annual Allowable Cut in 2001 and 2003 (in m3)

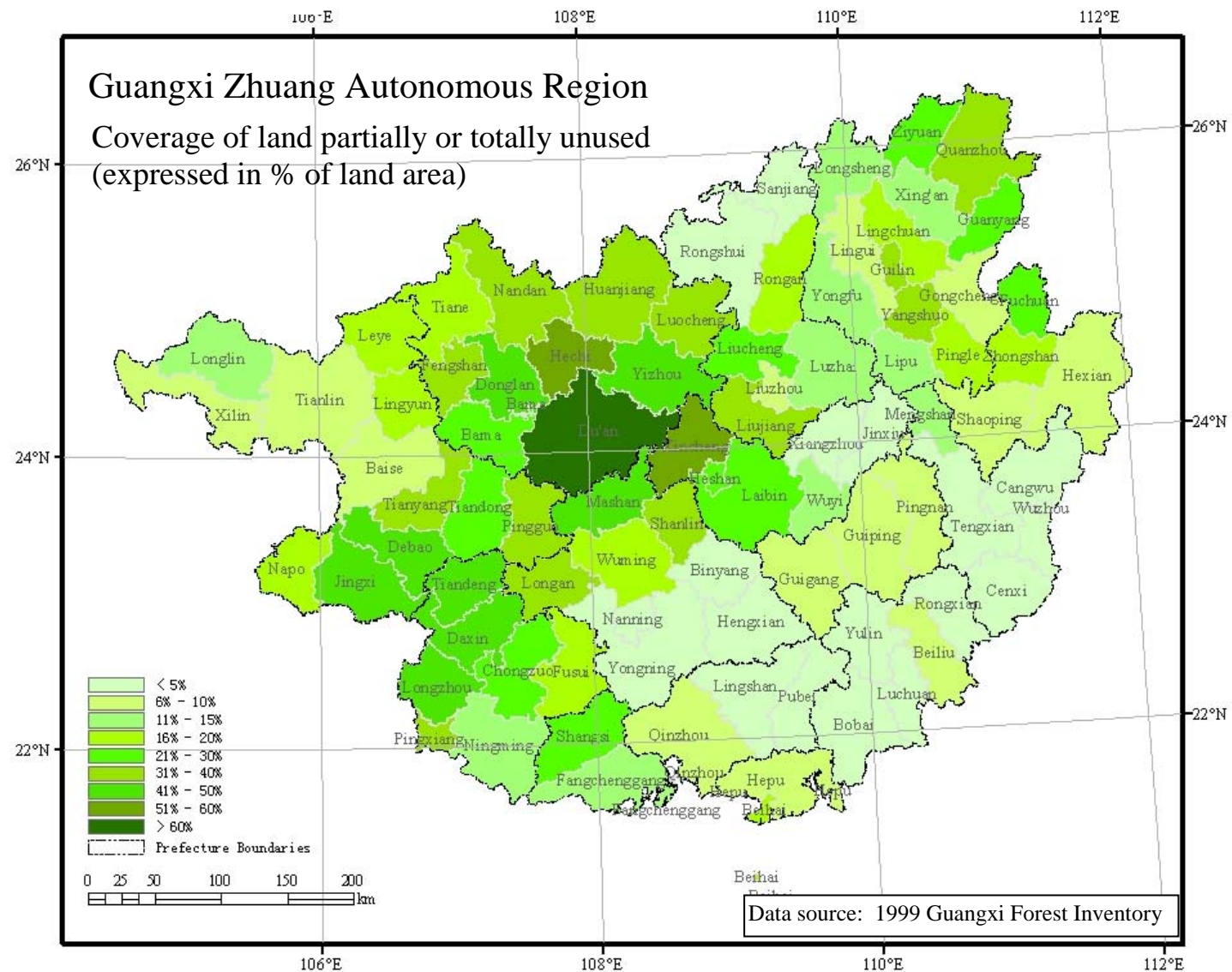
	2001 Timber Harvest Total Volume (in m3)	2003 Timber Harvest				
		Total Volume (in m3)	Collective land	F.F.under Prefecture & County	F. F under Guangxi F.B.	F. F. under other Gov. agencies
TOTAL for Guangxi	4,207,376	4,513,078	59.86%	22.25%	16.93%	0.97%
Nan Ning	168,957	272,699	78.27%	21.73%	0.00%	0.00%
Chong Zuo	141,703	152,684	56.14%	43.86%	0.00%	0.00%
Liu Zhou	392,677	378,249	71.70%	28.30%	0.00%	0.00%
Lai Bin	204,987	181,721	46.15%	53.85%	0.00%	0.00%
Gui Lin	420,902	412,168	81.95%	18.05%	0.00%	0.00%
Wu Zhou	414,633	397,520	90.99%	9.01%	0.00%	0.00%
He Zhou	291,313	306,851	82.95%	17.05%	0.00%	0.00%
Yu Lin	122,852	195,016	77.69%	22.12%	0.00%	0.20%
Gui Gang	100,247	158,918	75.44%	24.56%	0.00%	0.00%
Bai Se	432,164	491,740	74.10%	25.90%	0.00%	0.00%
He Chi	468,197	506,219	58.47%	41.53%	0.00%	0.00%
Be Hai	44,164	82,981	53.33%	46.67%	0.00%	0.00%
Qin Zhou	70,663	85,347	68.51%	31.49%	0.00%	0.00%
Fang Cheng Gang	66,957	83,637	70.16%	29.84%	0.00%	0.00%
Forest Farms under Guangxi F.B.	801,636	763,976	0.00%	0.00%	100.00%	0.00%
State-owned F.F. under other agencies	65,324	43,352	0.00%	0.00%	0.00%	100.00%

Data source: Guangxi Forestry Bureau's Forest Monitoring Center

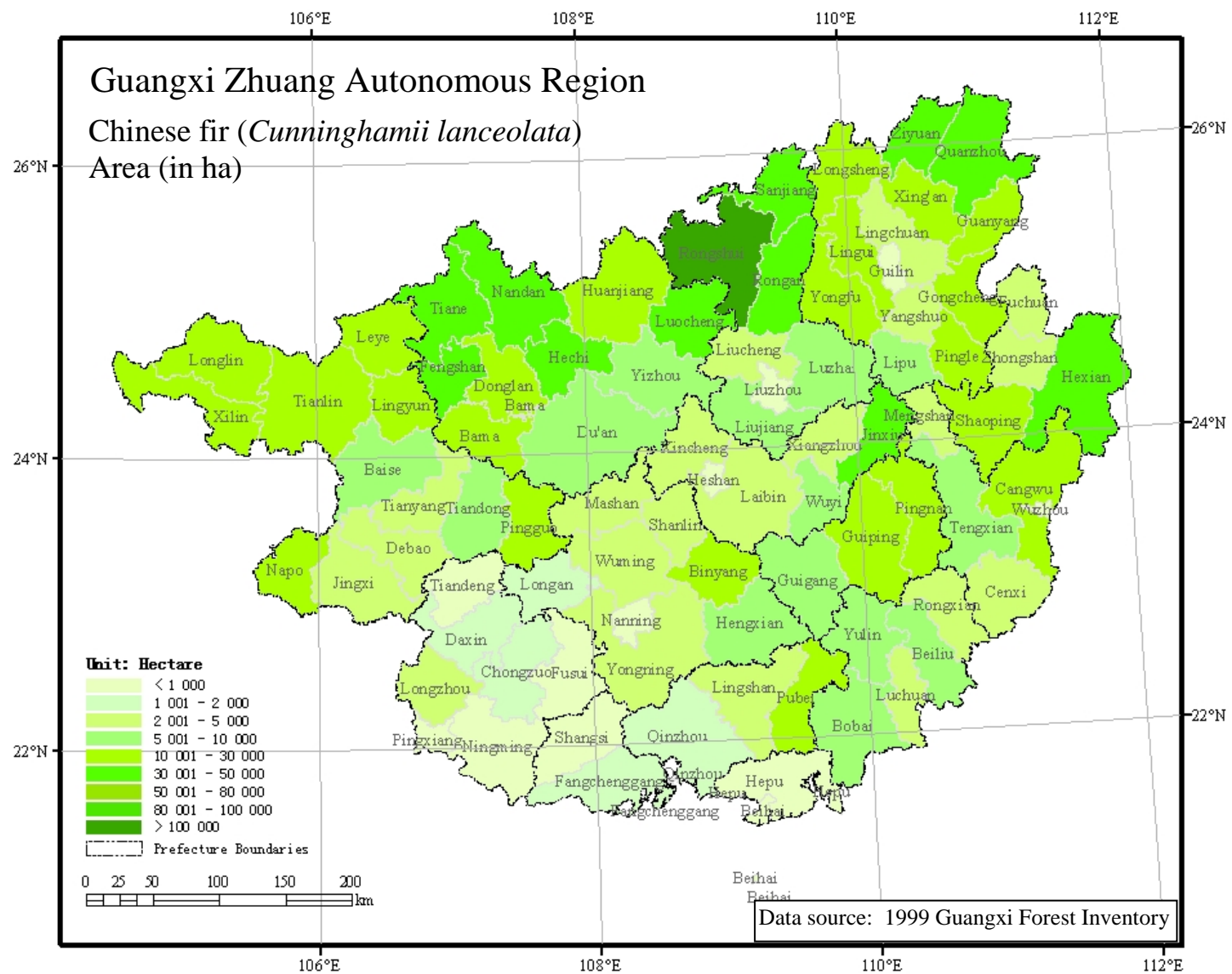
Map 2.1



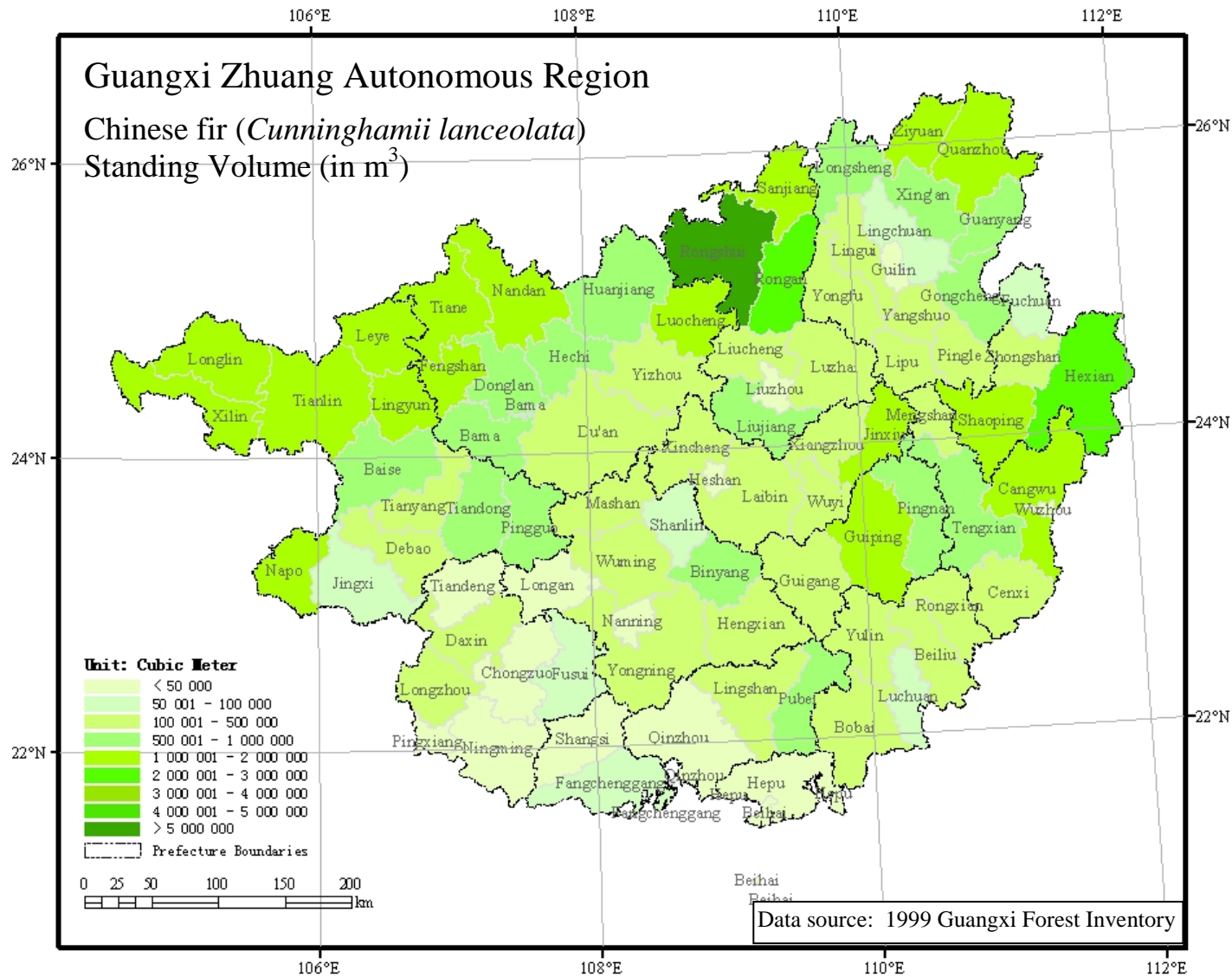
Map 2.2



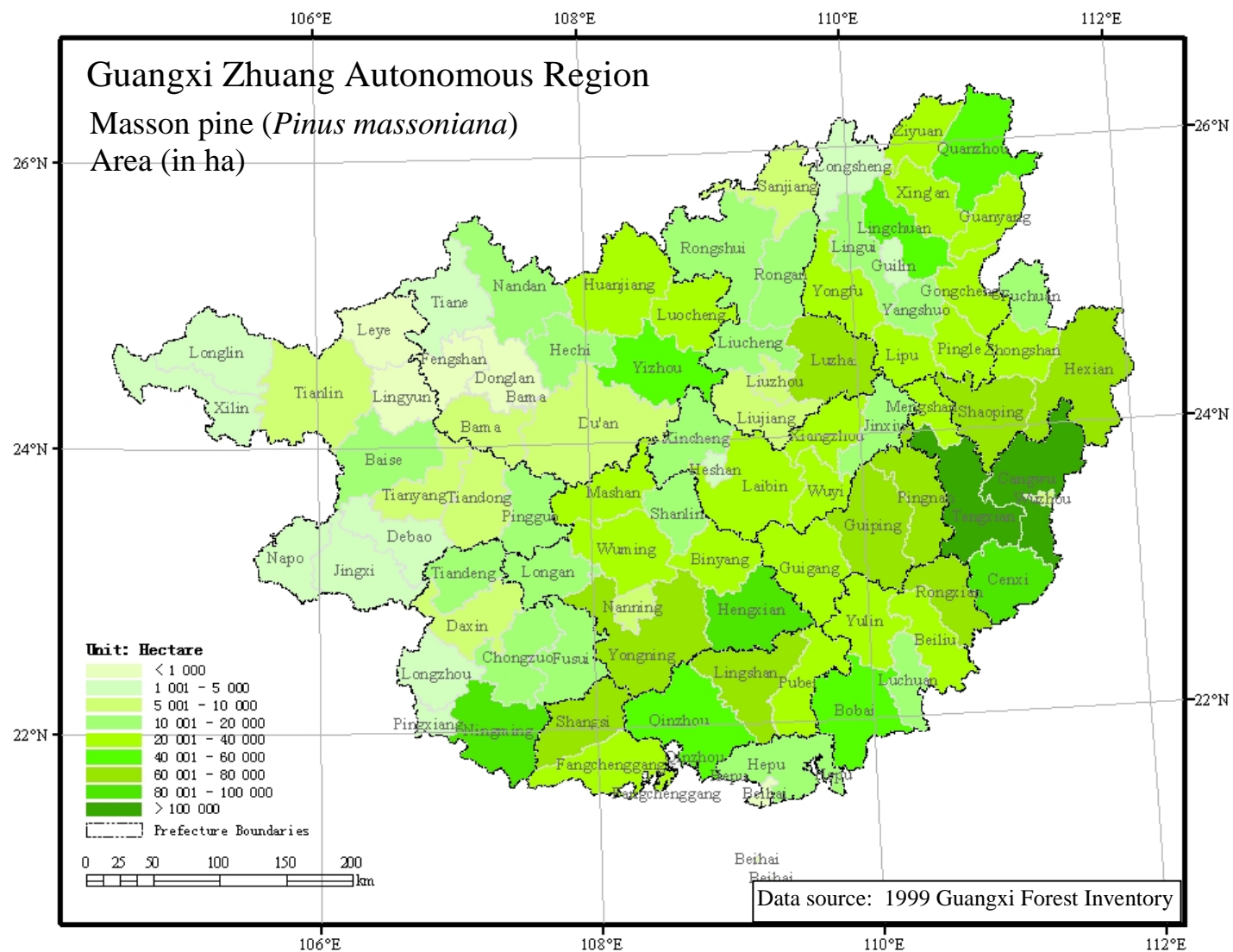
Map 2.3



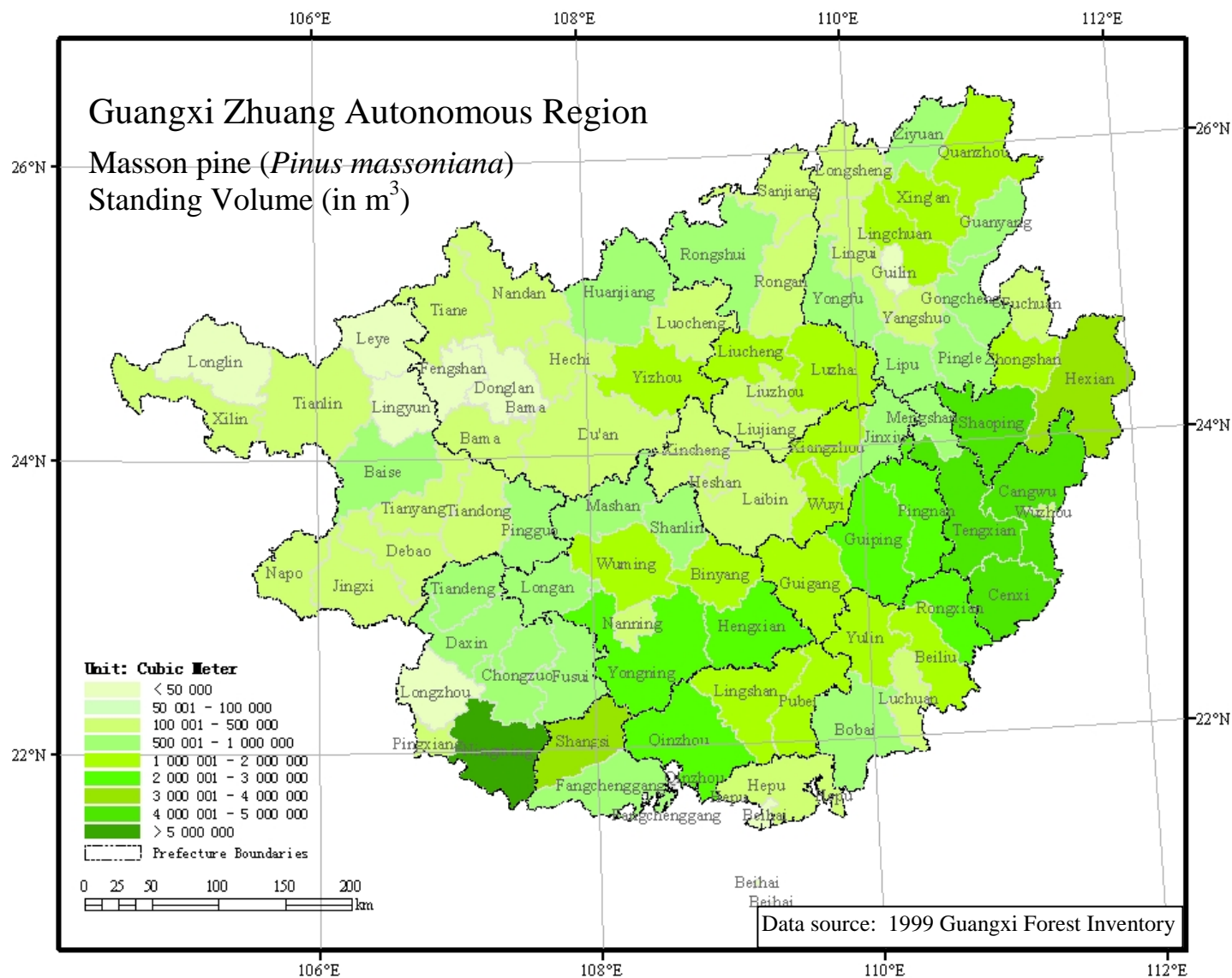
Map 2.4



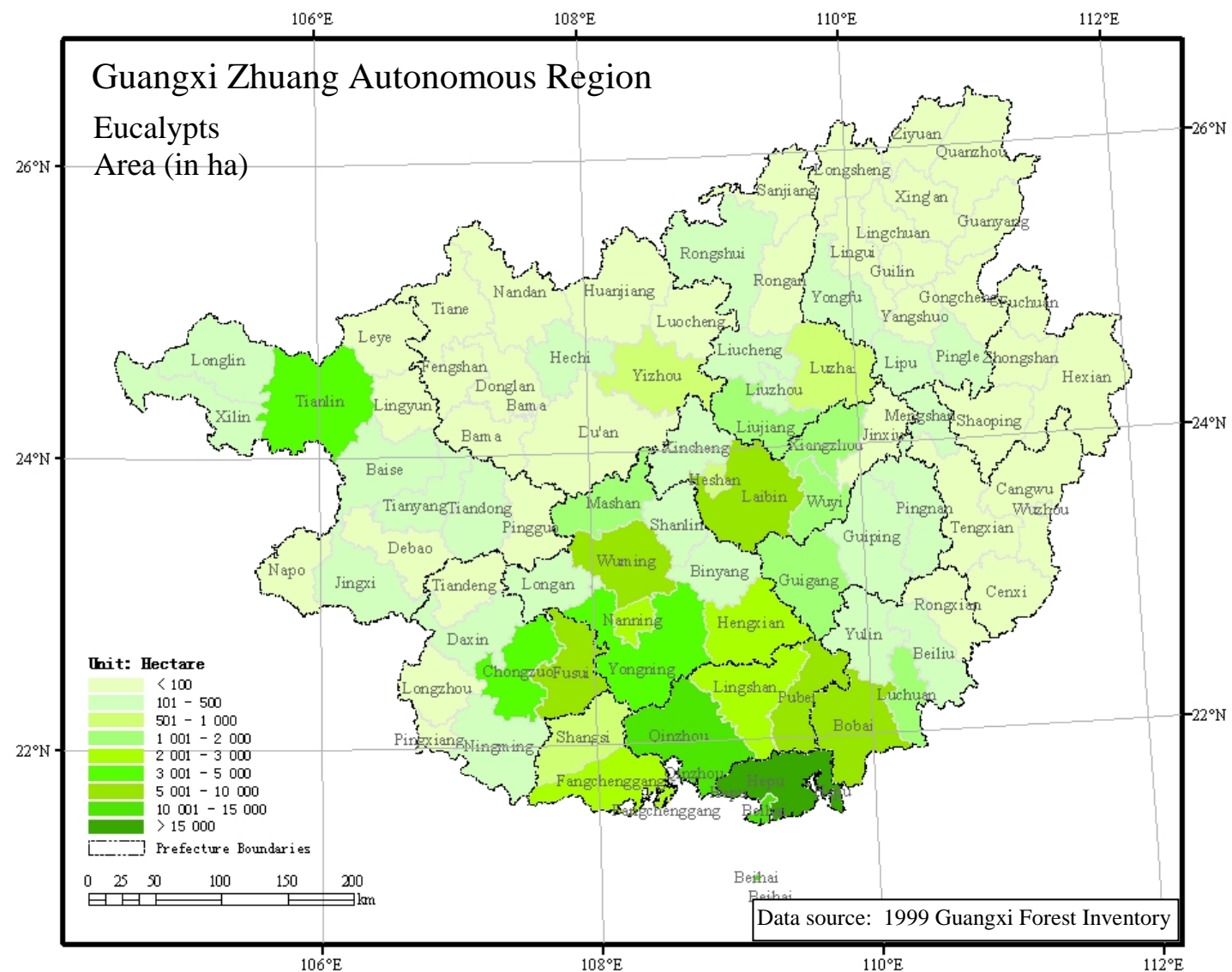
Map 2.5



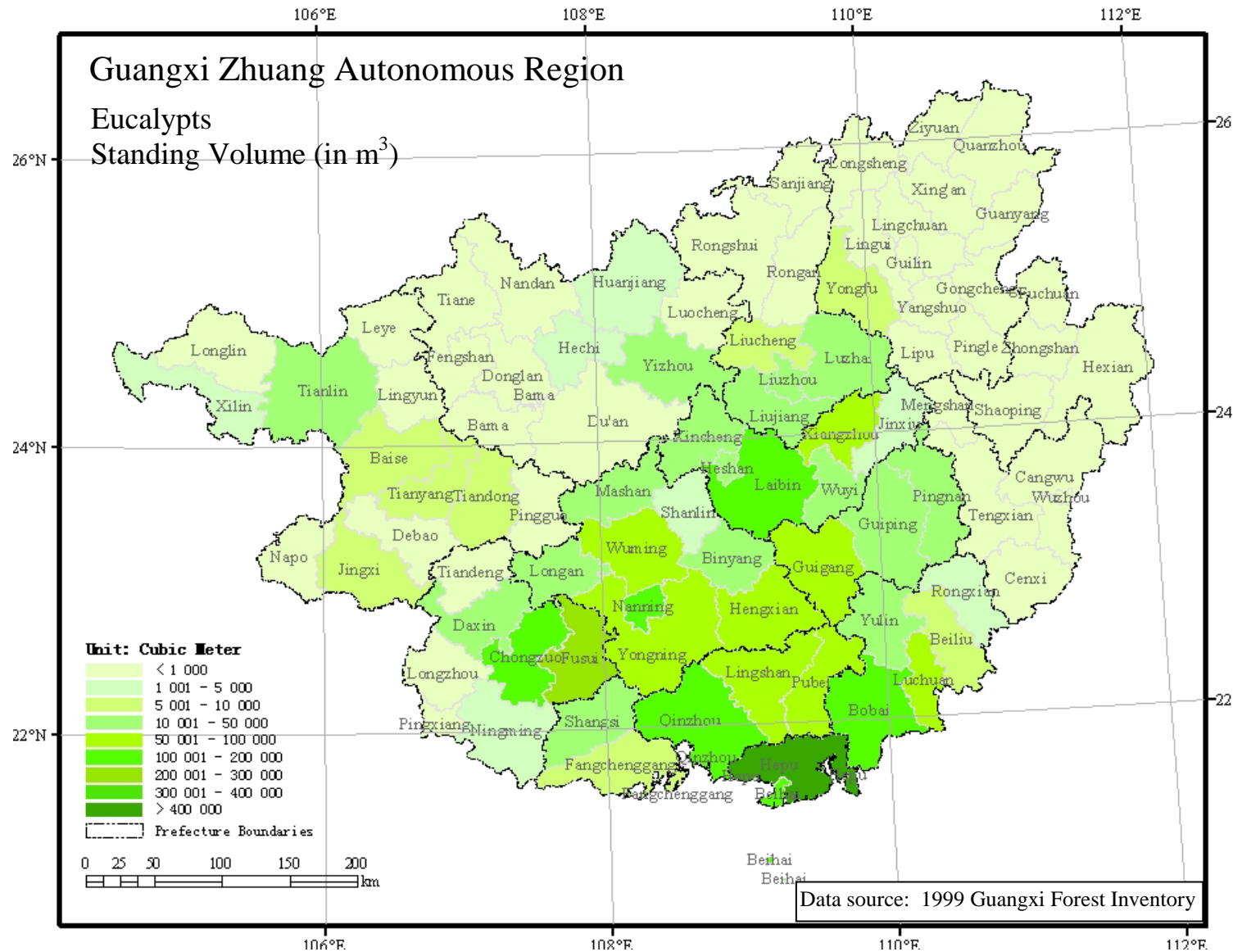
Map 2.6



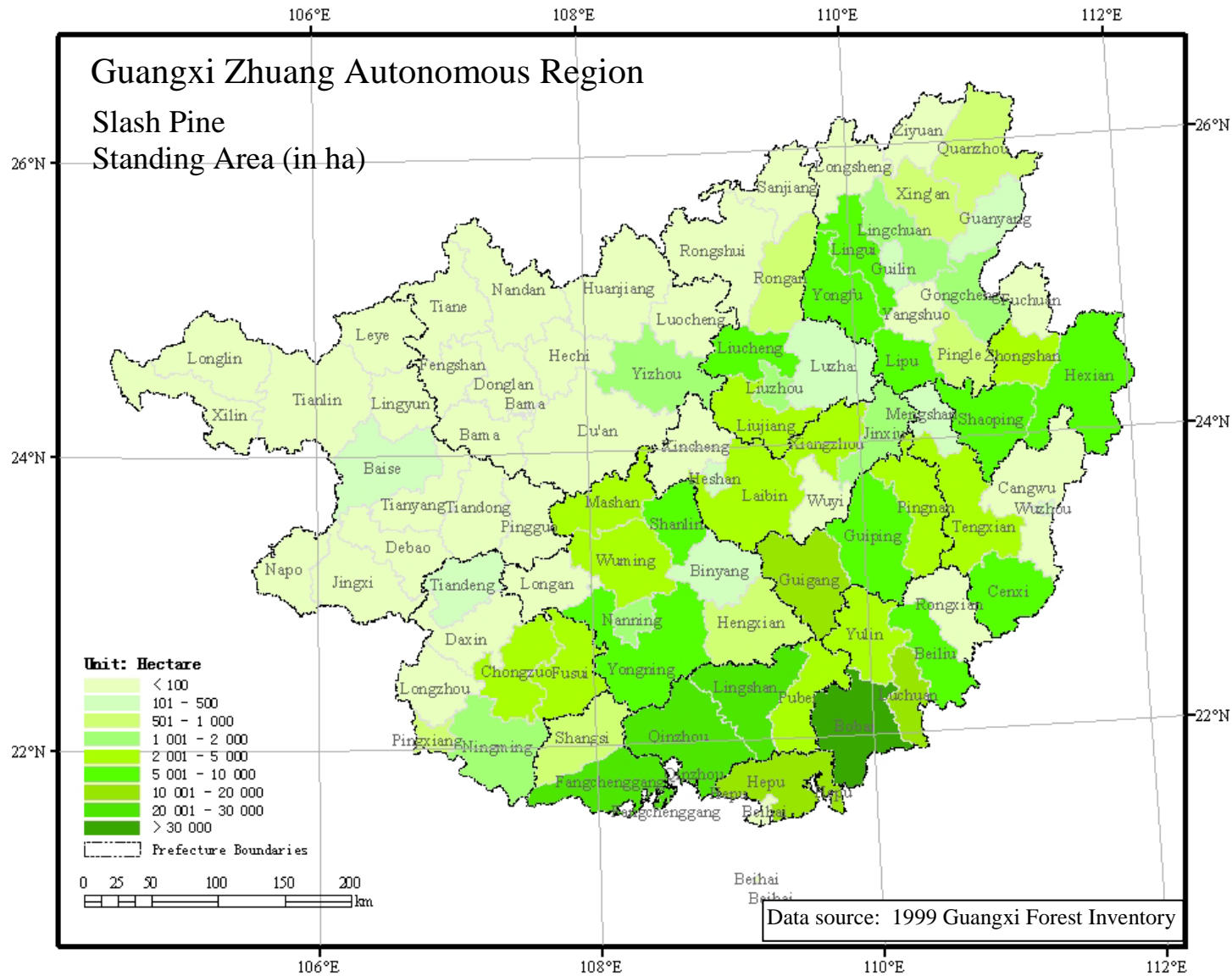
Map 2.7



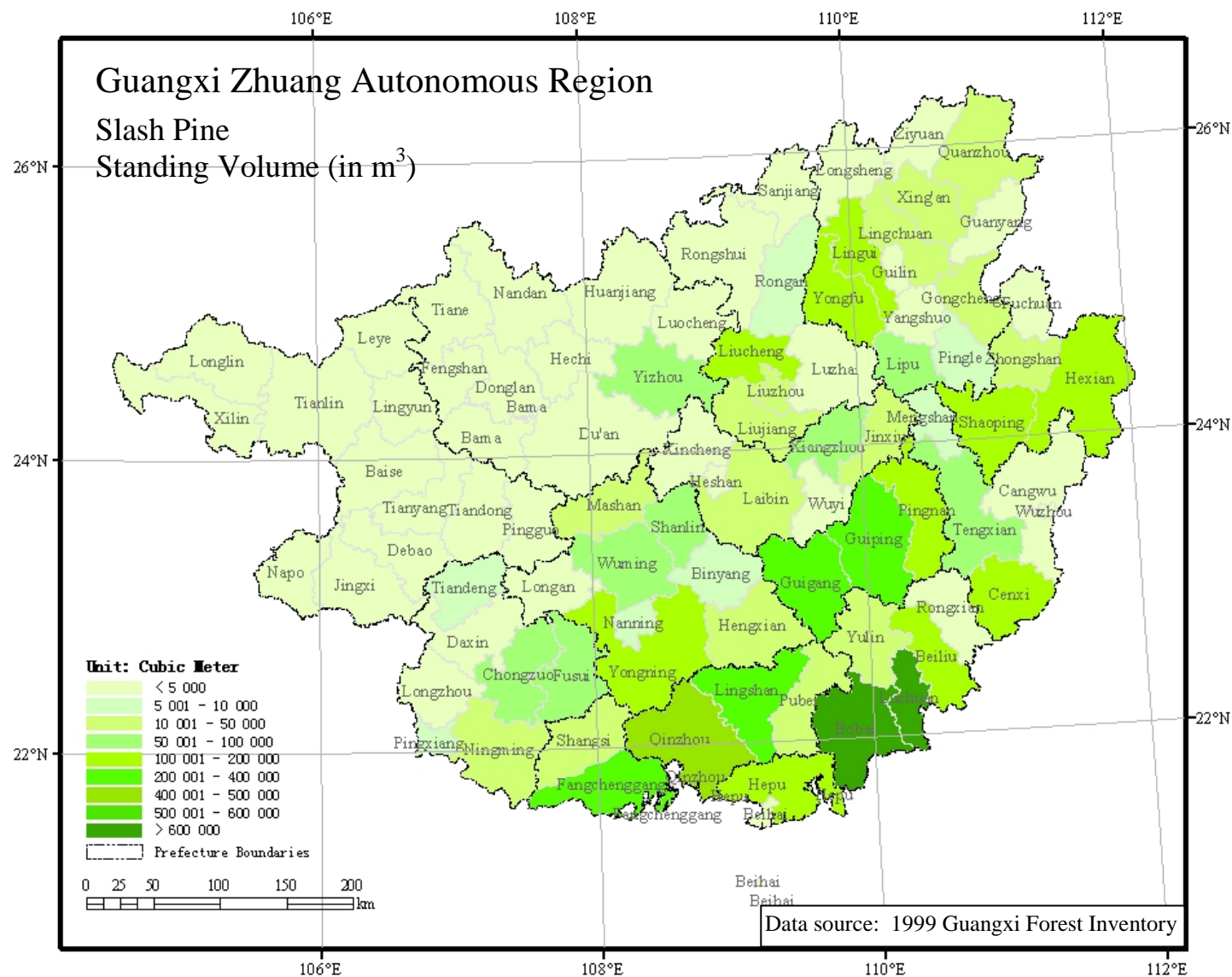
Map 2.8



Map 2.9



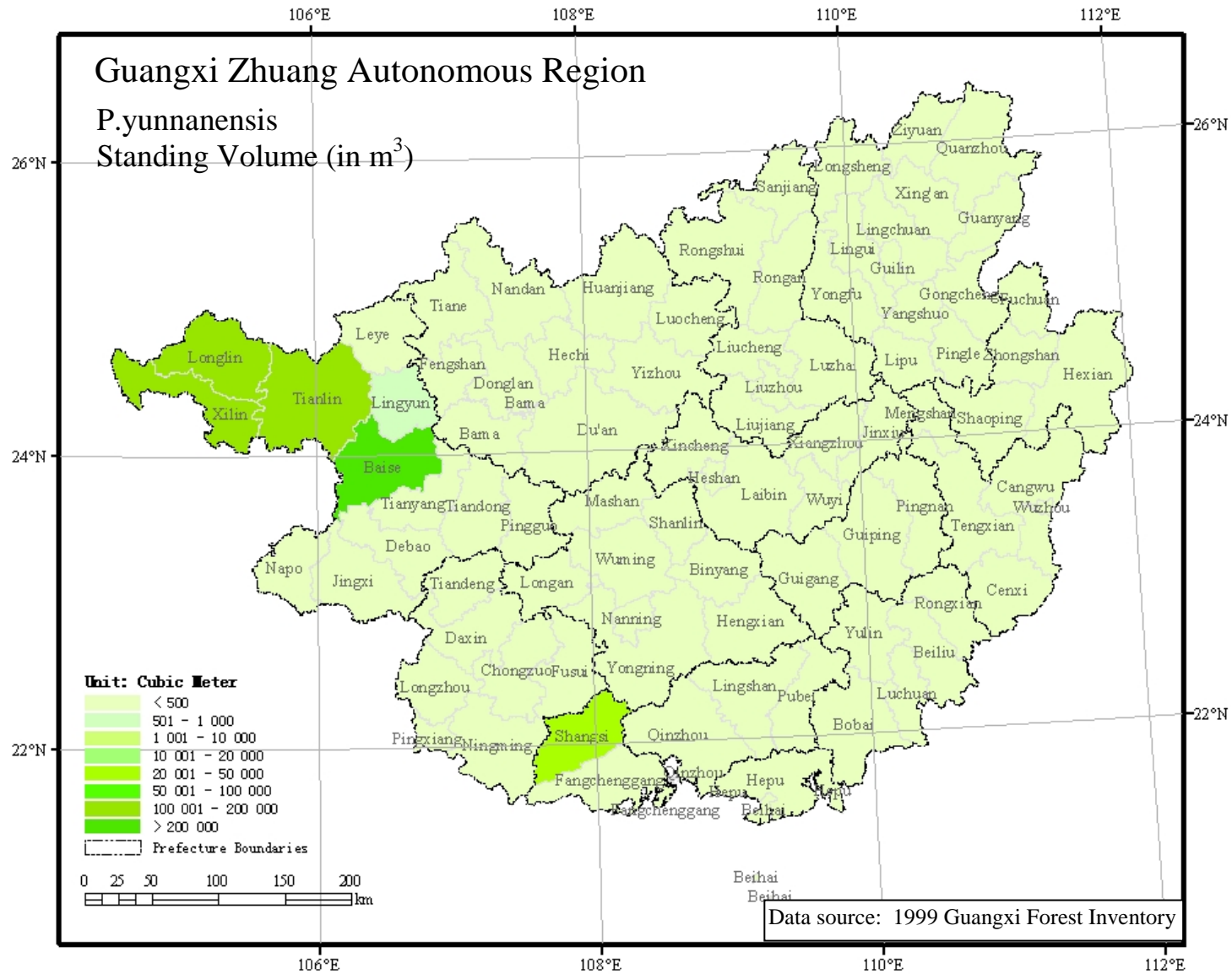
Map 2.10



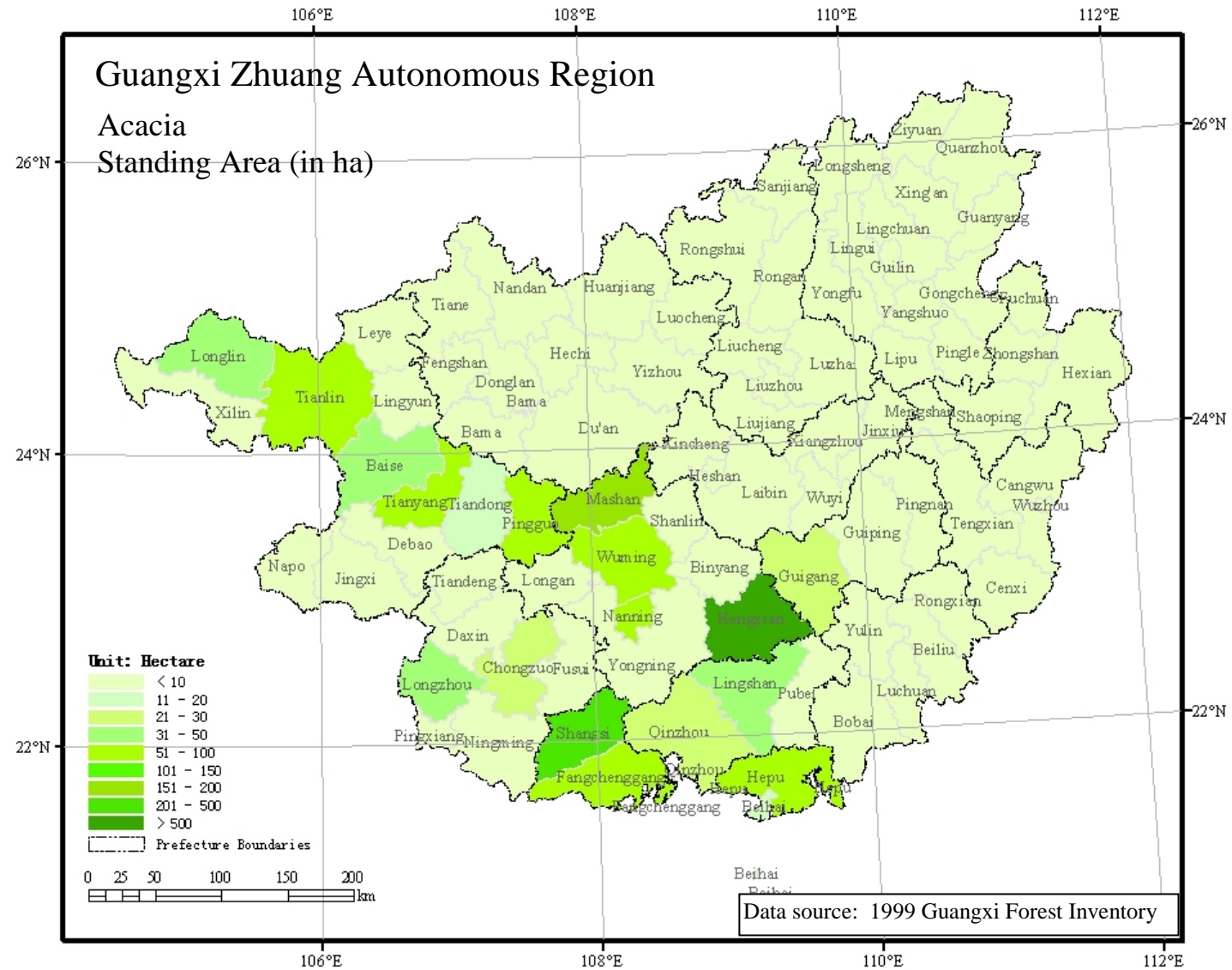
Map 2.11



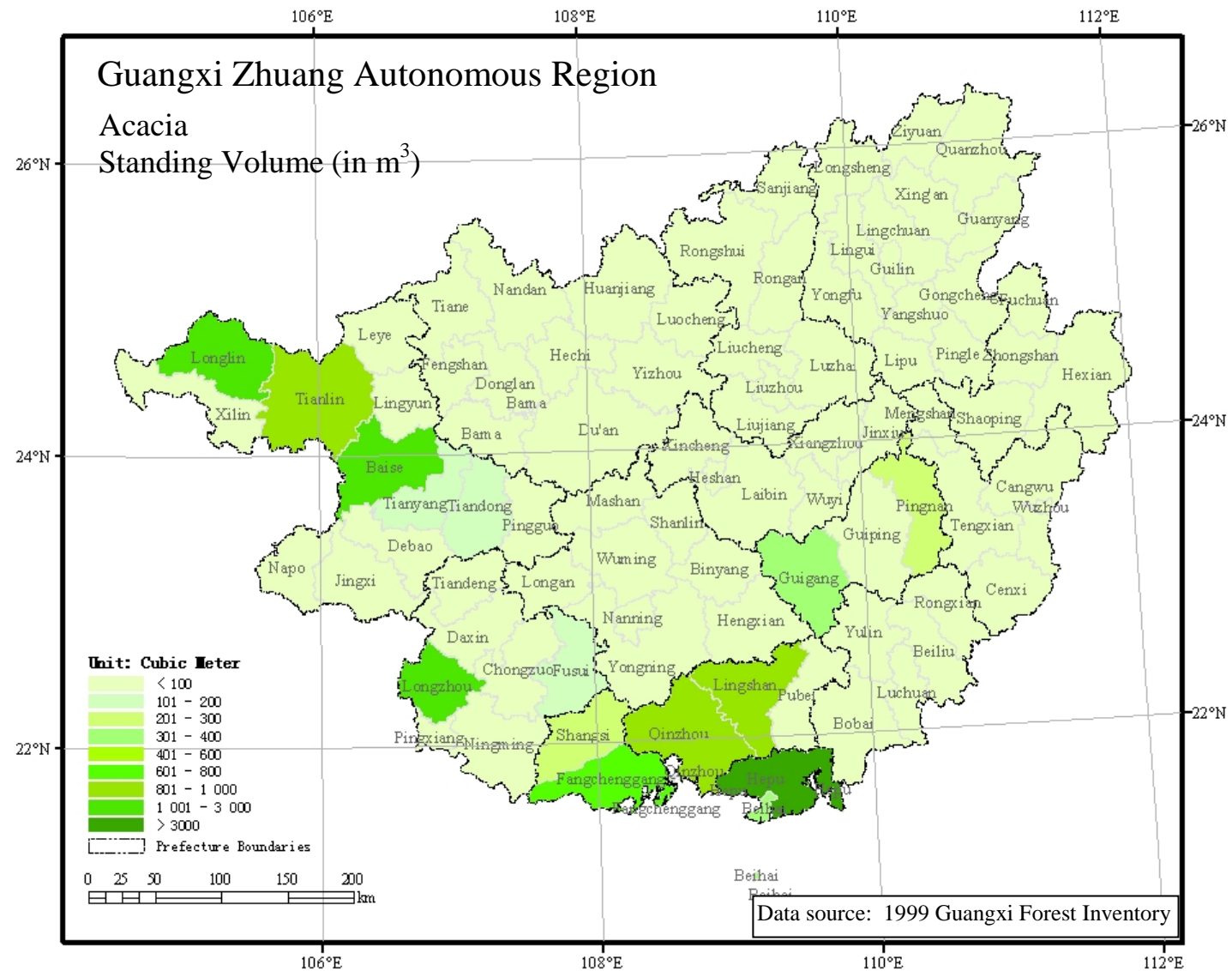
Map 2.12



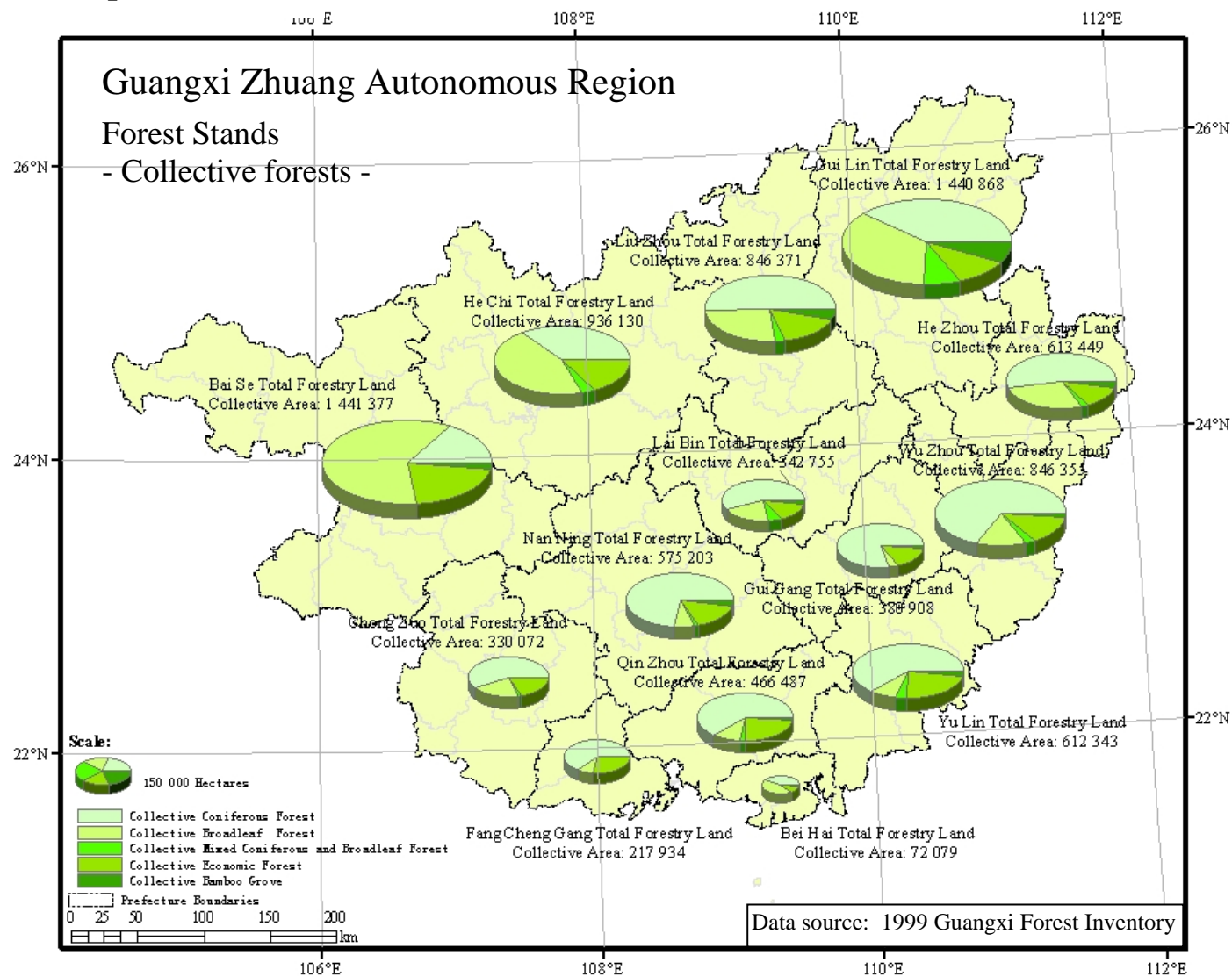
Map 2.13



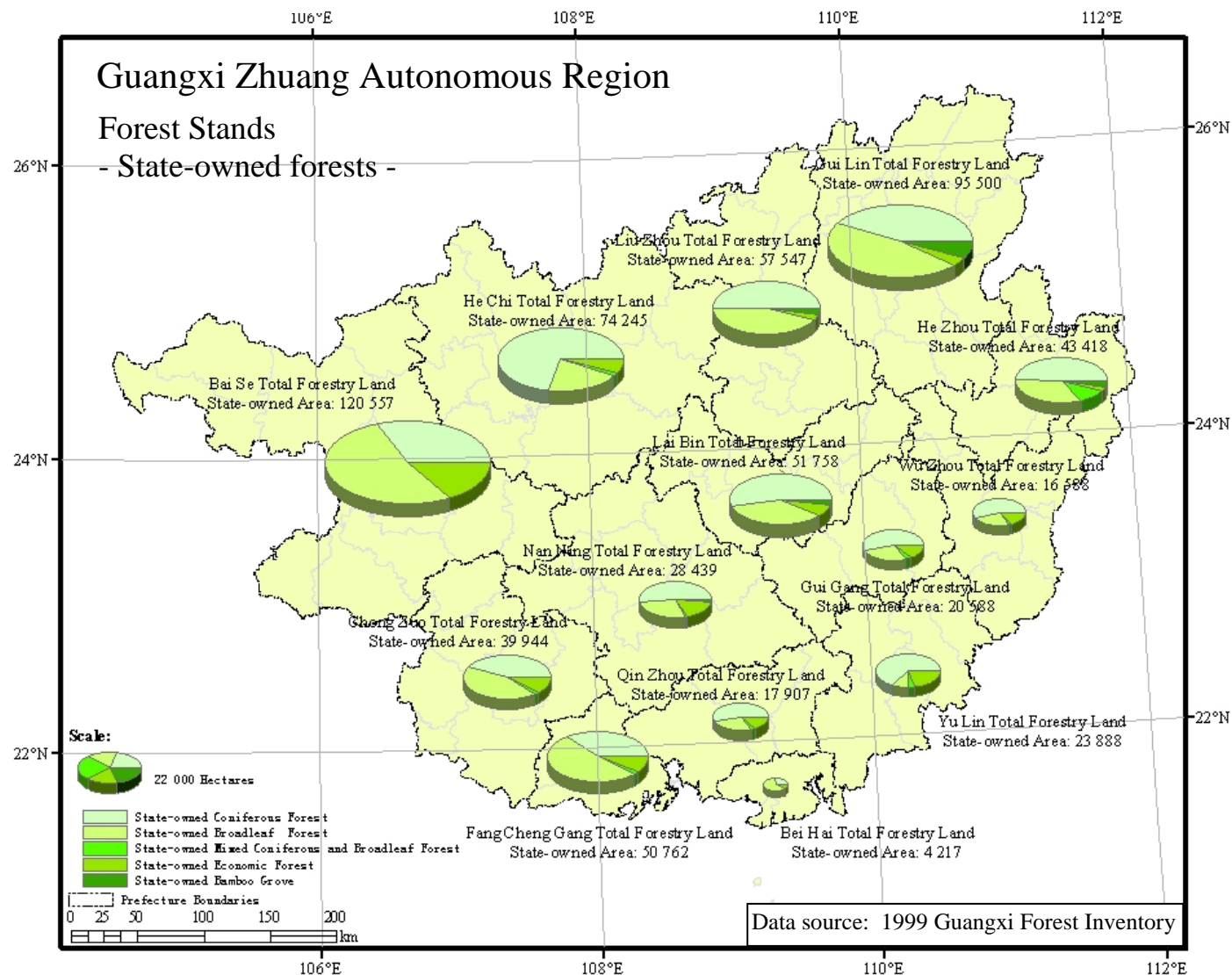
Map 2.14



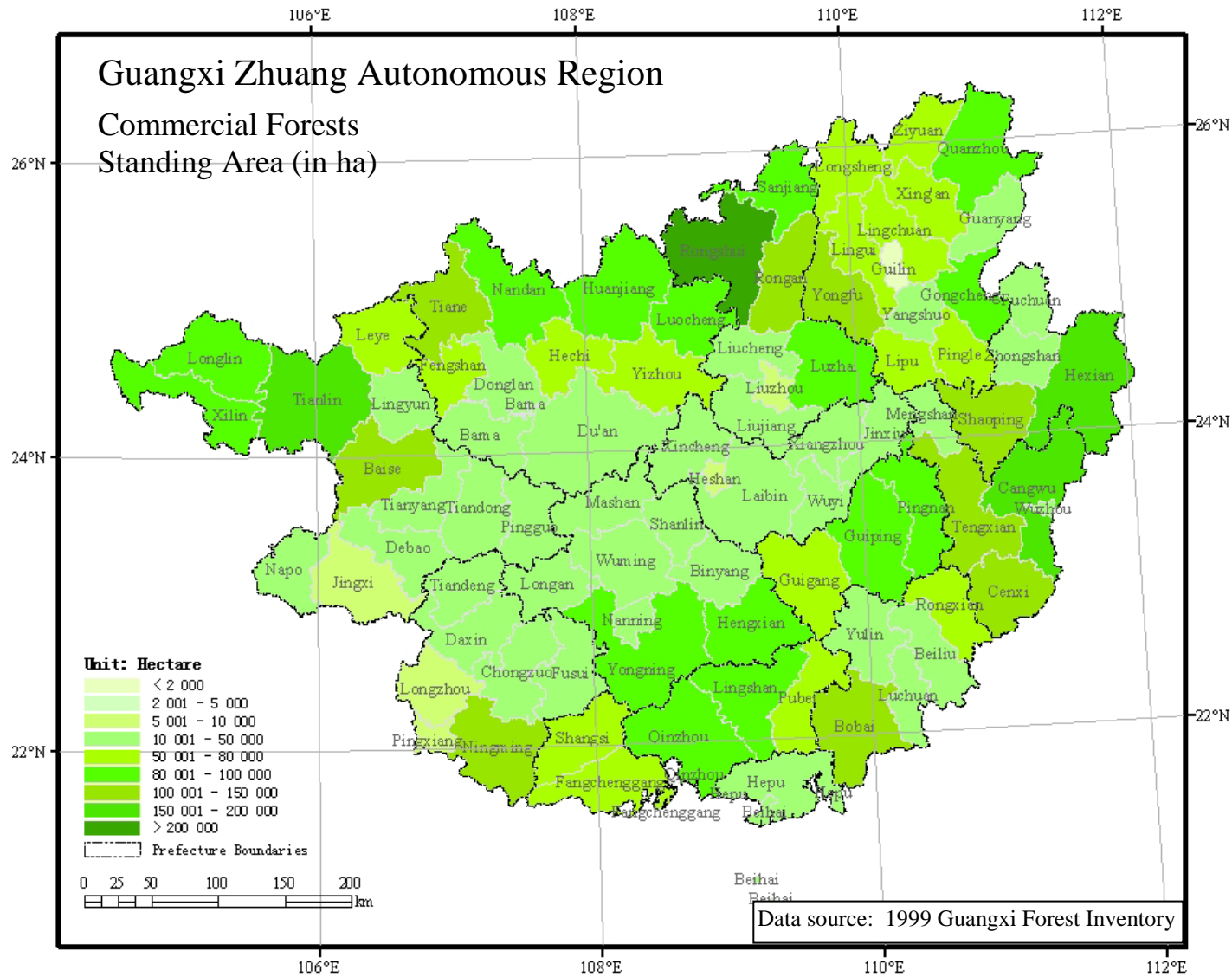
Map 2.15



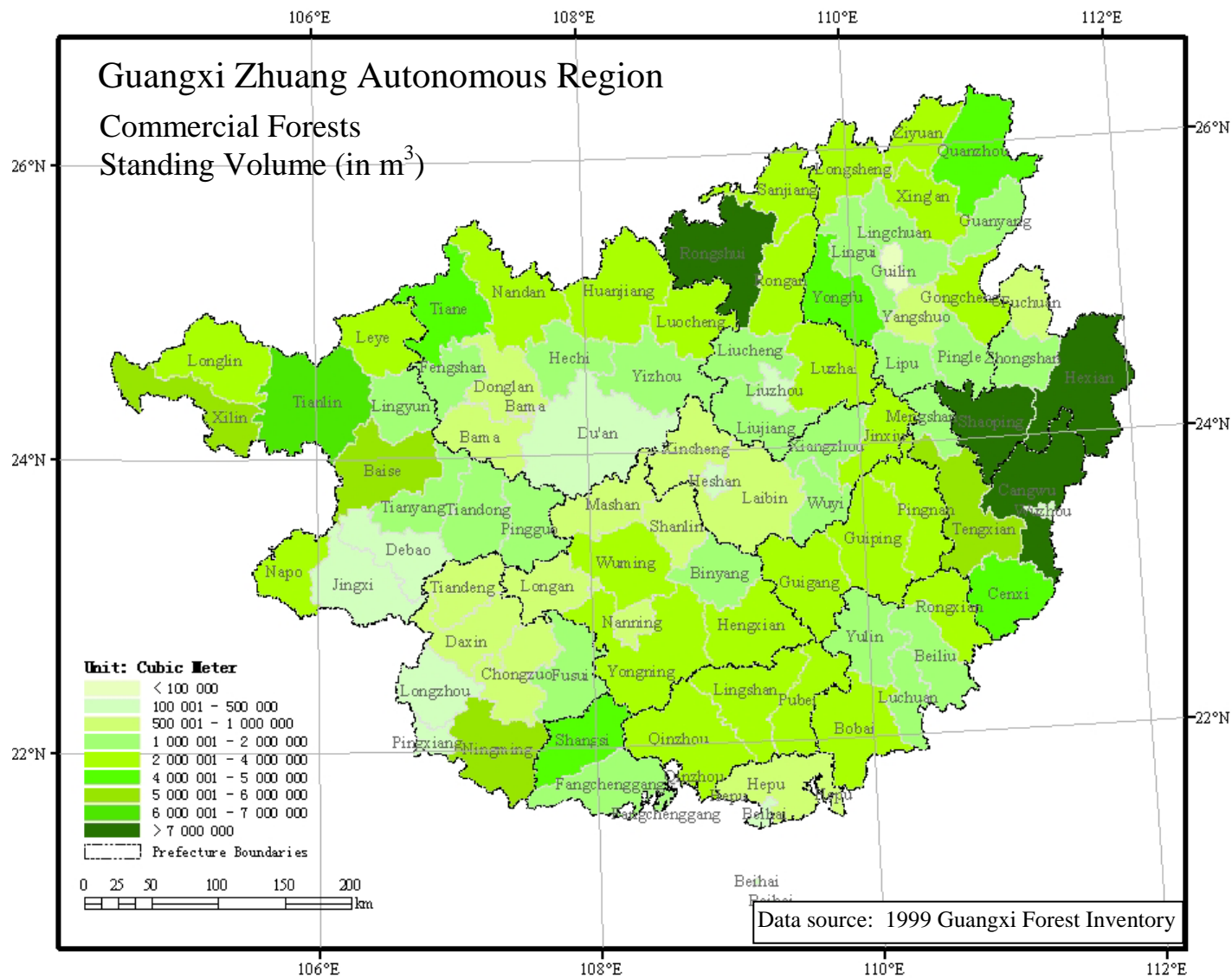
Map 2.16



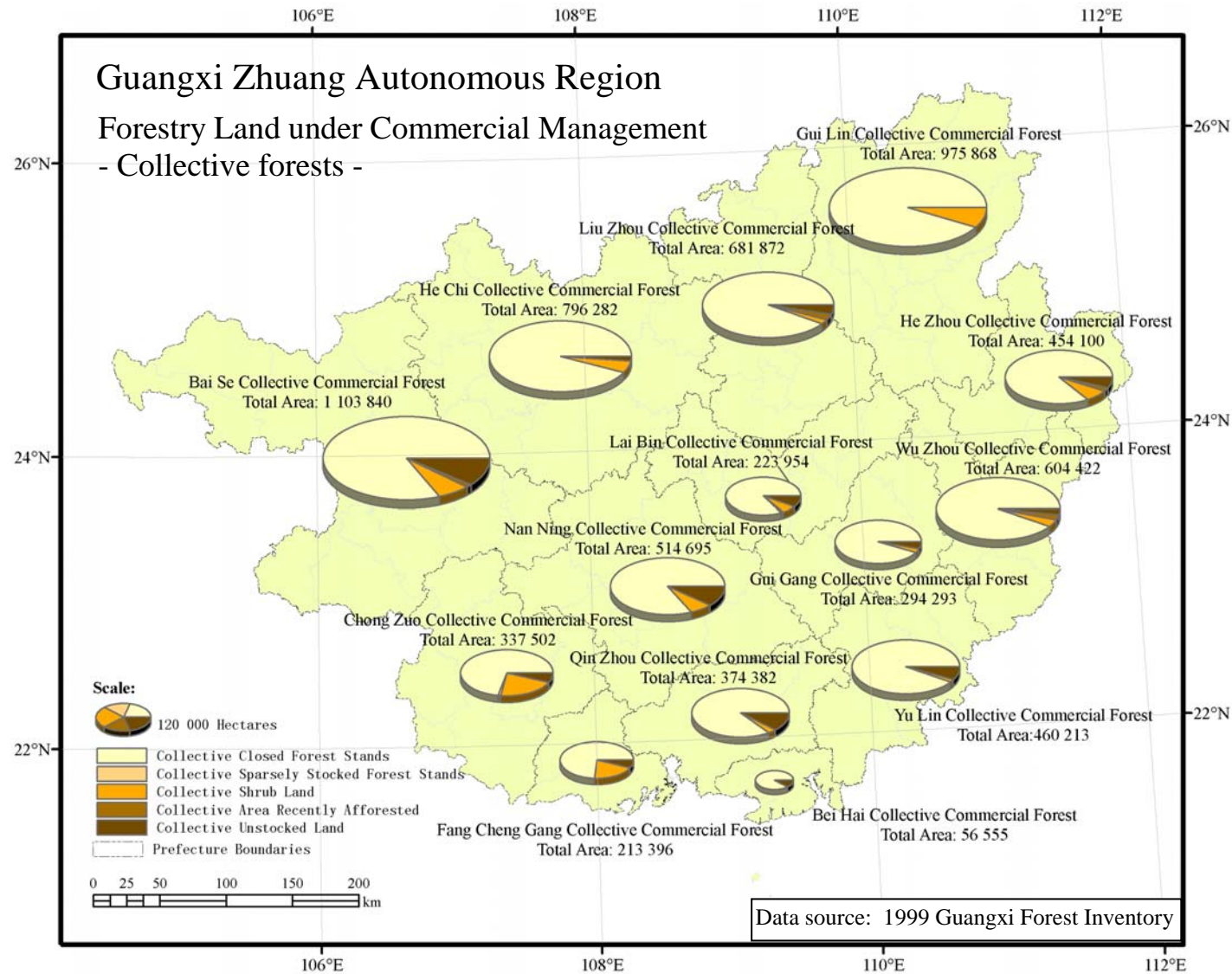
Map 2.17



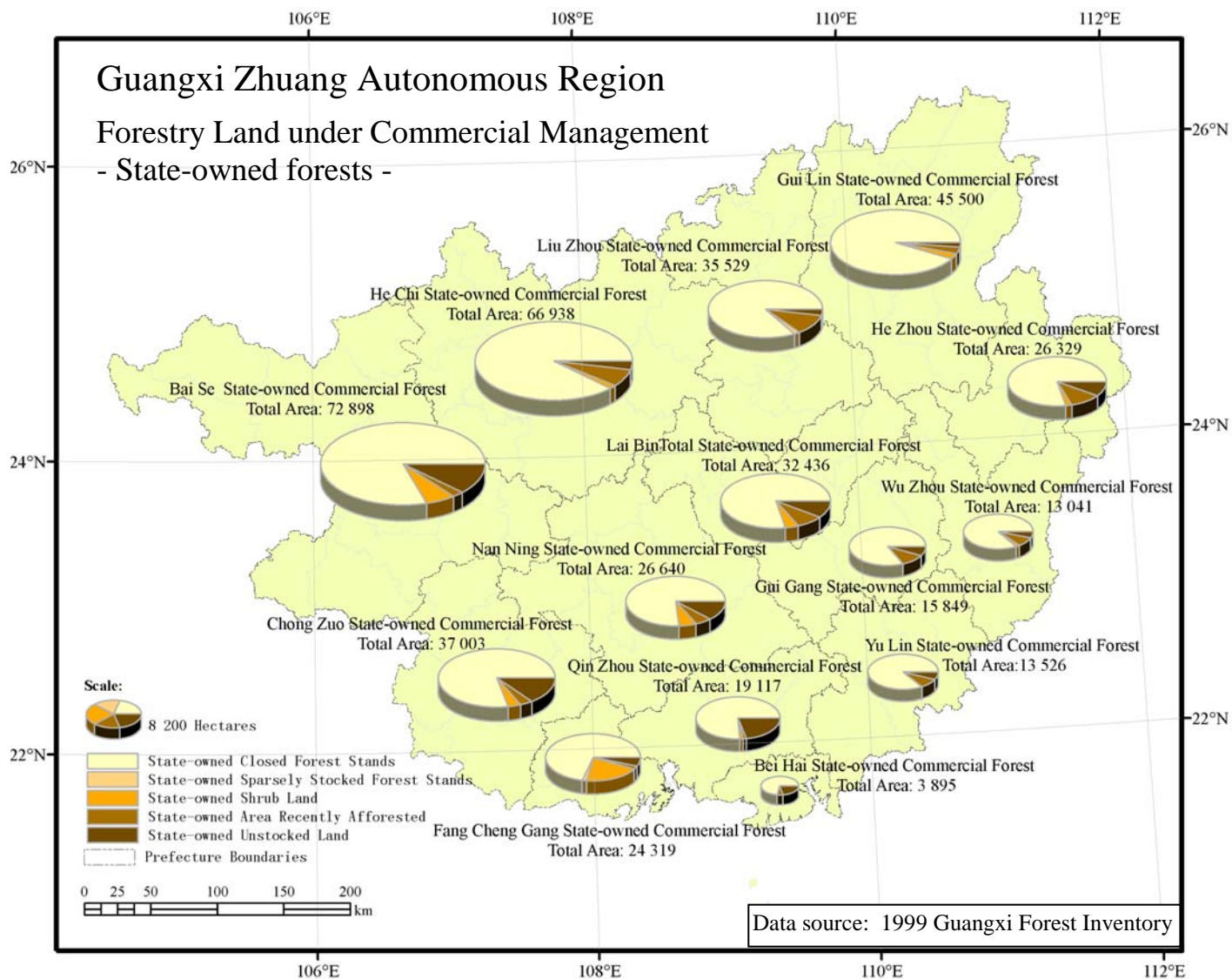
Map 2.18



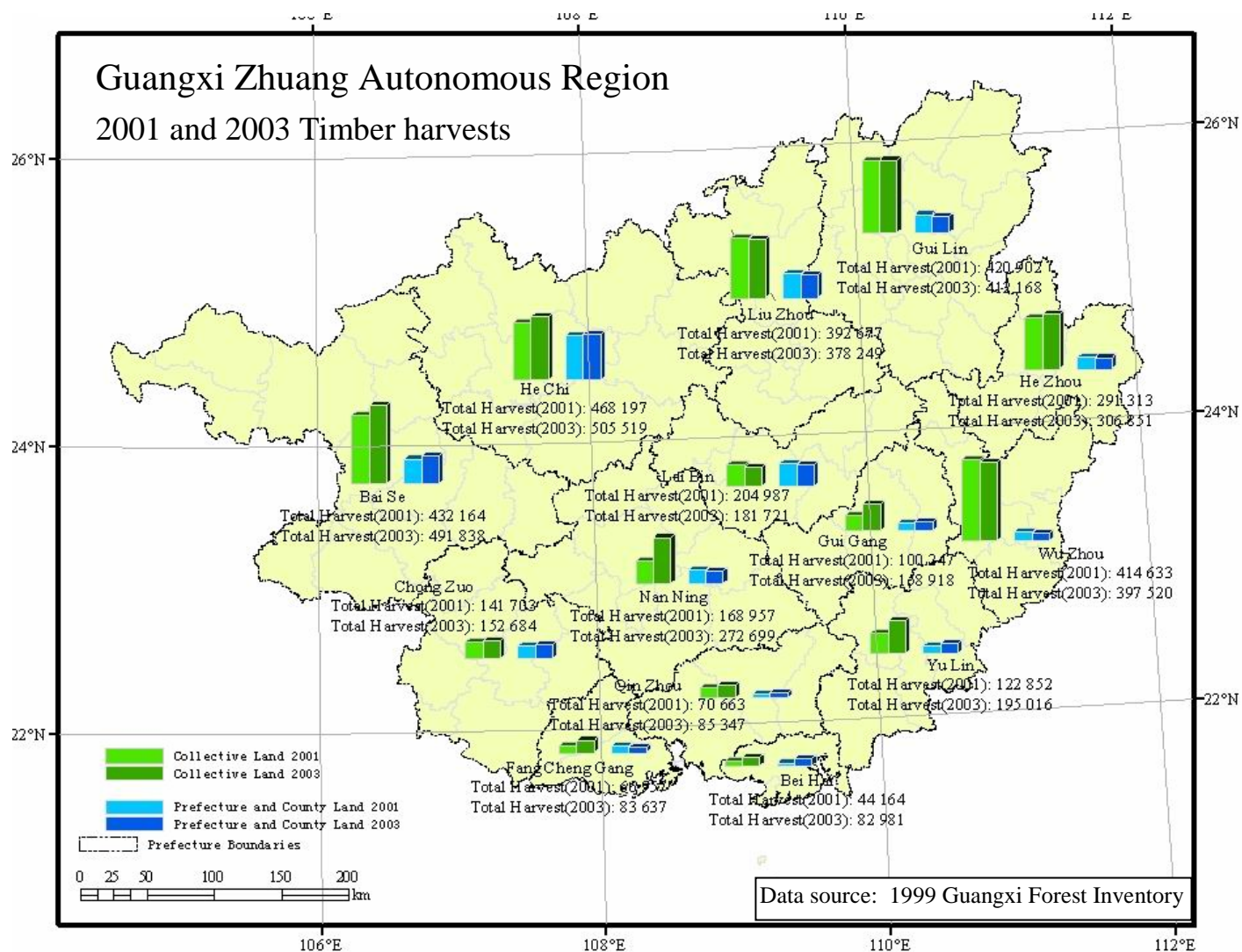
Map 2.19



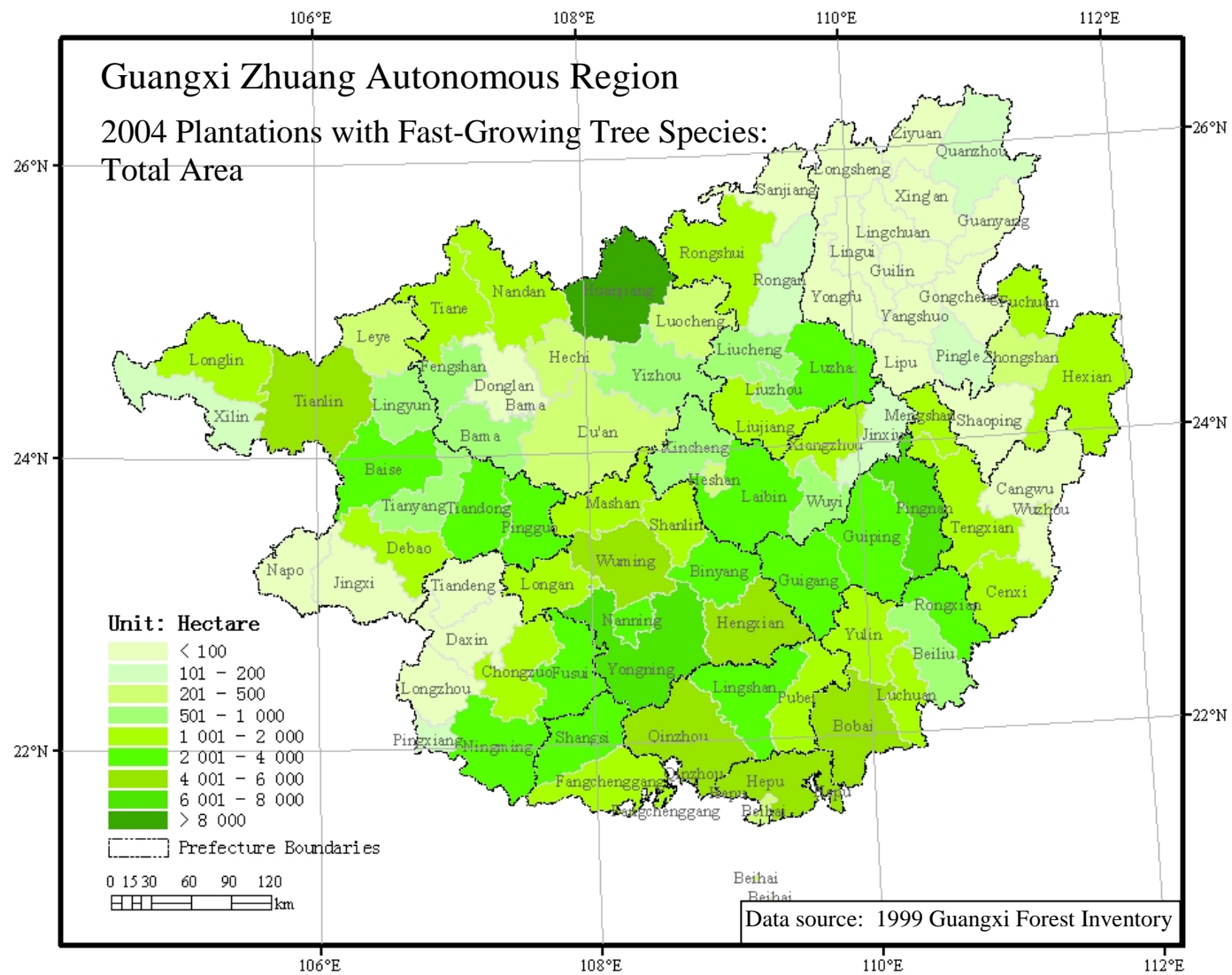
Map 2.20



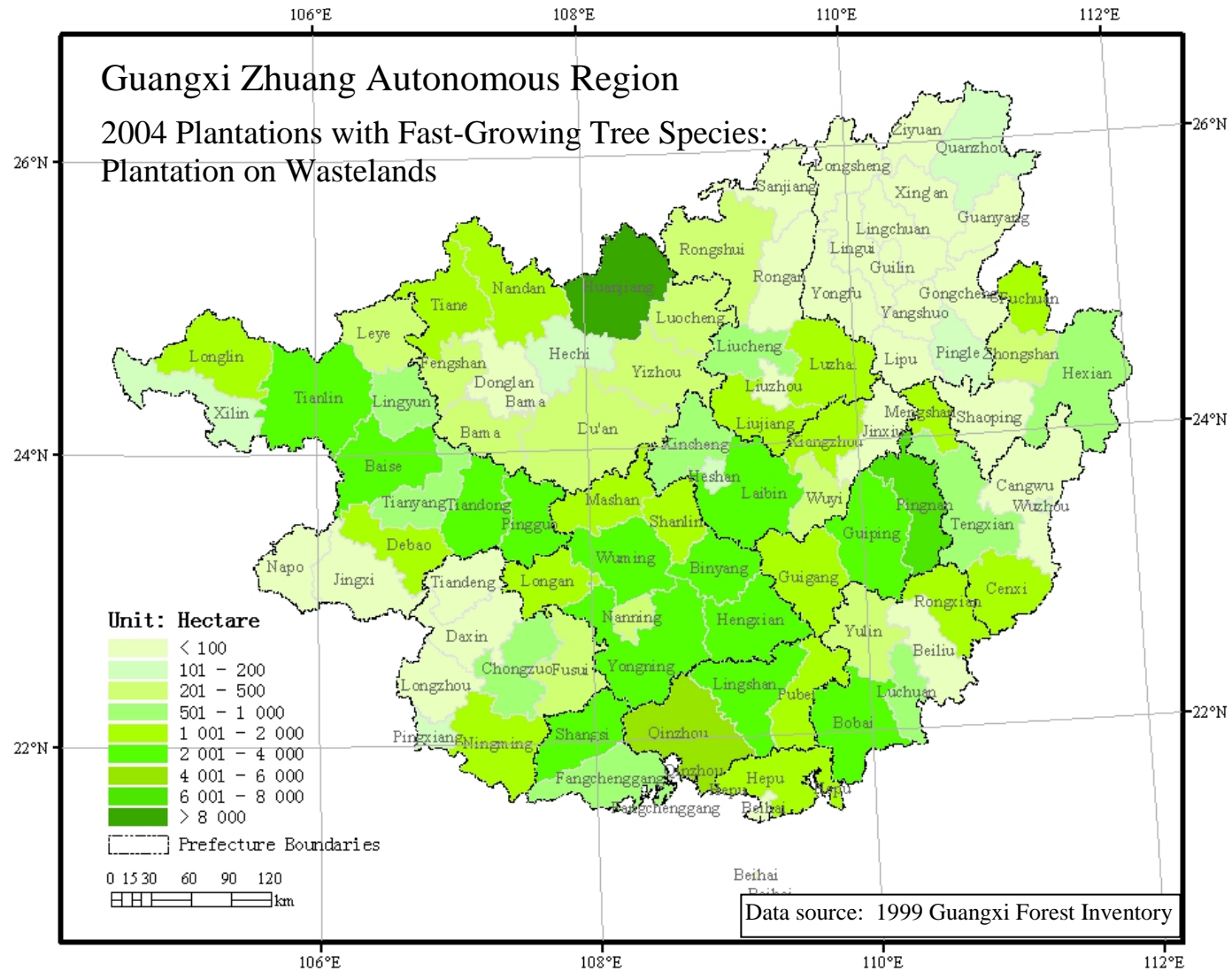
Map 2.21



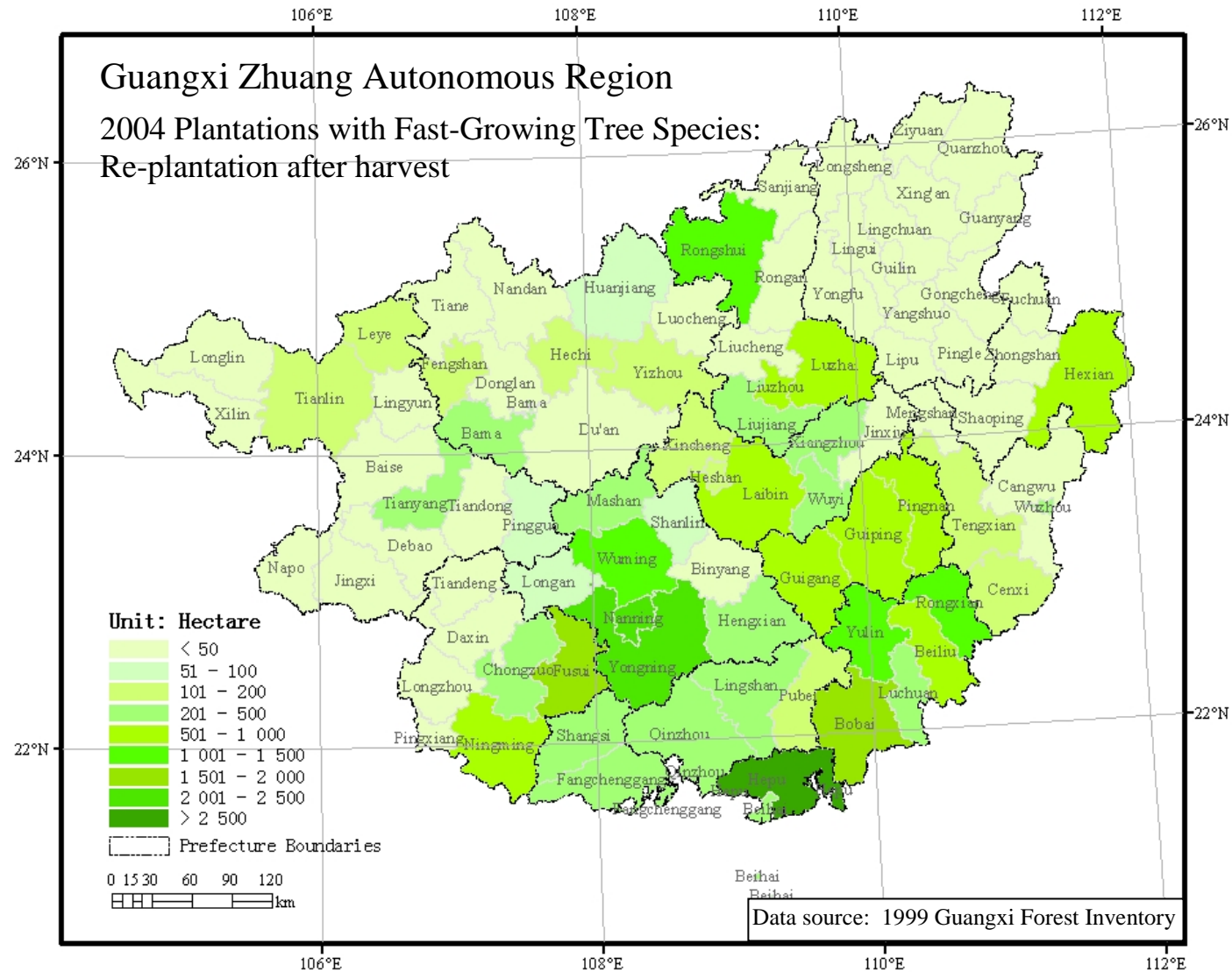
Map 2.22



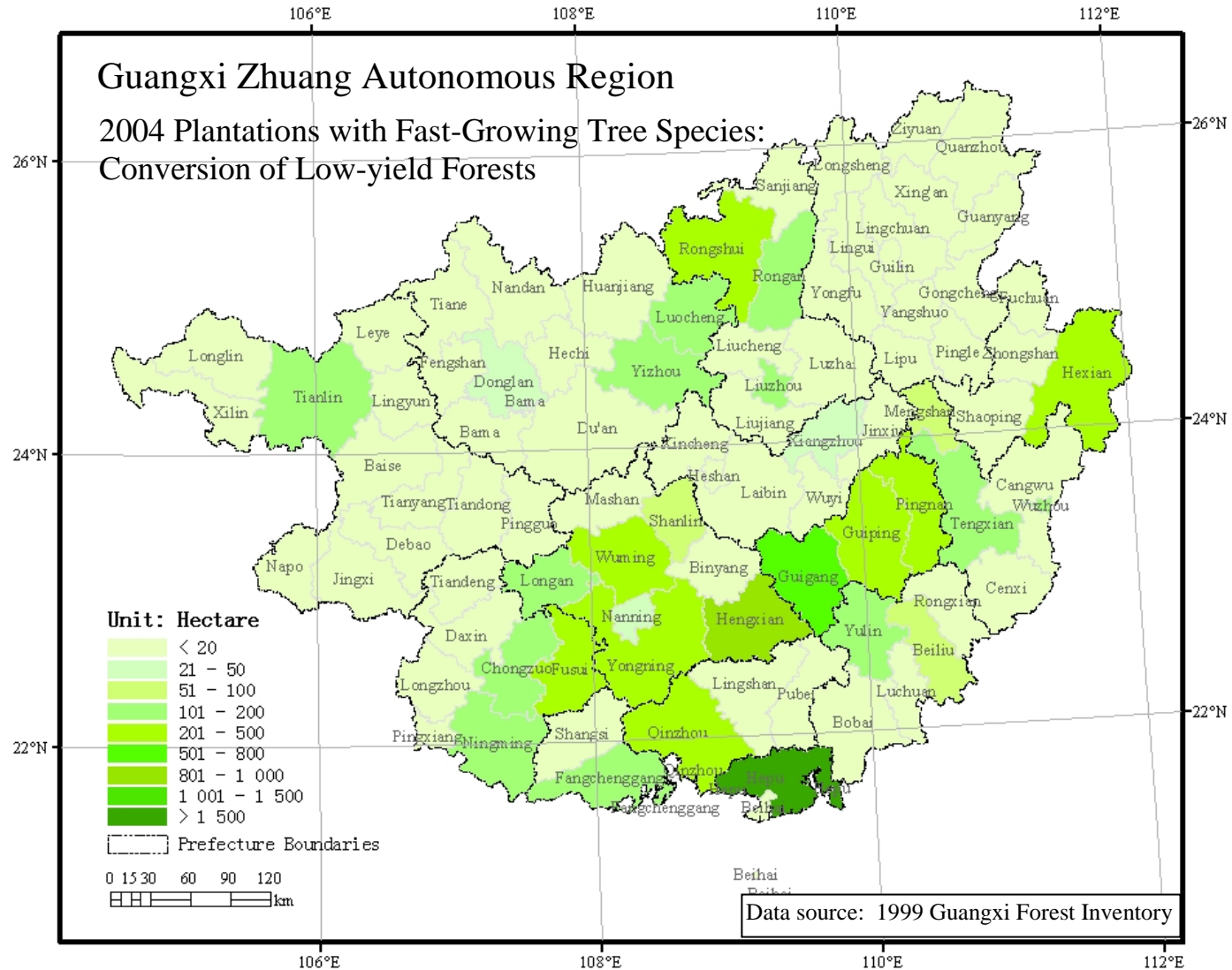
Map 2.23



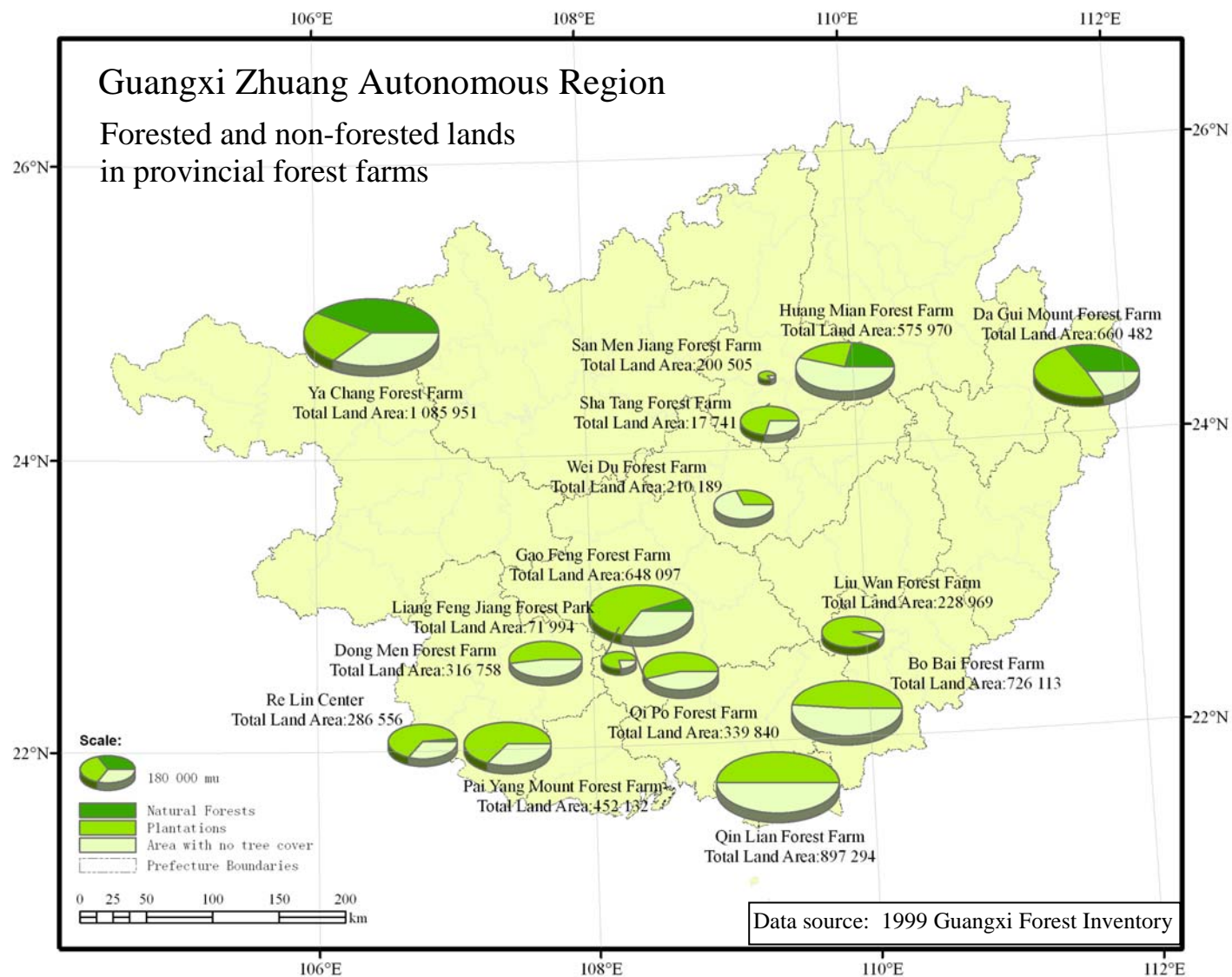
Map 2.24



Map 2.25



Map 2.26



Chapter 3: Overview of Guangxi's Wood Processing Sector

3.1 Introduction

This chapter examines the structure of Guangxi's wood processing sector, and analyzes the current demand for wood within the province. The analysis focuses largely on demand for small-diameter wood fiber, with relatively less attention given to larger diameter roundwood used for structural purposes.

The chapter summarizes recent production trends for major grades of wood panels, wood-based pulp, and wood chips, and assesses the implications of these for wood consumption on the part of each industry segment. Estimates of installed processing capacity are used to quantify the effective demand for wood fiber by the main industry segments at existing capacity levels. Based on data obtained from this study's survey of wood processing industries in Guangxi, an effort is made to disaggregate wood demand by the various grades of wood utilized by each industry segment in order to assess the implications of current demand trends on the province's forest resource base.

3.2 Structure of Guangxi's Wood Processing Sector

This section provides a brief overview of the major segments of Guangxi's wood processing sector, including: sawnwood; wood panels; pulp and paper; and wood chips. The information presented is largely based on data provided by the Guangxi Provincial Forestry Bureau, either in published reports or in unpublished form. Further details on each of the industry segments – with the exception of sawnwood, which has not been a primary focus of this study -- will be provided in following sections.

3.2.1 Sawnwood

Guangxi has 3,904 sawmills with a total capacity of nearly 3.2 million m³/yr, according to figures provided by Provincial Forestry Bureau staff in each of the province's 14 prefectures. The industry is estimated to have produced some 1.9 million m³ of sawnwood in 2004, reflecting an increase of approximately 50 percent from 2001 when output is estimated to have been 1.2 million m³.

As Table 3.1 shows, three prefectures – Nanning, Hechi, and Liuzhou – account for some 57.6 percent of the industry's overall capacity. Nanning also has the largest number of mills with 947, while five other prefectures have over 300 mills. Mean mill capacity varies widely, ranging from a low of 76 m³/yr in Guigang to a high of 5,067 m³/yr in Laibin. Overall, the average mill capacity in Guangxi is 1,557 m³/yr.

Table 3.1: Sawnwood Capacity by Prefecture in Guangxi, 2005

Prefecture	Region	No. Mills	Capacity (m3/yr)	Percent of Total	Mean Capacity (m3/yr)
Nanning	South	947	728,772	23.0%	770
Hechi	North West	408	600,000	18.9%	1,471
Liuzhou	North	187	500,000	15.7%	2,674
Hezhou	South East	188	300,000	9.4%	1,596
Yulin	South East	522	290,000	9.1%	556
Qingzhou	South	377	210,000	6.6%	557
Laibin	North	30	152,022	4.8%	5,067
Baise	North West	517	150,000	4.7%	290
Beihai	South East	200	100,000	3.1%	500
Wuzhou	South East	97	50,000	1.6%	515
Guilin	North	8	30,400	1.0%	3,800
Guigang	South East	396	30,000	0.9%	76
Chongzuo	South	7	24,000	0.8%	3,429
Fangchenggang	South	20	10,000	0.3%	500
Total		3,904	3,175,194	100.0%	1,557

Data Source: Unpublished data provided by Guangxi Forestry Bureau (2005)

3.2.2 Wood panels

Guangxi has a total of 156 mills that produce panel products of various types, with an aggregate production capacity of 2.75 million cubic meters per year (m3/yr), according to survey data obtained by the Provincial Forestry Bureau in 2003. These figures include mills producing both wood-based panels and panels made from non-wood materials such as bagasse and bamboo. They also include mills that were already operating when the survey was conducted and those that were then under construction.¹

As Table 3.2 shows, Guangxi's panel industry is dominated by medium and high density fiberboard production. The province's 24 MDF and HDF mills have an aggregate production capacity of 1.9 million m3/yr, accounting for 70 percent of the sector's total panel capacity. The province also has 67 plywood mills, accounting for the largest number of individual production units; however, aggregate capacity is only 315,000 m3/yr, or 11 percent of the provincial total.

Guangxi has 20 particleboard mills – over one-half of which use bagasse as the main raw material -- with a combined capacity of 365,000 m3/yr, or 13 percent of the

¹ The survey was limited to mills with a production capacity of 2,000 m3/yr or more, and therefore does not include the apparently large number of wood panel mills with an operational scale smaller than this. As very little data on these smaller mills exist, this section focuses only on producers with a capacity at or above 2,000 m3/yr. While mills above this threshold capacity account for the vast majority of the province's panel production, it should not be overlooked that in some industry segments (plywood, for instance) and in some parts of the province, mills with less than 2,000 m3/yr of capacity do, on aggregate, play an important role in local economies.

province's overall capacity. In addition, Guangxi has 43 blockboard mills that are capable of producing a combined 132,000 m³/yr. Each of these industry segments will be discussed in greater detail the following sections.

Table 3.2: Structure of Guangxi's Panel Industry, 2003

Panel Type	No. of Mills	Production Capacity (m ³ /yr)		Total Capacity (m ³ /yr)	% of Total
		Installed	Under Construction		
MDF	23	795,000	830,000	1,625,000	59.05
HDF	1	0	300,000	300,000	10.90
Wet-process fiberboard	2	15,000	0	15,000	0.55
Particleboard (wood) *	7	151,000	0	151,000	5.49
Particleboard (bagasse)	13	214,000	0	214,000	7.78
Plywood (furniture-grade)	37	141,000	0	141,000	5.12
Plywood (construction panels)	30	174,000	0	174,000	6.32
Blockboard	43	132,000	0	132,000	4.80
Total	156	1,622,000	1,130,000	2,752,000	100.01

Note: This table includes only mills with a capacity \geq 2,000 m³/yr.

Source: Guangxi Provincial Forestry Bureau (2003)

Guangxi's MDF and HDF production is especially concentrated in the South East region of the province – encompassing Wuzhou, Hezhou, Yulin, Guigang, and Beihai prefectures (see Table 3.3). These prefectures have 12 mills capable of producing 1.1 million m³/yr, or 61 percent of the province's overall fiberboard capacity. With 40 plywood mills, the South East also accounts for 50 percent of the province's capacity in that segment.

The South region – covering Nanning and Chongzuo prefectures – has 7 MDF mills with a combined capacity of 495,000 m³/yr, representing 25 percent of the provincial total. The region's 10 particleboard mills account for nearly 40 percent of the province's overall capacity for this grade. Notably, however, many of these are bagasse mills supplied by fiber from the region's extensive sugar cane plantations.

Wood producing areas in the Guangxi's North region – including Liuzhou, Laibin, and Guilin prefectures – account for nearly three-quarters of the province's block board capacity, with 30 mills and a combined capacity of 96,000 m³/yr. This region also supports 48 percent of Guangxi's particleboard capacity and 30 percent of overall plywood capacity.

Guangxi's North West quadrant is, by any measure, the province's least developed wood processing region. It has a single MDF mill -- albeit a large one, with 100,000 m³/yr capacity -- which represents 5 percent of the province's total fiberboard capacity. It has only one plywood mill and four blockboard mills capable of operating above 2,000 m³/yr.

Table 3.3: Geographic Distribution of Guangxi's Panel Industry by Provincial Sub-Region, 2003

Region	Prefectures	Panel Type	No. of Mills	Capacity (m3/yr)	% of Total by Panel Type
South East	Wuzhou; Hezhou; Yulin; Guigang; Beihai	MDF & HDF	12	1,185,000	61.08 %
		Plywood	40	160,000	50.79 %
		Particleboard	2	48,000	13.15 %
		Blockboard	4	12,000	9.09 %
		Sub-total	58	1,405,000	
South	Nanning; Chongzuo; Qinzhou; Fangchenggang	MDF & HDF	7	495,000	25.51 %
		Plywood	10	54,000	17.14 %
		Particleboard	10	139,000	38.08 %
		Blockboard	5	14,000	10.61 %
		Sub-total	32	702,000	
North	Liuzhou; Laibin; Guilin	MDF & HDF	6	160,000	8.25 %
		Plywood	16	96,000	30.48 %
		Particleboard	8	178,000	48.77 %
		Blockboard	30	96,000	72.73 %
		Sub-total	60	530,000	
North West	Baise; Hechi	MDF & HDF	1	100,000	5.15 %
		Plywood	1	5,000	1.59 %
		Particleboard	0	0	0.00 %
		Blockboard	4	10,000	5.74 %
		Sub-total	6	115,000	
Total			156	2,752,000	

Source: Guangxi Forestry Bureau (2003)

3.2.3 Pulp and paper

Guangxi has over 200 pulp and paper mills of various scales, according to figures published by the Provincial Development and Reform Committee of in November 2004. The province's annual production of paper and paperboard has grown from 712,000 tonnes in 1999 to approximately 960,000 tonnes in 2005.² In addition, pulp producers in Guangxi reportedly generate 320,000 air-dried tonnes per year (Adt/yr) of various types of commercial pulp.

The vast majority of Guangxi's pulp and paper mills have installed production capacities of less than 10,000 Adt/yr. Of the 29 mills with capacities above this level, 17 are able to operate in the range of 10,000-30,000 Adt/yr; six have capacities of 31,000-70,000 Adt/yr; and six have capacities greater than 70,000 Adt/yr.

² The 1999 production figure was reported by the China Paper Almanac, 2003.

Figures published by the Provincial Development and Reform Committee offer the following general estimates regarding the relative proportions of fiber types consumed by the province's paper mills: bagasse fiber (35 %); wood pulp (30 %); waste paper (30 %); and bamboo pulp (5 %). Guangxi has seven pulp mills with capacities to produce 20,000 Adt/yr or more of wood-based pulp. Two of these produce bleached kraft pulp for sale on the market, while the rest are integrated with paper-making operations.

3.2.4 Wood chips

According to figures provided by Provincial Forestry Bureau staff in each of Guangxi's 14 prefectures, the province has 213 wood chip mills with an aggregate annual capacity of over 1.3 million bone dry metric tonnes (BDMT). With the single exception of Liuzhou Prefecture, nine of the 10 largest prefectures in terms of capacity are located in the South and South East parts of the province.

Table 3.4: Wood Chip Capacity by Prefecture in Guangxi, 2005

Prefecture	Region	No. Mills	Capacity (m3/yr)	Percent of Total	Mean Capacity (m3/yr)
Nanning	South	56	285,125	21.7%	5,092
Liuzhou	North	15	200,000	15.2%	13,333
Guigang	South East	3	170,000	12.9%	56,667
Chongzuo	South	19	151,700	11.5%	7,984
Yulin	South East	25	110,000	8.4%	4,400
Fangchenggang	South	4	100,000	7.6%	25,000
Qingzhou	South	11	67,400	5.1%	6,127
Hezhou	South East	32	60,000	4.6%	1,875
Wuzhou	South East	8	60,000	4.6%	7,500
Beihai	South East	10	50,000	3.8%	5,000
Hechi	North West	12	42,000	3.2%	3,500
Baise	North West	9	15,000	1.1%	1,667
Guilin	North	9	3,460	0.3%	384
Laibin	North	n.a.	n.a.	n.a.	n.a.
Total		213	1,314,685	100.0%	6,172

Data Source: Unpublished data provided by Guangxi Forestry Bureau (2005)

3.2.5 Geographic concentration

Guangxi's wood processing industry is heavily concentrated in the South East and South quadrants of the province. This is particularly evident in the wood panel sector, as the 90 panel mills located in these two regions have a combined production capacity of 2.1 million m3/yr, accounting for over 77 percent of Guangxi's total panel capacity. Similarly, some 80 percent of the province's wood chip capacity is located in these two regions.

In relative terms, the sawnwood industry is more evenly distributed. The province's South East region accounts for only 30 percent of the province's total sawnwood

production, while the South region accounts for 24 percent. Guangxi's North West and North regions respectively account for 21.5 and 23.6 percent of overall sawnwood capacity.

The industry's heavy concentration in the province's South East and South regions reflects a number of factors, the most important of which relate to biophysical conditions, wood supply, and industrial infrastructure. In particular, the biophysical conditions in the South and South East are more conducive to the development of short-rotation, fast-growing varieties of trees – and especially eucalyptus hybrids. As such, these areas have more extensive commercial plantation resources than are found in the North and North West parts of the province, while the latter have more extensive ecological plantations.

In addition, the physical infrastructure – including road networks, ports, and power plants – are more developed in the South East and South than in other parts of the province. The proximity of these sub-regions both to coastal shipping points and to the region's dominant market in Guangdong's Pearl River Delta provide added incentives for panel industries and wood chip plants to be located in these areas.

3.2.6 Ownership

Guangxi's wood processing sector is dominated by state-owned companies. In the wood panel sub-sector, for instance, state-owned enterprises have an aggregate production capacity of 1.6 million m³/yr, or 61 percent of the provincial total (see Table 3.5). Indeed, many of the 46 state-owned panel mills are owned by or affiliated with Guangxi's forest farms that are managed by governments at the provincial and county levels. Many of the forest farms have also established sawmills or wood chipping operations, and some are affiliated with pulp and paper mills. These companies have generally been established to add value to the wood produced at the state forest farms and to create jobs for farm employees.

In recent years, there has been a growing trend among state-owned forestry companies to issue equity shares, thereby creating a new model of companies that are owned partially by the government and partially by private companies or individuals. In addition, some state-owned companies have actively sought out joint ventures with private sector investors. The Gaofeng Group – the shareholders of which include the Provincial Forestry Bureau and 8 of the provincial forest farms – has been particularly active in this regard. Already, the Gaofeng Group has developed three MDF mills, and it has plans to invest in several more over the coming years. In addition, the group has entered into joint ventures with both Stora Enso and APP to establish the plantation resource base needed to support the substantial investments those companies are planning to develop wood-based pulp industries.

Of the province's 156 panel mills, some 106 mills with a combined capacity of 795,000 m³/yr are owned by private Chinese investors. Accounting for 29 percent of the province's total panel capacity, these mills generally operate on a much small scale than Guangxi's state-owned mills. Whereas state-owned panel mills have an

average capacity of 36,000 m³/yr, privately owned mills have a mean capacity of 7,500 m³/yr. This reflects the fact that it has generally been state-owned companies that have had access to both the wood supply and financial resources needed to invest in MDF production, which involves a much larger economy of scale than other types of panels. In many cases, such investments have been made by private investors working with state-owned companies. By contrast, purely private domestic investments have often been limited to smaller scale production facilities, such as plywood and blockboard mills.

In 2003, Guangxi had only four wholly foreign-owned panel companies. These mills had a combined capacity of 285,000 m³/yr, accounting for 10 percent of the provincial total.

Table 3.5: Ownership of Panel Mills in Guangxi Province, 2003

Ownership	No. of Mills	Capacity (m ³ /yr)	% of Total Capacity
State-owned	46	1,672,000	61%
Domestic privately-owned	106	795,000	29%
Foreign-owned	4	285,000	10%
Total	156	2,752,000	100%

Data Source: Guangxi Provincial Forestry Bureau (2003)

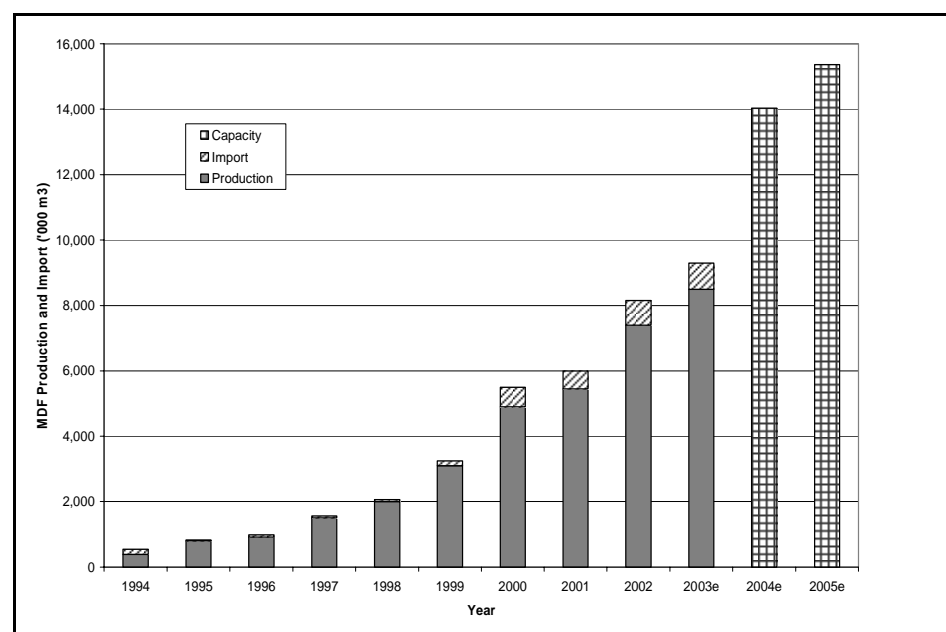
3.3 Medium and High Density Fiberboard

3.3.1 Recent Trends in China

Since the mid-1990s, MDF has been the fastest growing segment of China's wood processing sector. Installed MDF capacity has grown by an astonishing 3,300 percent over the last 12 years, increasing from approximately 450,000 m³/yr in 1994 to an estimated 15.3 million m³/yr in 2005. Capacity growth has been particularly rapid in recent years: in 2003, 40 new production lines were added with a combined capacity of 2.6 million m³/yr; in 2004, 50 new lines were added with a capacity of 4.5 million m³/yr; and in 2005, at least 13 new lines with a capacity of 1.3 million m³/yr are expected to be installed.

To put these figures in perspective, China alone is believed to account for 66 percent of the world's MDF capacity expansion during 2004-2005. With an estimated 15.3 million m³/yr of installed capacity, China has now exceeded the aggregate capacity of Europe (estimated to be 14.3 million m³/yr in 2005) and has nearly tripled the capacity of North America (which stands at 5.4 million m³/yr in 2005). The exponential growth of MDF capacity in China has largely been driven by the rapid expansion of the country's furniture industry and, to a lesser extent, the construction sector.

Figure 3.1: China's MDF Production, Imports, and Capacity, 1994-2005



Data Source: Jaakko Pöyry Consulting for 1994-2003e production and import figures; *Wood Based Panels International* for 2004-2005 production capacity estimates.

3.3.2 Industry Structure in Guangxi

Guangxi has played a significant role in the expansion of China's MDF industry, and the trajectory of the industry's growth in the province has mirrored that which has occurred at the national level. By 2003, Guangxi had 16 MDF mills with a combined 23 production lines and an aggregate capacity of 795,000 m³/yr (see Table A-1). At that time, an additional 7 MDF mills with a combined capacity of 830,000 m³/yr were under construction, as was one HDF mill with a capacity of 300,000 m³/yr. By the end of 2004, Guangxi's total medium- and high-density fiberboard capacity is estimated to have reached 1.9 million m³/yr. Currently, Guangxi's MDF capacity is surpassed only by Guangdong and Shandong provinces, and the province accounts for approximately 11 percent of China's overall MDF capacity.

In terms of operational scale, Guangxi's fiberboard mills can be divided into two general categories: 1) single line mills with production capacities of 30,000 m³/yr or less; and 2) multi-line mills with capacities of 80,000 m³/yr or more. Thirteen of the province's 26 fiberboard mills fall into the first category, with capacities ranging between 5,000 and 30,000 m³/yr. Many of these mills were built during the mid- and late-1990s with domestically produced machines. Operating with older equipment, less operational flexibility, and fewer of the benefits associated with economies of scale, these smaller mills generally run much less efficiently than their larger counterparts. In recent years, several wet-process fiberboard mills in Guangxi have been closed due to concerns about water pollution; in 2003, only two such mills remained in operation.

On the upper end of the scale, 13 of the 26 fiberboard mills that were either already operating or under construction in 2003 have production capacities of 80,000 m³/yr or more. Five of these mills have capacities at or above 150,000 m³/yr, the largest of which is a 300,000 m³/yr HDF mill built by the Sunway Group in Wuzhou prefecture in 2004. Its capacity will soon be matched by the Fenglin Group's mill in Baise prefecture, where a new 200,000 m³/yr MDF/HDF line is being added to the existing 100,000 m³/yr MDF line. Most of the larger mills have multiple production lines of 30,000 to 50,000 m³/yr, and typically at least one of these is built with an imported press. Among the larger producers, it is not uncommon for the mills to be built with a mix of imported and domestic equipment.

Most of the MDF lines operating in Guangxi – and all of those constructed with domestic machines – are built with multi-layer presses. Since 2003, however, at least three producers have installed continuous press production lines.³ Of the two types of machines, continuous presses have the advantage of being able to produce either MDF or HDF, whereas multi-layer presses can only produce MDF. Moreover, continuous presses can produce much thinner panels than multi-layer presses. Whereas the thinnest panels produced by a multi-layer press are approximately 6 mm, a continuous press can produce panels as thin as 2.5 mm.

Not surprisingly, production lines using a continuous press require a substantially greater capital investment than those using a multi-layer press – particularly when the latter are built with domestically-made, rather than imported, equipment. According to one estimate, a continuous press line with a capacity of 100,000 m³/yr would generally require an investment of approximately RMB 210 million (or US\$ 26.3 million), whereas a domestically produced multi-layer press with the same capacity would require RMB 850 million (or US\$ 10.3 million).

3.3.3 Products and Markets

Most of the MDF mills in Guangxi produce thick panels (> 8 mm), and the vast majority of this is used for furniture production. Indeed, the rapid growth of Guangdong's furniture industry has been the leading driver of MDF expansion in Guangxi over the past decade. According to Jaakko Pöyry (2003), China's domestic furniture production grew at an average rate of 16.5 percent per annum between 1995 and 2002; and by 2003, the total value of furniture production had reached an estimated US\$ 22 billion per year.

With approximately 6,000 furniture mills of various sizes, Guangdong has been China's largest center of ready-to-assemble and upholstered furniture, a substantial portion of which is produced in the special economic zones of the Pearl River Delta (BIS Shrapnel, 2004). The province particularly dominates China's furniture export market, accounting for some 54 percent of the US\$ 5.4 billion generated by the country's furniture shipments in 2002. Jaakko Pöyry (2003) estimates that in 2002,

³ These include a 100,000 m³/yr MDF line and a 300,000 m³/yr HDF line at Sunway Group's Wuzhou mill sites; a 150,000 m³/yr HDF/MDF line at Gaofeng Group's Rongzhou (Yulin) mill; and a 200,000 MDF/HDF line now being installed by the Fenglin Group at its Baise mill.

Guangdong's furniture sector consumed 7 million m³ of wood products, with wood-based panels accounting for 30 percent of this, and logs and sawnwood accounting for 69 percent.

In addition to making thick panels for furniture production, Guangxi's larger MDF and HDF mills are now producing growing volumes of thin panels (< 8 mm) for a variety of construction and interior design applications. These include the panel base for laminated flooring, interior paneling, door skins, and moulding. In addition, some producers are selling thin panels for other, more specialized end-uses, such as electronic panel boards and shoe heels. Larger mills producing higher value thin panels frequently base their production on customers' specifications.

Virtually all of the MDF and HDF producers surveyed in this study listed Guangdong as their leading destination market, with most mills selling between 70 and 90 percent of their panels there. Producers of higher value panels also reported selling smaller portions of their output to buyers in Shanghai and other markets along China's east coast. In addition, some producers reported selling increasing volumes of MDF to buyers in Sichuan, Hunan and other parts of China's Southwest region.⁴ Demand for wood panels is apparently growing rapidly in Chengdu, Chongqing, and other inland urban centers, many of which are easily reached by rail from Nanning and Guangxi's northern region.

In addition, some MDF and HDF producers reported that they have recently begun to export panels to Vietnam, in response to growing demand from that country's burgeoning furniture and electronics industries. When interviews for this study were conducted in March 2005, several producers reported that buyers in Vietnam were then paying slightly higher prices than those in Guangdong's Pearl River Delta. Panel producers in Guangxi are well-placed to respond to this growing demand due to the province's well-developed rail and road linkages with Vietnam, although some producers indicated that such shipments are often complicated by delays at customs when crossing the border. It is expected that the volume of Guangxi's MDF and HDF exports to Vietnam and to other Southeast Asian markets could increase substantially as the ASEAN economic zone develops. Significantly, Nanning hosts the permanent secretariat for the ASEAN-China Free Trade Agreement.

Until now, only a small portion of the MDF and HDF produced in Guangxi has been utilized within the province. Indeed, none of the producers interviewed during the course of this study reported selling more than 20 percent of their panels within Guangxi. This is a reflection of both the very limited furniture production and other end-use industries that exist within the province, and the strong demand that does exist in external markets. It is quite possible that this will change over the next several years as household construction accelerates in Guangxi, and as local furniture production and other types of secondary processing expand in the province.

⁴ Liuzhou Wood Mill, which operates a 50,000 m³/yr MDF mill in Liuzhou County reportedly sold 40 percent of its panels to buyers in Chengdu and Chongqing in 2004.

3.3.4 Prices and Cost Structures

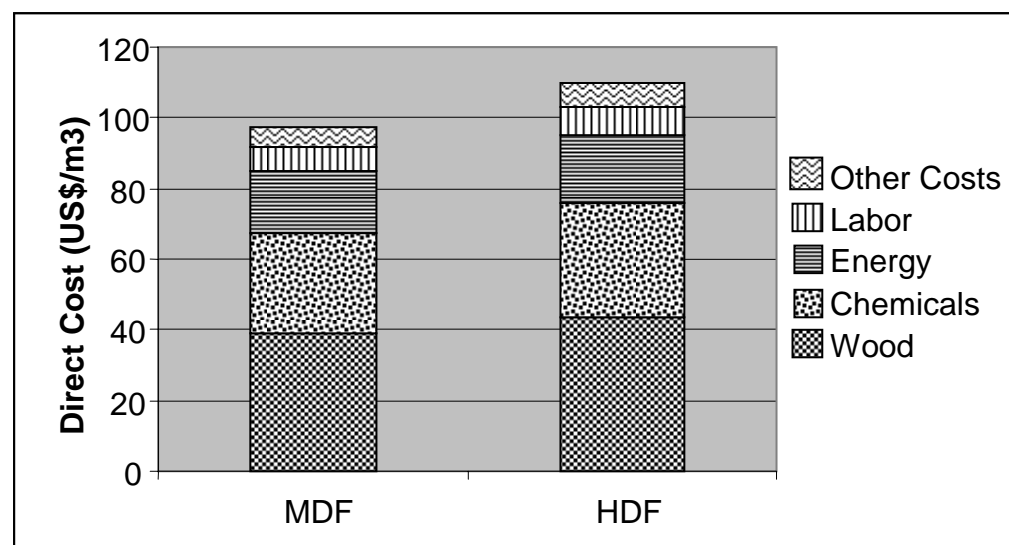
In spite of strong market demand, prices for MDF have declined slightly in recent years due to the significant new capacity that has come online. In March 2005, the average price for 12-15 mm thick panels was reported to be RMB 1,100-1,200 per m³ (US\$ 134-146). This reflects a drop from 2003 when prices for thick panels averaged RMB 1,200-1,450 per m³ (US\$ 146-177) and, and even more significantly, from 1997 when prices peaked at RMB 1,800 per m³.

Among the producers contacted during this study, direct production costs for MDF were reported to range between RMB 700-900 per m³ (US\$ 85-110 per m³), excluding depreciation (which typically would add an additional RMB 200-250 per m³). For HDF, direct costs were reported to be in the range of RMB 800-1,000 per m³ (US\$ 97-122 per m³), depending both on relative input costs and the grade of panels produced.

For both MDF and HDF production, wood and adhesives are the two most significant components of a mill's cost structure, together accounting for roughly two-thirds to three-quarters of direct production costs. Wood typically accounts for between 35 and 45 percent of a mill's direct costs. Chemicals, which include adhesives, resins, wax, and additives, typically account for between 22 and 36 percent of direct costs. Compared to other types of wood panel producers, MDF mills also use substantial volumes of energy, which generally accounts for between 15 and 21 percent of direct costs. By contrast, labor typically accounts for less than 8 percent of MDF and HDF production costs.

Figure 3.2 shows indicative direct cost structures for MDF and HDF production, as reported by 10 producers that responded to the questionnaire distributed during this study.

Figure 3.2: Indicative Direct Costs Per Cubic Meter of MDF and HDF



3.3.5 Wood Consumption

One of the main competitive advantages of MDF and HDF production is that it can utilize virtually any type or grade of wood. Most MDF and HDF producers in Guangxi obtain the majority of their fiber from wood that falls within a category known as the “three residues”. As the term suggests, this category encompasses three types of residual wood: branches obtained from thinning; tops of felled trees and irregular logs (including those with bends, holes, knots, and/or less than 2 meters in length) generated by commercial harvesting activities; and residues from wood processing operations. In addition to the “three residues”, some mills use wood chips and/or small-diameter logs for a portion of their fiber supply.

The reliance of MDF producers on residual wood is largely driven by cost. Most MDF producers contacted during this study indicated that they utilize wood with diameters as small as 3-4 cm and as large as 8 cm. Producers reported that the delivered cost for wood below 8 cm in diameter generally averages between RMB 200-210 per tonne (green wood over bark), although there is considerable seasonal variation. During low season (September-April), residual wood costs are reported to range between RMB 180-190 per tonne; and during high season (May-August), prices can reach RMB 240-250 depending on species and grade.

In many cases, MDF producers reported that they cannot afford to purchase wood with diameters above 8 cm unless it falls below commercial grade (i.e. it is classified as irregular), as sellers can usually get a higher price for commercial logs above 8 cm from sawmills. When site visits for this study were conducted in March 2005, for instance, one producer located in Nanning reported that the cost for commercial logs of 8-12 cm diameter was RMB 310 per tonne, while irregular logs and those less than 8 cm were selling for RMB 210-220 per tonne.

At the same time, several producers interviewed voiced concern over the fact that prices for residual wood have increased steadily over the last several years. The price of residual green wood from thinning and harvesting operations, for instance, has reportedly risen from an average of RMB 150 per tonne in 2000. This appears to be primarily due to the fact that the substantial new MDF capacity that has come online has outpaced plantation development. Some producers indicated that increasing competition for branches and harvest residues has led them to purchase growing volumes of wood chips and residues from other wood processing mills.⁵ The latter commonly include small-diameter poles from plywood mills (i.e. the unused core from the log peeling process), irregular and damaged sheets from veneer mills, and trimmings and unused pieces from wood panel mills, sawmills, and furniture factories.

⁵ The Fenglin Group, for instance, reportedly purchased wood chips to supply 30 percent of the fiber consumed by its 160,000 m³/yr MDF mill in Nanning. The remaining 70 percent of the mill's fiber supply came from the “three residues”. By contrast, in 2000 wood chips accounted for only 10 percent of the mill's fiber consumption. The company reported wood chip prices remaining fairly steady at RMB 380-420 per tonne.

In spite of the higher prices for commercial logs above 8 cm, some MDF and HDF producers are, in fact, using logs of up to 12 cm in diameter. One company that is doing so is the Gaofeng Group's Rongzhou Wood Panel Co., which operates a 150,000 m³/yr HDF mill near Yulin. The company reportedly uses pine logs of 8-12 cm for up to 70 percent of its fiber, for which it pays an average of RMB 250-280 per tonne. The mill's use of commercial diameter logs is, in part, a reflection of the mill's ability to pay a higher wood cost than most MDF mills because it is producing higher value thin panels. It also probably reflects the company's desire to use a more uniform wood supply in order to better control the density of the panels produced.

It should be noted that informal observations at two other MDF mills visited during the course of this study suggests that these mills are using small-diameter logs of apparently commercial length (i.e. 2 m), diameter (i.e. 8-12 cm) and quality for at least a portion of their fiber input. This is significant in that it suggests that, in practice, there may be some direct overlap in the type of wood consumed by MDF and HDF mills, on the one hand, and wood-based pulp mills, on the other. To the extent this is the case, it could signal increased competition for fiber between Guangxi's MDF and HDF producers and pulp producers as planned capacity expansion projects in both industries are carried out over the next several years.

Most MDF producers contacted for this study reported conversion rates of between 1.5 and 1.6 green tonnes of residual wood and/or small-diameter logs per cubic meter of MDF produced. One producer – the Gaofeng Wood Panel Co., which runs a two-line 120,000 m³/yr MDF mill near Nanning -- reported a conversion rate of 1.75 tonnes of green wood per cubic meter of MDF, although the mill's panels are of slightly higher density than normal MDF. The single HDF mill visited during this study reported an average conversion rate of 1.6 tonnes of green wood per cubic meter of HDF (with an average weight of 840 kg per m³), although pine generally requires more wood input than broad-leaved species due to its lower basic density.

Producers using wood chips and/or dry residues from other wood processing facilities reported conversion rates of 0.77 bone dry metric tonnes (BDMT) per cubic meter of MDF. Indicative prices provided by producers visited during this study include: RMB 380-420 per BDMT for wood chips (reported by an MDF producer near Nanning), and RMB 470 per dry tonne of wood poles and wood panel residues from plywood mills (reported by an MDF producer near Liuzhou).

Systematic data on either the real production of MDF and HDF in Guangxi or on the volumes of fiber consumed by the industry are, unfortunately, not readily available. However, the figures presented in the preceding paragraphs do allow us to estimate the volume of fiber that would be needed to produce the 1.925 million m³/yr of MDF and HDF capacity that was either installed or under construction in Guangxi in 2003. Table 6 presents a disaggregated estimate of the volumes of different fiber types that would likely be consumed by the industry to produce 1.9 million m³ of panels. A central assumption in this calculation is that green wood residues obtained from thinning and commercial harvesting operations (i.e. branches, tops, irregular logs) account for some 50 percent of the MDF/HDF industry's total fiber consumption;

small-diameter commercial logs (< 8 cm) account for 18 percent; larger commercial logs (8-12 cm) account for 7 percent; wood chips account for 10 percent; and residues from wood processing mills account for 15 percent.

To secure their fiber resource base, several of the larger MDF producers are now taking steps to develop their own plantations. The Fenglin Group, for instance, has planted 12,000 mu of eucalyptus near Nanning, and plans to plant a total of 150,000 mu at the site. Ultimately the group aims to secure 50 percent of the fiber utilized at its Nanning mill from its own plantations. Similarly, Fenglin is initiating plantation development in the area around its new Baise MDF facility, with a target of planting 300-500,000 mu over the next six years. In addition, the Gaofeng Group is collaborating with Fenglin to develop the plantations for the first phase of the Huangjiang MDF mill.

Table 3.6: Estimated Volume of Fiber Required by Guangxi's MDF and HDF Mills to Produce 1,925,000 m3 of Panels

Type of Fiber	Assumed % of Total Fiber	Approx. Volume of Panels (m3)	Fiber Conversion Ratio (per m3 panels)	Total Weight of Fiber Consumed	Average Density	Total Volume of Fiber Consumed
Green wood residue (branches, tops, irregular logs)	50 %	962,500	1.6 tonnes	1,540,000 tonnes	1.2 tonnes/m3	1,283,333 m3
Commercial logs (4-8 cm)	18 %	346,500	1.6 tonnes	554,400 tonne	1.2 tonnes/m3	462,000 m3
Commercial logs (8-12 cm)	7 %	134,750	1.6 tonnes	215,600 tonnes	1.2 tonnes/m3	179,667 m3
Wood chips	10 %	194,000	0.77 BDMT	149,380 BDMT	2.1 m3/BDMT	313,698 m3
Dry mill residue	15 %	291,000	0.77 BDMT	224,070 BDMT	n.a.	n.a.
Total	100 %	1,940,000				

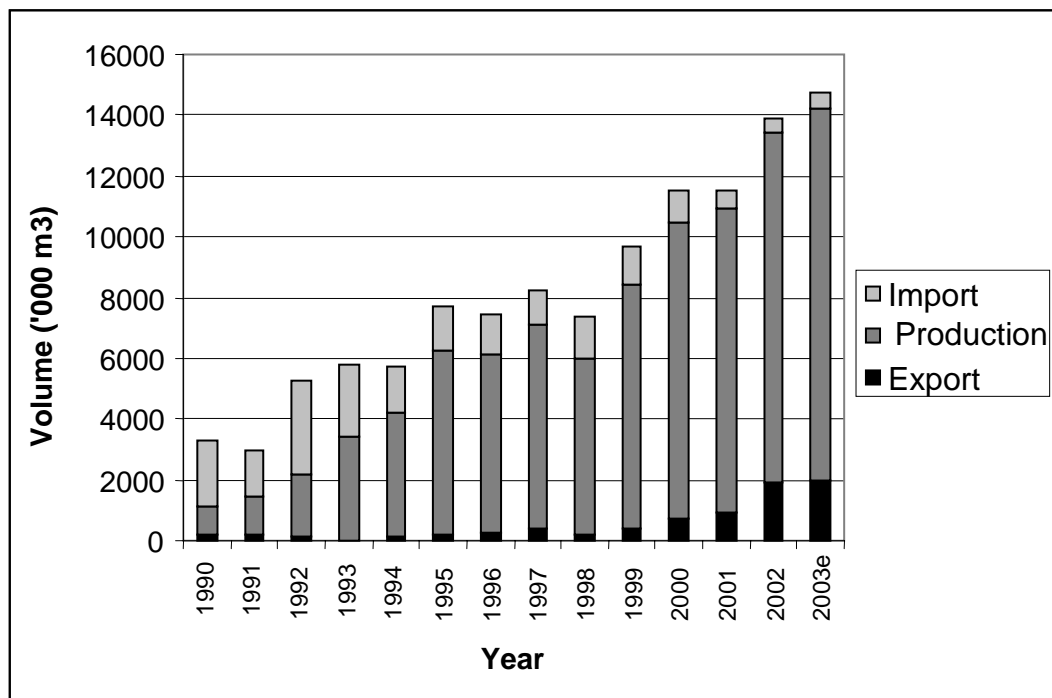
3.4 Plywood and Veneer

3.4.1 Recent Trends in China

China's plywood production has grown rapidly since the early-1990s. In 2003, domestic output is estimated to have reached 14.0 million m³, representing an increase of some 300 percent over the previous decade (see Figure 3.3). Plywood imports have fallen from 2.0-3.0 million m³/yr in the early-1990s to approximately 500,000 m³/yr at present. Indeed, China has emerged, in recent years, as a net plywood exporter with some 2.0 million m³/yr now being sold to foreign markets, particularly Japan.

China's sharp increase in plywood production has largely been driven by strong demand from the country's furniture industry and interior decoration sector, where its main applications include wall linings, doorskins, and door frame overlay. Increasing volumes of concrete-forming panels are also being used in construction. In a growing number of interior applications, plywood is now being substituted by MDF and particleboard.

Figure 3.3: China's Plywood Production and Trade, 1990-2003e



Data Source: Jaakko Pöyry (2004)

3.4.2 Industry Structure in Guangxi

Guangxi's plywood industry can be divided into two segments: 1) mills producing furniture-grade flat panels and irregular plywood; and 2) mills producing concrete-forming panels for construction. In addition, the province has large numbers of mills that produce veneer sheets which are sold to other panel producers.

According to 2003 data provided by the Provincial Forestry Bureau, Guangxi has 37 furniture-grade plywood mills above 2,000 m³/yr in capacity, with a combined capacity of 141,000 m³/yr (see Table 3.A-3). In addition, the province has a significant number of smaller plywood mills effectively operating on a household scale. However, the absence of data on these smaller mills makes it impossible to estimate their numbers or aggregate capacity.

With a median capacity of 3,000 m³/yr, Guangxi's 37 furniture-grade plywood mills are quite small by international standards. These mills are highly concentrated geographically, with over 85 percent of Guangxi's installed capacity for furniture-grade plywood located in the province's south-east region. Some 28 mills with an aggregate capacity of 81,000 m³/yr are located in Rongxian County in Yulin Prefecture alone. Four additional mills with a combined capacity of 39,000 m³/yr are located in neighboring Hezhou Prefecture.

Guangxi has 30 plywood mills that produce concrete-forming panels which, according to the 2003 data, have an aggregate capacity of 174,000 m³/yr. The median capacity of these mills is 5,000 m³/yr. Indeed, the province has only two mills with capacities of 10,000 m³/yr or more, and 22 of the 30 mills have installed capacities of 5,000 m³/yr or less. Production of concrete-forming panels is concentrated in Guangxi's northern region, which have substantial plantations of pine and Chinese fir. The largest concentration of concrete-forming plywood mills is found in Liuzhou Prefecture, which has 7 mills with a combined capacity of 49,000 m³/yr. Guilin Prefecture has 6 mills with an aggregate capacity of 36,000 m³/yr.

3.4.3 Products and Markets

Most of Guangxi's furniture-grade plywood mills focus their production on irregular panels, and only a small number of mills produce flat panels. Virtually all of these mills produce thin hardwood panels (typically < 6 mm) that are used for furniture production and, to a lesser extent, interior design. For interior design applications, thin plywood is often used for walls, door skins, and doorframe overlays.

In particular, Rongxian County has developed a niche industry for curved plywood panels that are used in the production of revolving chairs and sofas, for both home and office furniture. Over the last 15 years, Rongxian's plywood industry has emerged as the leading source of irregular panels for Guangdong furniture manufacturers, which had previously relied on bamboo to make curved panels. Some sources estimate that

approximately 80 percent of the curved panels used in Guangdong now come from Rongxian⁶

One industry actor interviewed for this study noted that irregular panels can account for 10 percent of a revolving chair's overall production costs, and it is not unusual to see an increase in prices for some types of furniture in Guangdong when raw material prices increase in Rongxian. With much of the furniture ultimately being exported to the US and European markets, Guangxi plywood producers are increasingly being asked by Guangdong furniture manufacturers to meet environmental and quality specifications required by those markets.

Concrete-forming panels are generally made from softwood and are at least 15 mm thick. These panels are exterior grade, and are widely used in construction projects that involve concrete forming. They are rarely used in other temporary or permanent construction end-uses; however, they are used to make truck beds and container decks (Jaakko Pöyry 2000).

A significant portion of the concrete-forming panels made by Guangxi's plywood producers have been utilized by the construction sector in Guangdong. Demand has been strong over the past decade as the province's rapid economic growth has been accompanied by an ongoing construction boom, with large numbers of homes, offices and infrastructure projects being built. In recent years, growing volumes of panels have also been utilized by construction projects within Guangxi, which has experienced its own construction boom, albeit on a much smaller scale

3.4.4 Prices and Cost Structures

In March 2005, plywood producers in Rongxian County reported that prices for curved panels ranged between RMB 2,200 and 2,500 per m³. Prices for flat panels were generally reported to be RMB 1,600-1,800 per m³. One producer claimed to be getting RMB 2,300 per m³ for flat panels, although this involved sales under contract with significant volumes of curved panels and careful quality control requirements to meet the buyer's product specifications.

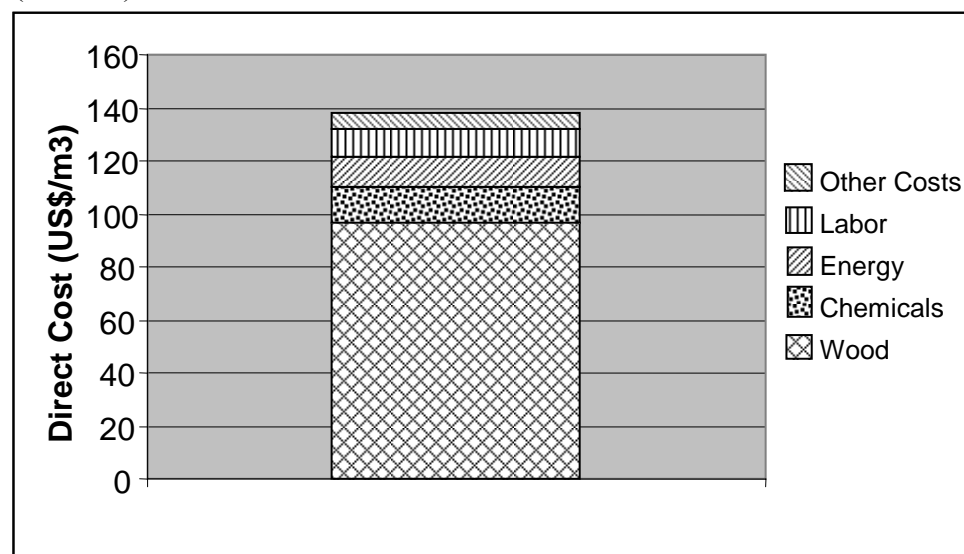
Direct production costs for irregular plywood are currently in the range of RMB 1,100-1,200 per m³ and have shown little fluctuation over the last couple of years, according to producers interviewed. At prevailing prices, this would suggest that producers are able to make quite substantial profits from the production of irregular panels. If it assumed that indirect costs typically amount to approximately 30 percent of direct costs, this would imply that producers' overall costs are in the range of RMB 1430-1560 per m³. At the prices for curved panels reported above, this suggests that net profits for producers are in the range of RMB 640-1,070 per m³.

⁶ Interview with Mr. Zhou Peide, Hongfa Furniture Mill, Rongxian, March 28, 2005. Mr. Zhou noted, with a sense of irony, that "when furniture producers in Guangdong need irregular plywood, they immediately come to Rongxian. But when buyers from the rest of China need irregular plywood, they only think to go to Guangdong."

Wood is, by far, the single largest cost component for plywood production, accounting for approximately 65-70 percent of total direct costs. (By comparison, this is significantly higher than the 30-40 percent of direct costs that wood contributes to particleboard and MDF production, respectively). Adhesives typically account for 10-12 percent of direct costs; labor for 8-10 percent; energy for 8-10 percent; and other costs for 4-6 percent.

Figure 3.4 shows a typical direct cost structure for the production of irregular plywood, as reported by producers interviewed during this study.

Figure 3.4: Indicative Direct Cost Per Cubic Meter of Irregular Hardwood Plywood (< 6 mm)



3.4.5 Wood Consumption

In contrast to reconstituted panels, plywood production requires logs that can be peeled to produce veneer sheets, which are then glued together to make the panel. Producers in Guangxi generally require logs with a minimum diameter of 8 cm and a uniform length of at least 2 meters. Using small-spindle rotaries, they normally peel the logs to a core diameter of 3-4 cm. Many plywood producers also purchase a portion of their raw material from veneer mills in the form of veneer sheets.

Most, if not all, of Guangxi's plywood mills that make thin panels for furniture production and interior decoration utilize eucalyptus for the overwhelming majority of their wood inputs. According to producers interviewed, this preference is due to three factors: First, the relative hardness of eucalyptus, particularly in comparison to pine, means that it will produce a more durable panel, with less cracking and splintering than softwood panels. Second, eucalyptus has a flexible quality that makes it easier to use for curved and irregular plywood than many other hardwoods. Third, eucalyptus is readily recognized as a plantation species, making it preferable to US buyers, which are becoming increasingly sensitive to environmental concerns associated with use of

tropical hardwoods. On average, 1.50 m³ of eucalyptus is needed to produce 1 m³ of plywood.

The use of eucalyptus by plywood producers in Rongxian County is particularly striking in that most of the wood – some 90 percent according to one producer’s estimate -- is purchased from outside Yulin Prefecture. Producers interviewed for this study reported purchasing logs from a range of sources, including Nanning, Beihai, and Guilin prefectures, at distances that sometimes reach 550 km (which involves RMB 110-120 per m³ in transport costs)..In addition, producers in Rongxian are known to purchase eucalyptus logs from Maoming and Zhanjiang prefectures from neighboring Guangdong Province.

Producers interviewed in March 2005 reported delivered wood costs of RMB 480-500 per m³ for eucalyptus logs above 8 cm in diameter and with a uniform length of 2.6 meters. The cost of veneer sheets bought in from outside veneer mills was reported to be RMB 850-900 per m³. These wood costs are substantially higher than those associated with MDF, particleboard, and pulp production, reflecting both differences in wood requirements (i.e. plywood producers need peeler logs, whereas MDF producers can utilize residual wood) and the greater wood paying capacity of plywood mills, particularly given prevailing prices for curved panels. This would suggest that there is likely to be little direct competition for raw materials between plywood producers and most other types of wood processing companies.

For concrete-forming panels, producers utilize pine and Chinese fir. The standard conversion ratio is 1.55 m³ of roundwood to produce 1.0 m³ of plywood. Data on wood cost were not analyzed during this study, due to time limitations.

As shown in Table 3.7, it can be estimated that Guangxi’s plywood industry would require approximately 481,000 m³ of roundwood to operate at full capacity according to the sector’s capacity and industry structure in 2003.

Table 3.7: Estimated Volume of Fiber Required by Guangxi’s Plywood Mills to Produce 315,000 m³ of Panels, According to 2003 Industry Structure

Type of Plywood	Volume of Panels (m ³ /yr)	Roundwood Required per m ³ Panels	Total Roundwood Requirement (m ³ /yr)
Furniture-grade panels (flat and irregular)	139,000	1.50 m ³	208,500
Concrete forming panels	176,000	1.55 m ³	272,800
Total	315,000		481,300

3.5 Particleboard

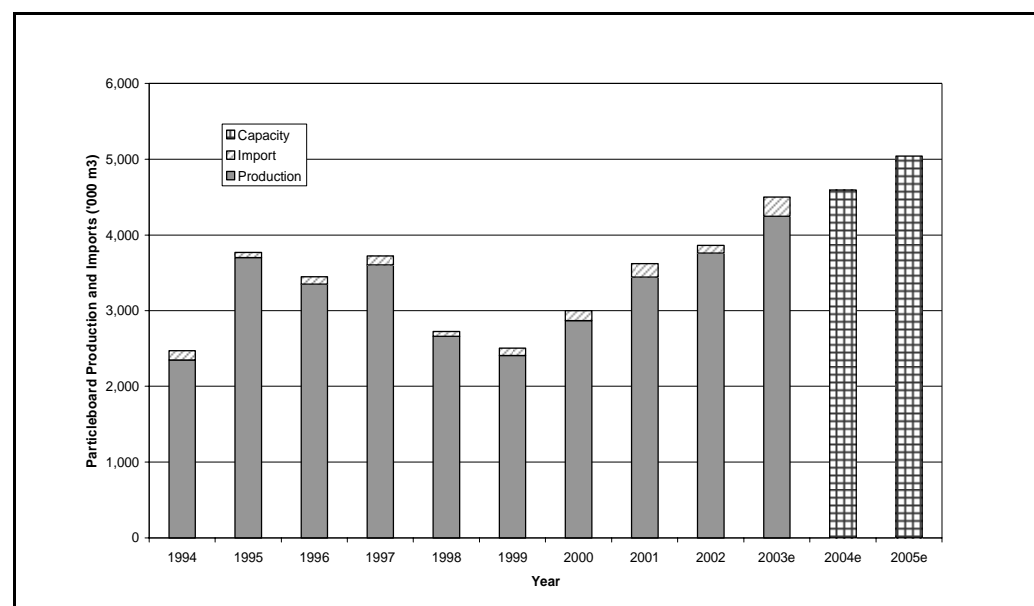
3.5.1 Recent Trends in China

In terms of installed capacity, China's particleboard industry is approximately one-third the size of the country's MDF and HDF industry. Estimates of current particleboard capacity vary considerably, ranging from 5.0 million to 6.0 million m³/yr depending on the data and assumptions used.⁷

During the decade 1994-2003, China's annual particleboard production rose from approximately 2.4 million m³ to 4.2 million m³. As Figure 3 shows, however the industry experienced a significant drop during the Asian financial crisis in the late-1990s, with annual production falling by approximately 33 percent between 1997 and 1999. Since then, the industry's annual output has climbed steadily, exceeding 4.0 million m³ in 2003, and installed capacity has also shown modest growth.

Virtually all of China's particleboard production is consumed domestically. The vast majority of this is used in furniture production and cabinetry, notably for kitchen and office use. Since the mid-1990s, particleboard imports have been relatively minimal, generally accounting for less than 5.0 percent of the country's overall consumption.

Figure 3.5: China's Particleboard Production, Imports and Capacity, 1994 – 2005e



Sources: Figures for 1994-1996 and 2003e derived from Jaakko Pöyry (2003); figures for 1997-2002 and estimates for 2004-2005 capacity are from BIS Shrapnel (2002)

⁷ BIS Shrapnel (2002), for instance, projected in 2002 that China's particleboard capacity would reach 045 million m³/yr in 2005. This was based on an estimate that installed capacity in 2002 was 4.515 million m³/yr and the assumption that the industry would grow at an average rate of 4.0 percent per year. A study by Intermark, published in *Wood Based Panels International* in 2004 estimated that China's particleboard capacity in 2002 had already reach 5.791 million m³/yr and would reach 6.091 million m³/yr by 2005 (Wadsworth 2004).

3.5.2 Industry Structure in Guangxi

According to data provided by the Guangxi Forestry Bureau, 20 particleboard mills were operating in the province in 2003, with a combined production capacity of 370,000 m³/yr. Of these, 13 producers make particleboard from bagasse, utilizing residues from harvested sugar cane. With an average production capacity of 16,400 m³/yr, bagasse-based mills account for 57.8 percent of the province's overall particleboard capacity. Nine of the 13 bagasse-based particleboard mills are located in Guangxi's southern prefectures of Nanning and Chongzuo, where much of the province's sugar cane is grown.

In 2003, Guangxi had seven wood-based particleboard mills with a combined capacity of 156,000 m³/yr. The capacities of these mills range in size from 10,000 to 50,000 m³/yr, with an average capacity of 21,600 m³/yr.⁸ Guangxi's wood-based particleboard mills are concentrated in the province's south-east region, which has three mills with a combined capacity of 86,000 m³/yr; and north region, which has three mills with a combined 60,000 m³/yr. By international standards, most of the particleboard mills in the province are relatively small and inefficient, utilizing domestically manufactured equipment to produce thick commodity grade panels.⁹

One exception is the 50,000 m³/yr mill in Wuzhou Prefecture operated by the Sunway Group, which is generally recognized as being "one of the most modern companies in the forest and wood products industry in China" (BIS Shrapnel 2002). Sunway's particleboard mill, which utilizes a single-opening press imported from Sweden in 1989, is located at a large industrial complex which is designed to capture value-added at several points along the product chain. Together, this and two nearby facilities also in Wuzhou Prefecture, include:

- Two continuous press MDF mills with a capacity of 100,000 m³/yr;
- One HDF mill with a capacity of 300,000 m³/yr;
- Three short-cycle laminating lines with a capacity of 6.0 million m²/yr;
- Two laminate flooring lines with annual output of 5.0 million m²/yr;
- A coated paper line which produces coatings for flooring with high-wear resistance, décor paper, balance paper, and furniture paper;
- A furniture production plant with an annual capacity of 60,000 pieces;
- A resin factory capable of producing 50,000 tons of formaldehyde solution and 100,000 tons of urea formaldehyde resin.

⁸ In its 2003 survey of the province's wood panel industry, the Guangxi Forestry Bureau listed Guangxi Sunway Forest Industry Group's mill in Wuzhou prefecture as the province's largest particleboard facility, with a capacity of 45,000 m³/yr. However, several other published sources put the Sunway Wuzhou mill's capacity as 50,000 m³/yr. In this report, we use the higher figure.

⁹ By comparison, imported particleboard machines generally outperform domestically manufactured machines in three aspects: 1) they typically have a larger capacity per production line; 2) they produce higher quality panels (with finer particles, higher densities, and more refined surfaces); and 3) they use considerably less energy per unit of production. The manager of the Sanmenjiang Particleboard Mill in Liuzhou noted, for instance, that his mill – which has two 5,000 m³/yr lines using domestic equipment – typically consumes 140 kilowatts per cubic meter of panels, whereas the Sunway mill in Wuzhou requires only 50-60 kilowatts per cubic meter.

Within this highly integrated operation, Sunway's particleboard mill supplies panels to the company's furniture plant, which exports some 60,000 pieces of panel based furniture annually. With the capacity to produce E1 quality panels, the company's panel furniture components generally meet high quality standards and are utilized by IKEA, among others. In addition, the company uses both particleboard and MDF to produce overlaid panels. Sunway is the leading supplier of overlaid panel in Southern China (BIS Shrapnel 2002).

3.5.3 Products and Markets

Most of the particleboard produced in Guangxi is used for furniture and cabinetry applications. Some producers reported that a portion of their panels are used in the manufacturing of loud speakers and electronic panels. In some parts of China, particleboard also has a variety of end-use applications in packaging, ships, and trains. To a much lesser extent, particleboard is used in construction, particularly residential construction, where it can function as the base for reinforced or laminated flooring.

As with MDF, the vast majority of the particleboard produced in Guangxi is sold to furniture producers in Guangdong. Given its generally lower quality and lower price compared to MDF, a substantial portion of the particleboard produced in Guangxi – perhaps as much as 30 percent – is also sold to end-users within Guangxi itself. In addition, some producers reported that Vietnam, with its burgeoning furniture sector, is rapidly emerging as an important market. For example, the Sanmenjiang Forest Farm Particleboard Mill, which has a two-line facility (10,000 m³/yr capacity) in Liuzhou Prefecture, reported that orders from Vietnam have risen sharply since 2003 and that the mill now sells 35-40% of its product to Vietnamese producers.¹⁰

3.5.4 Prices and Cost Structures

In March 2005, particleboard prices in Guangxi were reported to be RMB 900 per m³ for 9 mm panels and RMB 750-800 per m³ for 16 mm panels. According to producers interviewed for this study, prices have been fairly stable in recent years, showing relatively little fluctuation.

Medium-scale producers using domestic equipment reported direct costs for thick panels (16 mm) to be in the range of RMB 600-700 per m³, excluding depreciation. As with MDF production, wood and chemicals are the two most significant direct costs, together typically accounting for over 60 percent of a mill's production costs. Among the mills surveyed for this study, wood purchases represented between 19.8 and 37.1 percent of overall direct costs.¹¹ The purchase of chemicals accounted for

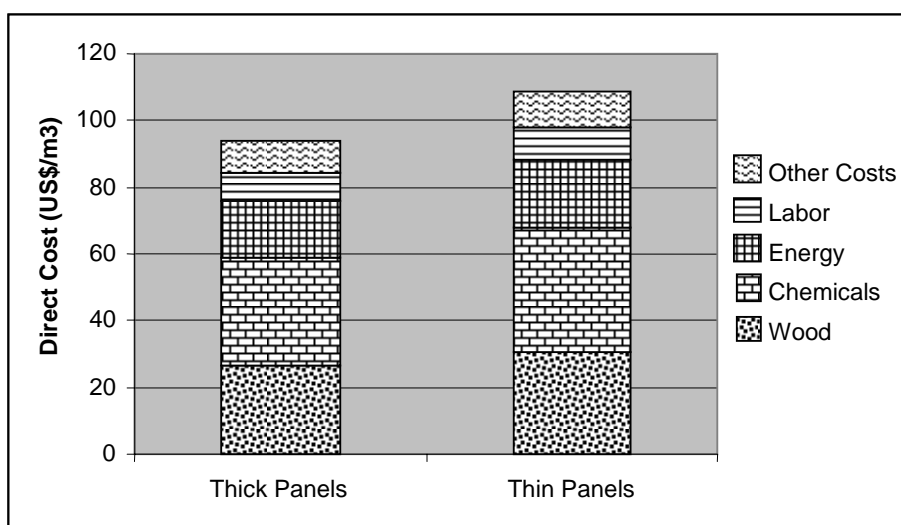
¹⁰ At the same time, however, the mill manager at Sanmenjiang Forest Farm Particleboard Mill noted that at least one new particleboard mill is now being constructed in Vietnam; it is quite possible that further capacity increases in that country could limit demand for particleboard from Guangxi.

¹¹ Three particleboard producers completed sections related to production costs structures on the questionnaire distributed during this study. These included two mills with a designed capacity of 18,000 m³/yr apiece, and one with a designed capacity of 15,000 m³/yr.

between 31.4 and 35.9 percent of direct costs. Energy costs ranged between 13.2 and 22.5 percent of direct production costs, suggesting that some producers are far more energy efficient than others. Labor costs ranged between 8.6 and 9.6 percent of direct costs, suggesting that particleboard production is slightly more labor intensive than MDF production.

Figure 3.6 shows an indicative direct cost structure for particleboard production, as reported by three producers that responded to the questionnaire distributed during this study.

Figure 3.6: Indicative Direct Costs Per Cubic Meter of Particleboard



3.5.5 Wood Consumption

Even more so than MDF and HDF producers, Guangxi's particleboard mills rely almost exclusively on residual wood for their raw material supply. This includes both green wood residues (branches, tops, and irregular logs) and residues from other wood processing mills (i.e. damaged and irregular veneer, sawdust, and residues from furniture and panel factories). There is some utilization of purchased wood chips, but this is believed to be quite small.

According to the limited sample of firms contacted during this study, particleboard producers typically source 50-60 percent of their raw materials through purchases of residues from other mills (or, in the case of integrated operations, through internal transfers of such materials). This is due to the relatively low cost of mill residues compared to residual wood from harvesting operations. In Liuzhou Prefecture, for instance, sawdust and residues from furniture factories were reported to cost RMB 80-90 per tonne, compared to RMB 120-130 per tonne for veneer residues and RMB 160-180 per tonne for green wood residues. Some particleboard producers also reported growing competition for residual wood from MDF and HDF producers, which generally have a higher wood-paying capacity than particleboard mills. It is

estimated that Guangxi's particleboard producers, on average, obtain 35-45 percent of their wood from green wood residues and no more than 5 percent from purchased wood chips.

Based on these assumptions, Table 3.8 shows presents a disaggregated estimate of the volumes of different fiber types that would likely be consumed by Guangxi's particleboard industry if it were to operate at its 2003 capacity level of 156,000 m³/yr.

Table 3.8: Estimated Volume of Fiber Required by Guangxi's Wood-Based Particleboard Mills to Produce 156,000 m³ of Panels

Type of Fiber	Assumed % of Total Fiber	Approx. Volume of Panels (m ³)	Fiber Conversion Ratio (per m ³ panels)	Total Weight of Fiber Consumed	Average Density	Total Volume of Fiber Consumed
Green wood residue (branches, tops, irregular logs)	40 %	62,400	1.7 tonnes	106,080 tonnes	1.2 tonnes/m ³	127,296 m ³
Commercial logs (8-12 cm) for veneer	5%	7,800	1.5 m ³			11,700 m ³
Wood chips	5 %	7,800	0.77 BDMT	6,006 BDMT	2.1 BDMT/m ³	12,612 m ³
Dry mill residue	50 %	78,000	0.77 BDMT	60,060 BDMT	n.a.	n.a.
Total	100 %	156,000				

3.6 Wood-Based Pulp Production

3.6.1 Recent Trends in China¹²

During the last 15 years, China has emerged as a leading player in the global pulp and paper sector. China has accounted for more than 50% of the world's overall growth in paper and paperboard production since 1990, when the country produced an aggregate of 13.7 million tonnes across all grades. With 43.0 million tonnes of paper and board production in 2003, China is now the world's second largest producer, surpassed only by the United States. The country's aggregate paper and board production is expected to reach 68.5 million tonnes per year by 2010, as domestic producers modernize their operations and as international producers seek to capture a share of China's growing market (He and Barr 2004).

Historically, China's domestic pulp industry has been structured around large numbers of small-scale mills relying heavily on nonwood fibers, including bamboo, bagasse, wheat straw and other agricultural residues. More recently, however, much of the new paper and board capacity now coming online relies on recovered paper obtained from both domestic sources and imports (Spencer 2004). Demand for wood-based pulp is also growing rapidly, particularly as China's production of printing and writing paper and other high-grade papers has expanded.

A recent forecast projects that by 2010, China's paper and board industry will consume some 60 million tonnes of fiber annually across all types and grades – that is, recovered paper, nonwood pulp, and wood-based pulp (He and Barr 2004). On a national scale, demand for various grades of wood-based pulp is expected to reach 15.1 million tonnes per year by 2010 -- up from 9.2 million tonnes in 2003 -- at which point wood pulp will account for approximately 25 % of total fiber consumed by Chinese producers. Bleached hardwood kraft pulp (BHKP) and bleached softwood kraft pulp (BSKP) are expected to account for roughly two-thirds of this demand, while unbleached kraft pulp (UKP) and mechanical and semi-mechanical wood pulp account for the remainder.¹³

To meet this growing demand, the Chinese government has aggressively promoted the development of a domestic wood pulp industry. It has done so by setting ambitious capacity expansion targets for projects that integrate wood pulp and high-grade paper production and by allocating several million hectares for the establishment of fast-growing pulpwood plantations. The provinces of Guangdong, Hainan, and Guangxi along China's south coast currently represent the most active region for the development of wood-based pulp production. In late 2004, Asia Pulp & Paper (APP) initiated production at its 1.0 million Adt/yr BHKP mill in Hainan. APP and Stora

¹² This section has been extracted from C. Barr and C. Cossalter (2004) "China's Development of a Plantation-based Wood Pulp Industry: Government Policies, Financial Incentives, and Investment Trends," *International Forestry Review*, December.

¹³ Specific projections of demand for the various grades of wood pulp in 2010 are as follows: BHKP -- 6.1 million tonnes; BSKP -- 4.3 million tonnes; UKP -- 2.2 million tonnes; and mechanical/semi-mechanical wood pulp -- 2.3 million tonnes (see He and Barr 2004).

Enso are also assessing plans for either CTMP and/or BHKP mills in Guangxi, although these have not yet been finalized. (These will be discussed further in Chapter 5 on projected wood demand in Guangxi).

3.6.2 Industry Structure in Guangxi

There is a general lack of detailed data on the production capacities and operational levels of individual mills in Guangxi's pulp and paper sector, and this project has not yet been able to compile a complete list of mills with installed capacities by major grade of product. In particular, little specific information is available on the types of fiber used by most producers. However, Guangxi's Development and Reform Committee offers the following general figures regarding the relative proportions of fiber types consumed by the province's paper mills: bagasse fiber (35 %); wood pulp (30 %); waste paper (30 %); and bamboo pulp (5 %).

According to the Development and Reform Committee figures, Guangxi has 14 paper-making enterprises with capacities over 10,000 Adt/yr that utilize wood pulp as a raw material source. At the same time, a 2000 survey of forest industries in Guangxi produced by the Provincial Forestry Bureau identified 18 wood-based paper and paperboard mills and two mills producing wood-based market pulp. However, details concerning these mills' capacities by grade of product or the types of pulp produced and/or utilized were not provided in a format that would make it possible to estimate the volumes and types of wood fiber utilized.

This project has been able to identify seven mills in Guangxi with wood-based pulp production capacities of 20,000 Adt/yr or more (see Table 3.9). Of these, at least two mills – Nanning Phoenix and Heda – are known to produce market pulp, and four mills are directly integrated with paper and paperboard production. It is unclear whether Guangxi Guofa's 80,000 Adt/yr bleached hardwood kraft pulp (BHKP) mill is an integrated operation or structured to produce market pulp.

In terms of operational scale, there is a clear distinction between bleached kraft and mechanical pulp producers. The two mills producing thermo-mechanical pulp (TMP) have wood pulping capacities of 20,000 Adt/yr. By contrast, the three bleached kraft pulp producers have wood pulping capacities of 70,000-100,000 Adt/yr. Producers of unbleached kraft pulp (UKP) appear to operate at an intermediate scale, ranging from an estimated 20,000 Adt/yr at the Wanli Paper mill to 50,000 Adt/yr at Lipu Paper.

3.6.3 Wood Consumption

To estimate the volumes of wood consumed by Guangxi's pulp industry, we use the following conversion figures:

- 2.5 m³ of roundwood per 1.0 Adt of TMP;
- 4.15 m³ of roundwood (eucalyptus) per 1.0 Adt of BHKP.
- 4.7 m³ of roundwood (pine) per 1.0 Adt of UKP or BSKP;

Using these conversion factors, we estimate each producer's effective demand for hardwood and softwood fiber in Table 3.10. It should be noted that these figures assume that each mill's wood-pulping capacity is fully utilized. Systematic data on capacity utilization rates in the sector are not available. However, anecdotal information suggests that while some producers may operate below their full capacity for certain periods, many mills are now running their wood pulping operations at or above their designed capacities due to strong market demand. It should also be noted that these calculations only cover mills with wood pulping capacity > 20,000 Adt/yr.

From these calculations, it is estimated that effective wood demand from Guangxi's seven intermediate or large-scale wood pulp mills at 2004 capacity levels is just under 1.1 million m³ of softwood and approximately 477,000 million m³ of hardwood.

The following sections provide brief profiles of the fiber supply strategies of three of Guangxi's wood-based pulp mills.

Table 3.9: Current Capacity of Wood Pulp Producers in Guangxi Province, 2005

No	Company Name	Type of Enterprise	Location		Start Date	Paper & Paperboard		Wood Pulp		Comments on Fiber Supply
			County	Prefecture		Major Grades	Capacity (Adt/yr)	Major Grades	Capacity (Adt/yr)	
1	Guangxi Nanning Phoenix Paper	SOE	Nanning	Nanning	1996			BSKP	120,000	Co. uses 500-600,000 m3/yr of southern pine and masson pine; 40% sourced as pulpwood logs, 60% as woodchips. Co. has 80,000 mu plantations.
2	Guangxi Guofa Forestry Paper Co. Ltd.	SOE (?)	Luzhai	Liuzhou	1971			BHKP (?)	80,000	*BHKP production is unconfirmed
3	Guangxi Heda Pulp & Paper Co.	SOE	Hezhou	Hezhou	1996			BSKP, BHKP	70,000	Co. uses masson pine & eucalyptus; now establishing 100,000 mu plantation base
4	Guangxi Forestry Lipu Paper Industry	Collective	Lipu	Liuzhou	1970	Linerboard		UKP	50,000	Planned expansion: 50,000 Adt/yr UKP, pine furnish
5	Zhaoping County Hexing Paper Industry	Private	Zhaoping	Hezhou	2002	Packaging	35,000	TMP	est. 20,000	Co. also produces chemical bamboo pulp
6	Guangxi Liujiang Paper-making Mill	SOE	Liuzhou	Liuzhou	1975	Newsprint; P&W paper		TMP	20,000	Also has 2 lines of chemical bamboo pulp (total capacity = 75,000 Adt/yr); plans to add 170,000 Adt/yr bleached chemical bamboo pulp
7	Guangxi Rong County Wanli Paper Mill	Private	Rongxian	Yulin	1992	Kraft paper; packaging; mosaic paper	25,000	UKP	est. 20,000	Currently almost 100% pine furnish, but moving towards 50% eucalyptus

Note: Adt = air-dried tonnes; BSKP = bleached softwood kraft pulp; BHKP = bleached hardwood kraft pulp; UKP = unbleached kraft pulp; TMP = thermo-mechanical pulp

Table 3.10: Effective Wood Demand from Mills with > 20,000 Adt/yr Wood Pulp Capacity, 2005

No	Company Name	Wood Pulp		Softwood		Hardwood	
		Major Grades	Capacity (Adt/yr)	Conversion Factor* (m3/Adt)	Volume (m3)	Conversion Factor* (m3/Adt)	Volume (m3)
1	Guangxi Nanning Phoenix Paper	BSKP	120,000	4.70	564,000		
2	Guangxi Guofa Forestry Paper Co. Ltd.	BHKP	80,000			4.15	332,000
3	Guangxi Heda Pulp & Paper Co.	BSKP**	35,000	4.70	164,500		
		BHKP	35,000			4.15	145,250
4	Guangxi Forestry Lipu Paper Industry	UKP	50,000	4.70	235,000		
5	Zhaoping County Hexing Paper Industry	TMP	20,000	2.50	50,000		
6	Guangxi Liujiang Paper-making Mill	TMP	20,000	2.50	50,000		
7	Guangxi Rong County Wanli Paper-making Factory	UKP	20,000	4.70	84,600		
Total					1,157,500		477,250

Note: *The conversion factor refers to the volume of roundwood required to produce 1.0 air-dried tonnes (Adt) of pulp.

** It is assumed that Guangxi Heda's output is divided evenly between BSKP and BHKP

3.6.4 Nanning Phoenix Pulp & Paper Co.

The Guangxi Nanning Phoenix Pulp & Paper Co. is a partially state-owned mill located in Nanning Prefecture which started production in 1999.¹⁴ It has an installed capacity of 120,000 Adt/yr and can produce either bleached softwood kraft pulp (BSKP) or bleached eucalyptus kraft pulp (BEKP). Over the past year, the mill has sought to raise production from an estimated 100,000 Adt in 2004 to 120,000 Adt in 2005. At present, all of the mill's output is BSKP and 100 percent of this is sold as market pulp. Nanning Phoenix is the largest producer of BSKP in southern China.

The company reports that it consumes 500-600,000 m³ of softwood fiber on an annual basis. Most of this is Masson pine, and a small portion is Southern pine. The mill obtains approximately 40 percent of its wood in the form of pulpwood logs; and 60 percent in the form of woodchips. The mill purchases wood chips from approximately 50 chip plants located within a 200 km radius of the mill. The largest of these supplies 10,000 BDMT/yr, while most supply an average of 5,000 BDMT annually.

Nanning Phoenix reportedly has some 80,000 mu of plantations. It is not clear what portion of these is already mature and ready for harvest. However in interviews, company officials expressed concern that they sometimes find it difficult to obtain harvesting permits. As such, they generally prefer to purchase wood from external suppliers. Company officials also voiced concerns that softwood production levels in Guangxi will decline over the medium term, as many areas where pine is being harvested are now being replanted with eucalyptus. In the event this leads softwood prices to increase substantially, the company is prepared to shift production to eucalyptus-based BHKP.

Information on the mill's delivered wood cost is not available. However, company officials did note that the mill's wood costs are quite high compared to BSKP producers in other countries. They indicated that wood accounts for approximately two-thirds of the overall pulp production cost.

3.6.5 Guangxi Liujiang Paper Mill

Guangxi Liujiang Paper Mill (Yinou Pulp & Paper Co.) is located in Liuzhou Prefecture, approximately 130 km from Guilin. The mill has five paper and paperboard production lines, with an installed capacity of 170,000 Adt/yr. The mill produces newsprint, writing paper, cup-based paper, and white board. In 2004, the mill produced 40,000 tonnes of offset newsprint; 10,000 tonnes of offset book paper; 10,000 tonnes of cup-based paper; and 10,000 tonnes of white board. In addition, the mill also sold some 20,000 tonnes of commercial bamboo pulp.

¹⁴ The Guangxi Forestry Bureau reportedly has a 50 percent share in Nanning Phoenix, and the remaining 50 percent is divided between collectively owned and privately held shares.

Liujiang Paper is the largest producer of bleached chemical bamboo pulp in Guangxi, with two lines with annual capacities of 35,000 Adt/yr and 40,000 Adt/yr, respectively. In addition, the mill has one wood-based pulp production line, capable of producing 20,000 Adt/yr of CTMP. The mill typically boils the wood and bamboo fibers separately, and then combine these once they are in the form of pulp to achieve the desired fiber mixes in the mill's various paper and board products.

In 2004, the mill consumed some 200,000 tonnes of whole stem bamboo. Most of its bamboos supply is secured through contracts with government-owned bamboo farms and individual growers. In some cases, the company has made investments in bamboo plantations, but these have been quite limited. In March 2004, the delivered cost of bamboo fiber was reported to be RMB 300/tonne within a 150 km radius of the mill. The company uses 4.0 tonnes of wet bamboo to produce 1.0 tonnes of chemical bamboo pulp.

By comparison, the company reports that it purchased some 60,000 m³ of pulpwood in 2004. Most of this was pine, with a small volume of eucalyptus. Approximately 80 percent of the wood the mill purchases is commercial roundwood with a diameter of 12-18 cm; the remaining 20 percent is 8-12 cm in diameter. The company reports that it prefers to use larger diameter logs because they have higher fiber content. This is important in the mill's effort to produce a mechanical pulp with sufficient fiber content to achieve the desired specifications of its paper furnish, as the mechanical pulp is generally mixed with bamboo pulp.

In March 2005, reported wood costs were RMB 450-460 per m³ for pine logs of 12-18 cm diameter; and RMB 380 per m³ for pine logs of 8-12 cm. The company purchases all of its pine wood from nearby forest farms and from timber brokers. The company reported that it is unable to purchase pine from farmers, though the reason for this was not entirely clear.

Liujiang Paper is now installing a new chemical bamboo pulp line with a capacity of 170,000 Adt/yr. Once this comes on line in 2006, this is expected to increase the mill's consumption of raw bamboo from approximately 200,000 tonnes to 1.0 million tonnes per year. The mill will continue to use mechanical wood pulp, however the portion of wood in the total volume of fiber consumed by the mill on an annual basis will decline.

3.6.6 Guangxi Rong County Wanli Paper Mill

The Guangxi Rong County Wangli Paper Mill is a privately owned mill located in Yulin Prefecture. It has four production lines with a total designed capacity of 15,000 Adt/yr, although actual capacity is reported to be 25,000 Adt/yr. The company is currently installing a fifth line with a capacity of 15,000 Adt/yr, which is scheduled to begin production trials in June 2005. The mill's main products are packaging, kraft paper, sack kraft, paper bags, and mosaic paper. All of its products are made with wood pulp, and the company uses some bamboo fiber in its furnish; the mill does not

use recycled content or other nonwood fibers. The company is now trying to increase the volumes of bamboo fiber that it uses.

Until now, nearly 100 percent of the wood fiber consumed by the mill has been pine, and the mill has used relatively small volumes of eucalyptus and other types of hardwoods. When interviewed for this study, the firm's General Manager attributed the mill's predominant use of pine to the fact that its fibers are more suitable for the production of sack kraft, one of the mill's main products, which requires the flexibility of softwood fibers. Moreover, until now pine has been more readily available for local use in the Yulin region, while eucalyptus is largely channeled to the export market due to strong demand from Japanese, Taiwanese, and South Korean buyers.

Some 80 percent of the wood used at the mill is 8-12 cm in diameter. In March 2005, delivered wood costs at the mill were reported to be in the range of RMB 290-300 per tonne (over bark) for pine logs > 8 cm and RMB 270-280 per tonne (over bark) for pine logs < 8cm. Other species were reported to cost RMB 230-250 per tonne for logs > 8cm; and RMB 200-220 per tonne for logs < 8cm. Irregular and residual wood was reported to sell at prices RMB 20-30 per tonne less than 4-8 cm logs.

Over the next 5-7 years, the company reportedly plans to move towards a wood furnish that is roughly 50 percent pine and 50 percent eucalyptus. In part, this reflects a shifting product mix, as the company plans to begin producing bleached office paper, which would utilize 100 percent eucalyptus fiber. In part, it also reflects growing competition for the area's declining pine resource base, particularly from MDF and HDF producers in the region. The company expects that increased use of eucalyptus will lower costs in two ways: First, eucalyptus is grown on a much shorter rotation than pine (i.e. 4-6 years as opposed to 15 years), which should result in significantly lower stumpage costs (although ultimately prices will depend on overall demand). Second, eucalyptus requires much less chemical use in bleaching than pine, which should reduce processing costs.

To secure its wood fiber supply over the medium- to long-term, the company is developing plans to establish a eucalyptus plantation base. It is considering a share-cropping model in which the company would finance farmers to develop the plantations on their own land; under the agreement, the farmers would provide a portion of the wood to the mill at harvest and would give the mill first option to purchase the remainder at market prices. The company has not yet determined how much area it will seek to plant under such an arrangement. However, under the provincial government's current policy to increase integration between pulp mills and plantations, the company is required to develop 20,000 mu to support its new 15,000 Adt/yr production line.

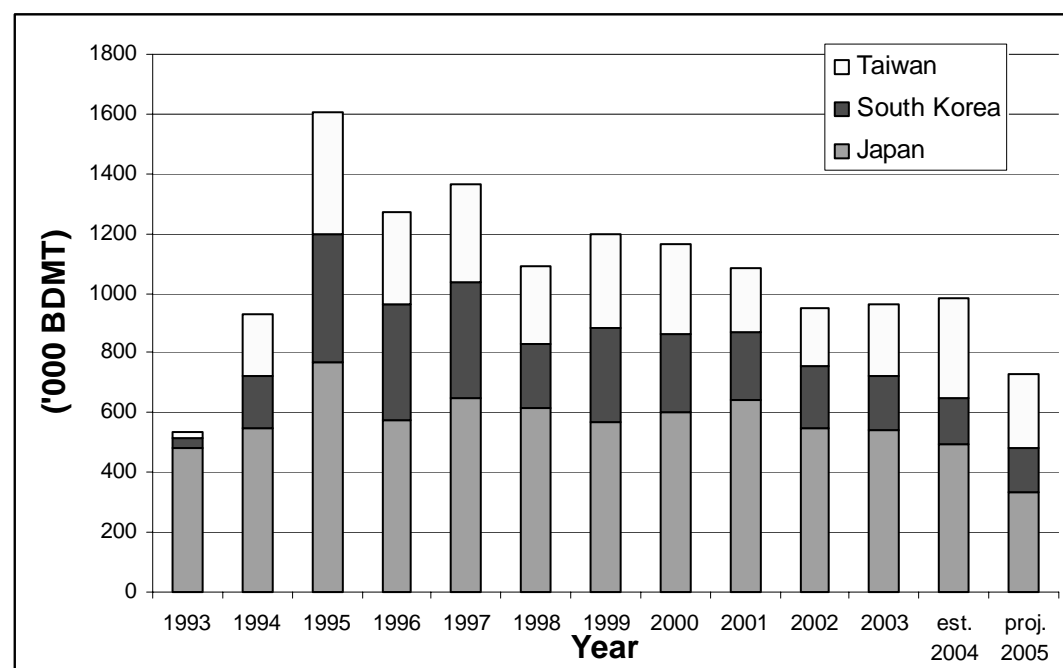
3.7 Wood Chips

3.7.1 Recent Trends in China

China began exporting wood chips in the late-1980s and has exported over 700,000 BDMT/yr of wood chips since 1994. As Figure 3.7 shows, wood chip exports peaked in 1995 when they reached 1.6 million BDMT, and they have slowly declined since then. In 2004, chip exports are estimated to have reached 980,000 BDMT. During this period, virtually all of China's wood chip exports have gone to three destination markets: Japan, South Korea, and Taiwan.

In South China, the provinces of Guangdong, Hainan, and Guangxi have emerged as a significant source of wood chip exports since the region's eucalyptus plantations came online in the early-1990s. In 2004, these three provinces accounted for some 80 percent of the country's total chip exports. It is projected, however, that the volumes of chips exported from South China will decline sharply in 2005, as growing volumes are consumed by APP's 1.0 million Adt/yr BHKP mill in Hainan and the Shandong Rizhao pulp mill in Shandong.

Figure 3.7: China's Wood Chip Exports by Destination Market, 1993-2005 (projected)



Data Source: DANA/WRI (2005)

3.7.2 Industry Structure in Guangxi

Guangxi's wood chip industry, as noted in Section 1 above, is composed of 213 chip mills with an aggregate annual capacity of over 1.3 million BDMT. These mills are heavily concentrated in the South and South East regions of the province, with their

distribution corresponding generally to the geographic distribution of eucalyptus plantations.

Table 3.A-6 presents a select list of 35 wood chip mills that responded to questionnaires distributed during this study. These mills range in capacity from 1,500 BDMT to 60,000 BDMT per year, and their median scale is 6,000 BDMT/yr. On aggregate, these mills reported producing some 269,000 BDMT in 2004, representing an overall capacity utilization of only 57.3 percent. To no small degree, this appears to be influenced by low capacity utilization rates on the part of the industry's largest producers. Of the 35 companies sampled, the 10 chip mills with installed capacities over 10,000 BDMT/yr operated on average at 53.6 percent of their capacity in 2004. By contrast, the 25 mills with capacities below 10,000 BDMT/yr operated on average at 80.9 percent of their capacity.

It is not clear what accounts for the lower average capacity utilization rates on the part of the larger mills. However, if the average capacity utilization rate of the mills in the sample were applied to the industry as a whole, it would suggest that Guangxi wood chip mills produced approximately 741,000 BDMT in 2004. It should be emphasized that this is only a very rough estimate and is not necessarily an accurate reflection of real production levels. At the same time, DANA and Wood Resources International (2005) estimate that Guangxi exported some 62,000 BDMT to the Japanese buyers through the ports of Fangcheng and Beihai. This figure represents a decline of 63 percent from 2001 when 168,000 BDMT was exported through these ports.

3.7.3 Prices and Cost Structures

The cost of wood, not surprisingly, accounts for most of the direct costs associated with wood chip production, as the process involves little more than putting raw logs through a chipping machine. Among the 35 companies surveyed, average direct costs were structured as follows: wood (82.9 %); energy (2.9 %); labor (8.6 %); and maintenance and other costs (5.7 %).

The conversion ratios for cubic meters of wood per BDMT, as published by Japan's Ministry of Finance, are 1.63 m³/BDMT for Chinese hardwood and 2.04 m³/BDMT for Chinese softwood (cited in DANA/WRI 2005). These figures would suggest, for example, that if delivered roundwood costs for eucalyptus were RMB 280 per m³ (US\$ 33.80), then the cost of wood per 1.0 BDMT of eucalyptus chips would likely amount to approximately RMB 456 (US\$ 55.12). Assuming that the cost of wood amounted to 82.9 percent of the total wood chip cost, then the production of 1.0 BDMT can be estimated to cost RMB 550 (or US\$ 66.43).

Similarly, if the delivered cost of pine logs is RMB 300 per m³ (US\$ 36.23), then the cost of wood per 1.0 BDMT of softwood chips would likely amount to approximately RMB 612 (US\$ 73.91). Assuming that the cost of wood amounted to 82.9 percent of the total wood chip cost, then the production of 1.0 BDMT can be estimated to cost RMB 738 (US\$ 89.16). It should be emphasized that these cost calculations are merely estimates provided for indicative purposes.

To put these figures in perspective, Table 3.11 shows the FOB price of wood chip exports from South China, by destination country, during the period 1995-2004 (DANA/WRI 2005). In nominal terms, the price of eucalyptus chips has ranged from a low of US\$ 82-84 per BDMT in 2002 to a high of US\$ 117.5 per BDMT in 1996. Overall, the price of eucalyptus has been strengthening steadily over the last three years, and during the second half of 2004, it averaged US\$ 101 per BDMT (an increase of some 11 percent over the second half of 2003). Until 2005, exporters also benefited from the governments policy of providing a value-added tax (VAT) rebate of 13 percent (FOB price basis) on wood chip exports.¹⁵

It is expected that with increased demand for wood chips from APP's BHKP mill in Hainan and the Rizhao mill in Shandong Province, both of which have come online over the last year, there is likely to be a steady decline in wood chip exports from South China. It is expected that a growing volume of wood chips from Guangxi may be channeled to one or both of these mills. More significantly, perhaps, it is also expected that over time substantial internal demand will emerge if one or both of the large-scale wood pulp mill projects that have been proposed by APP and Stora Enso on the province's south coast are ultimately developed.

¹⁵ As DANA/WRI (2005) explains, "In 2004, the VAT payment rebate made to Chinese woodchip exporters was to be revoked. In fact, this rebate was revoked for logs, lumber, pulp and paper, etc., but as of the end of 2004 had still not been revoked for woodchip exports. We assume that this VAT rebate will be revoked sometime in 2005, which will effectively mean that selling to domestic buyers will become about 13% (FOB basis price) more attractive than it had been, relative to exports. That is, the attractiveness of selling into the export market will reduce by the percentage of the VAT rebate."

Table 3.11: Hardwood Chip Prices by Species/Destination Country, 1995-2004 (US\$ per BDMT FOB)

Destination Country	1995	1996	1997	1998	1999	2000	2001	2002	2003 H1	2003 H2	2004 H1	2004 H2
Japan												
Eucalyptus	115	117.5	110	105	95-100	87	85	82-84	86	90	93.5	101
Mixed Hardwood	120	120	112.5	113	109	101.5	101.5	90	90	93	100	110
Taiwan												
Eucalyptus	100	95	85	80	80	72	73	72	83	87	90	99
Mixed Hardwood				100	95	80-85		85	90	93	91	91
Korea												
Casuarina	100	110	105	97.5	92.5	95	95	95	86	90	95	100.5
Mixed Hardwood	115	110	105	110	106	92-97	95	89	90	93	98	102

Data Source: DANA/WRI 2005

3.7.4 Wood Consumption

Of the 35 wood chip producers that responded to this study's survey, most rely exclusively or predominantly on residual wood for their raw materials. Fifteen respondents indicated that their companies rely on 'waste wood' for 100 percent of their wood inputs; while 13 reported that their companies use a mix of 'wood waste' and small-diameter commercial logs but with 'wood waste' accounting for over 50 percent of the fiber consumed. Six respondents reported that their mills rely on small-diameter logs for over 50 percent, and only one reported that his company relies on small-diameter logs for 100 percent of the fiber consumed. From these figures, we can assume (very roughly) that approximately 70 percent of the fiber consumed by wood chip producers in Guangxi is some form of 'wood waste'; while 30 percent are small-diameter logs.

As noted earlier, 'wood waste' is a term that is used in Guangxi to refer to several types of wood residues, including both green wood residues from thinning or harvesting activities (branches, tops, and irregular logs) and residues from other wood processing mills (i.e. damaged and irregular veneer, sawdust, and residues from furniture and panel factories). As these categories were not disaggregated on the questionnaire that was distributed, it is not possible to know what portion of the respondents' use of 'wood waste' is composed of green wood residues as opposed to wood processing residues. For the sake of estimating the total volume of fiber consumed by Guangxi's wood chip mills, we will assume that roughly 80 percent of the 'wood waste' utilized by these mills comes from green wood residues and 20 percent comes from mill residues.

We assume further that roughly 80 percent of the wood chips produced in Guangxi are made of eucalyptus or other types of hardwood, while 20 percent are made of softwood. These figures correspond to the fact that 80 percent of the province's overall wood chip capacity (or 1,054,000 BDMT/yr) is situated in the South and South East regions of Guangxi; while the remaining 20 percent (260,000 BDMT/yr) is located in the North and North West regions.

Based on the assumptions outlined in this section, Table 3.12 presents an estimation of the volumes of mill residues, green wood residues, and small-diameter commercial logs that would likely be needed to meet the effective demand from Guangxi's hardwood and softwood chipping facilities, if these mills were to run at full capacity. However, as noted above, it should be emphasized that the 35 wood chip producers that responded to this study's survey reported an average capacity utilization rate of only 57.4 percent in 2004.

Table 3.12: Derived Fiber Demand from Guangxi's Wood Chip Mills, 2005

	Hardwood	Softwood	Total
Installed Capacity (BDMT/yr)	1,054,000	260,000	1,314,000
Conversion Factor (m3/BDMT)	1.63	2.04	
Derived Fiber Demand (m3/yr)	1,718,020	530,400	2,248,420
Effective Wood Demand (m3/yr -- RWE)			
Residual Wood (70%)			
Mill Residue	240,523	74,256	314,779
Green Residue	962,091	297,024	1,259,115
Commercial Logs (30%)	515,406	159,120	674,526

Chapter 4: Economic Competitiveness of Guangxi Plantation Sector

4.1 Introduction

This chapter analyses the costs and profitability of two plantation types which dominate the development programme proposed within the *Guangxi Integrated Forest Development and Conservation Project*:

- i. Labor-intensive, short-rotation plantations on hills;
- ii. Semi-mechanized, short-rotation plantations on flat land

Plantations of the first type are today by far the most common in Guangxi. Hills sites represent the type of land the most readily available for future plantation expansion. The semi-mechanized plantations are to a large extent concentrated on the coastal areas where there is only limited amount of flat land available for forestry activities.

The two plantation types are making extensive use of recently developed eucalyptus clones. Eucalyptus is currently dominating the expansion of short rotation plantations in Southern China and will, by most accounts, be the main source of raw material of Guangxi's future modern pulp mills, while limited amount of eucalypt wood will also be used by the reconstituted panel industry and the plywood industry.

The cost data related to plantations on hills were collected during the first quarter of 2005 from 22 major State-owned forest farms and plantation companies in several counties of Guangxi. This data contained sufficient details to stratify the 22 cases in 3 categories: (i) high-cost cases; (ii) low-cost cases and, (iii) medium-cost cases.

The costs data that were obtained for Guangxi's semi-mechanized plantations did not contained many details. However, it was possible to make cost estimates using detailed cost data collected, during previous surveys, from 6 sites of the Leizhou region where site conditions and operational costs are similar to those of coastal Guangxi.

For both plantation types, the low, average and high operational cost categories provide a range of possible values. The 3 categories were also used to assess the sensitivity of wood costs to changes in productivity and land lease costs.

The main categories of costs associated with short-rotation plantations in Guangxi are:

- Land rental
- Fixed assets and infrastructure
- Plantation establishment and management for the first and subsequent coppice rotations
- Wood harvest and transport

- Taxes and fees at harvest
- Overhead costs

This report analyses compounded costs at various stages:

- End of the first (planted) rotation (Stumpage Costs)
- End of subsequent coppice rotations (Stumpage Costs)
- Cost at point of delivery (road side or mill gate) where information and cost data for the all chain of operations was available.

Appendix A analyses sensitivity of stumpage costs to two values of Discount Rate (7% and 13%), a range of potential Mean Annual Increments (M.A.I) and 2 scenarios of land rental increase in price at the start of the coppice rotation.

4.2 Conversion factors

The formula to convert RMB per mu into USD per ha is: $\text{USD/ha} = \text{RMB/mu} \times 15 / 8.215$

Reference to Mean Annual Increment (M.A.I) made in this report is always to “Recovered M.A.I” unless mentioned otherwise. “Recovered M.A.I” refers to the portion of the wood which forms the primary end product / has commercial value. A 75% recovery rate is applied all through the province for conversion between total stem volume and recovered / commercial wood volume.

The following table gives the correspondence between various values of Mean Annual Increment (M.A.I) used in this report. A recovery rate of 75% was used to compose this table.

Table 4.1: Conversion from cubic meter per mu to cubic meter per hectare

M.A.I. Total Stem Volume	m3 per mu	0.67	1.00	1.34	1.67	2.00
	m3 per ha	10	15	20	25	30
M.A.I. Recovered Volume	m3 per mu	0.5	0.75	1.00	1.25	1.50
	m3 per ha	7.5	11.25	15	18.75	22.5

4.3 Data sources

At the end of November 2004, a *Questionnaire for Tree Plantation Enterprises and Individual Tree Growers* (see Appendix C) was prepared in collaboration with the

Survey and Design Institute of Guangxi Forestry Bureau. It was distributed in December. Between end of February and mid-April 2005, a total of 35 plantation enterprises returned the questionnaire:

Most respondents provided answers to a large number of questions and costs data which were used in the cost analysis presented in this report.

Between mid-January and end of March 2005, field visits and interviews of plantation enterprise's managers and individuals engaged in tree growing activities took place in 8 sites within the following counties: Wuming, Pingguo, Xingbin, Shanglin (x 2), Pubei (x2) and Bobai. This information has been used to compose the plantation profile presented in Appendix B.

4.4 Cost Associated with Wood Production

4.4.1 Land rental

To a large extent, this section is based on the answers to our 'Plantation Questionnaire'

26 Government and private enterprises have provided detailed information on the way they operate to secure land for future expansion of their plantation. The overall trend is similar to what is being observed in the neighboring provinces of Guangdong and Hainan:

- Government forest farms have only limited amount of land available for increasing their area of plantations;
- Much of the suitable land for future expansion is held by local communities, farmers' cooperatives and individual households. Both private companies and government forest farms are seeking to gain access to new plantation land by establishing partnerships with users of collectively - owned lands;
- There are several partnership models in place; however, land rental is becoming the most common practice. This is the type of agreement that contains the least uncertainty and the lowest risks for the leaser;
- Land rental is not a practice restricted to collectively- owned lands. Government farms happen to lease part of their land to private companies, individual investors or other farms.

Among the 26 respondents to our questionnaires 16 were government forest farms: 6 were Provincial forest farms, 1 was a Prefecture farm, and 9 were County forest farms. They reported that the land they have available for future expansion amounts totally to 620,000 mu (equiv. to 41,300 ha). 12 reported that they were negotiating access to additional land with farmer groups, individual farmers and village leaders.

In most cases (60% of the respondents), land lease contracts were signed for 30 years. There was one case where a contract had been signed for 70-year duration and a few other cases with 50-year duration.

64% of the respondent indicates that duration somewhere in the 10-20 year range would be the shortest contract period acceptable for a plantation enterprise.

54% of the respondents indicated that they use to pay several years of land rental in advance at the time a contract is signed. In half of the cases a 5-year advance payment was agreed. 2 to 4 year advance payment was also a frequent practice (43% of the cases). Advance payment for duration of up to 10 years was reported.

42% of the respondent reported that the contract they had signed included a clause for revising land rental price: after a period ranging between 3 to 6 years in 55% of the cases and a period ranging between 7 to 10 years for the remaining 45%.

In the most part of Guangxi province land rental prices for forestry seem to be contained within the limit of RMB 30 per mu and per year - USD 54.8/ha/yr - (79% of the answers). A large proportion (47%) of land lease contracts is being negotiated between RMB 10 to 20 per mu and per year - USD 18.2 to 36.4/ha/yr. Land lease price below RMB 10 per mu and per year seem to become the exception (9% of the answers). Prices in the range of RMB 45 to 80 per mu and per year - USD 82.2 to 146.1/ha/yr - were reported (15% of the cases) for sites located on the coast (Hepu area) and in the neighborhood of large urban centers such as Nanning and Liuzhou.

4.4.2 Fixed assets and infrastructure

Fixed assets in a plantation project include housing, machinery, and infrastructure (including road, bridges and temporary on-site constructions)

Plantations on hill sites do not require heavy machinery and expensive equipments. In the case of semi-mechanized plantations, cost of machinery has been accounted for in operational costs.

Infrastructure and especially road costs tend to have the largest impact on the profitability of plantation projects. These costs can account for a substantial portion of final wood costs. They vary substantially depending on project site conditions.

In some cases, direct access to the plantation is provided by existing roads which are routinely maintained by county or township administrations. In other cases, branch roads connected to county / township road networks are already present and their maintenance may require only limited expenses. There is a third group of cases where the access to plantation sites is provided by paths or tracks which are too narrow or rough for access by 4-wheels vehicles. In this latter case substantial investment is required to create a proper branch road for cost-effective wood extraction.

Readily access to sites is less critical for plantation operations than for wood transport. In the context of Guangxi, the most substantial expenses in infrastructure tend to occur at the time of harvest. In doing so the risk of under-evaluating or not making enough provision for road construction is greater. Unexpected expenses at time of harvest may preclude a plantation which otherwise would have seem to be a financially profitable investment.

The 20 plantation managers who have responded to our questions^{1/} about road access to their plantation sites indicate that:

- Plantations roads are accessible to trucks with a load capacity ranging between 10 and 20 tons in 11 cases (52% of the respondents);
- Plantations roads are accessible to trucks with a load capacity of 20 tons and above in 6 cases (29%);
- Plantations roads are accessible to trucks with a load capacity below 10 tons in 4 cases (19%).

When plantation managers are asked to rank in priority order^{2/} the criteria that they put forward when they negotiate land lease prices one realizes that criteria related to on-site transport conditions come immediately after site quality criteria (soil structure / thickness and soil nutrient status). Distance to processing mills comes third.

The following table give an average costs for infrastructure development based on costs reported in the various plantation profiles which we have examined. These costs are direct costs. They do not include overheads.

Table 4.2: Average costs for infrastructure development in Guangxi plantation

	Year 0	Year 1	Year 2 to 5	Year 6 (Prior harvest)
RMB per mu	14.7	1.9	1.7 per year	32.4
USD per ha	26.8	3.5	3.1 per year	59.2

Data source: 26 State and private enterprises. Responses to the 'Questionnaire for Tree Plantation Enterprises and Individual Tree Growers'

These costs are low in comparison to what is being observed in South East Asian countries. A possible explanation is that:

- i. Harvesting operations are manual and therefore there is no need to create access roads and bridges for heavy equipment;
- ii. Wood transport is, to a very large extend, done by small contractors who have limited requirements with regard to road conditions.

^{1/} / See Appendix C: Questionnaire for Tree Plantation Enterprises and Individual Tree Growers. Questions C42-142 and C42-143.

^{2/} / See Appendix C: Questionnaire for Tree Plantation Enterprises and Individual Tree Growers. Questions C2-11 to C2-18

4.4.3 Plantation establishment and management

In Guangxi like in most other regions, plantation operation costs form the largest part of the wood production costs. They include:

- Survey and plantation design
- Purchase of clonal planting material
- Purchase of fertilizers
- Maintenance / replacement of tools
- Purchase of products for pest and disease treatments
- Site preparation
- Planting and replacing dead seedling at young age
- Tending
- Control and treatment of pest and diseases
- Protection against fire and illegal logging
- Supervision and quality control
- Transport of staff, workers and material

Tables 4.3 to 4.6 indicate the most common range of variation in plantation operation costs during the growing period. Costs are direct costs / do not include overheads.

4.4.3.1 Labor-intensive, short-rotation plantations on hills

Table 4.3: Range of variation of operational costs for a 6-year planted rotation in Guangxi

	Year 0	Year 1	Year 2	Year 3	Year 4 and 5
<i>Survey & Design</i> <i>Site preparation</i> <i>Planting</i> <i>Fertilizer application (FA)</i> <i>Tending (T)</i> <i>Pest & Disease control (PDC)</i> <i>Protection (P)</i>		<i>(FA)</i> <i>(T)</i> <i>(PDC)</i> <i>(P)</i>	<i>(FA) if Rqd</i> <i>(T) if Rqd</i> <i>(PDC)</i> <i>(P)</i>	<i>(PDC)</i> <i>(P)</i>	<i>(PDC)</i> <i>(P)</i>
Operational costs in RMB per mu	260 - 360	65 - 125	30 - 80	10 - 20	5 - 15 per year
Operational costs in USD per ha	475 - 657	119 - 228	55 - 146	18 - 36	9 - 27 per year

Data source: 16 State and private enterprises in responses to the ‘*Questionnaire for Tree Plantation Enterprises and Individual Tree Growers*’ and 7 plantation profiles surveyed during field visits. *Legend:* If Rqd stands for ‘if required’

Table 4.4: Average operational costs for a 5-year coppice rotation in Guangxi

	Year 6	Year 7	Year 8 to 9	Year 11
	<i>Land clearing after harvest of the previous rotation</i> <i>Singling coppices</i> <i>Fertilizer application (FA)</i> <i>Pest & Disease control (PDC)</i> <i>Protection (P)</i>	<i>(FA)</i> <i>(PDC)</i> <i>(P)</i>	<i>(PDC)</i> <i>(P)</i>	<i>Harvest</i> <i>Replanting</i>
Operational costs in RMB per mu	135	110	9 per year	
Operational costs in USD per ha	246.5	201	16.4 per year	

Data source: a private enterprise managing 1,300 mu of eucalyptus coppices of which 1,000 mu were harvested in 2004

Compounded costs (at a discount rate of 7%) calculated for a plantation profile close to average was:

- RMB 700 per mu equivalent to USD 1,278 per ha at year 5 (before first rotation is harvested);
- RMB 369 per mu equivalent to USD 674 per ha at age 10 (before coppice rotation is harvested);

4.4.3.2 Semi-mechanized, short-rotation plantations on flat land

Compounded costs (at a discount rate of 7%) calculated for a plantation profile close to average was:

- RMB 573 per mu equivalent to USD 1,046 per ha at year 5 (before first rotation is harvested);
- RMB 329 per mu equivalent to USD 601 per ha at age 10 (before coppice rotation is harvested);

Table 4.5: Average operational costs for a 6-year planted rotation in Guangxi

	Year 0	Year 1	Year 2	Year 3 to 5
	<i>Survey & Design</i> <i>Site preparation</i> <i>Planting</i> <i>Fertilizer application (FA)</i> <i>Tending (T)</i> <i>Pest & Disease control (PDC)</i> <i>Protection (P)</i>	<i>(FA)</i> <i>(T)</i> <i>(PDC)</i> <i>(P)</i>	<i>(FA) if Rqd</i> <i>(T) if Rqd</i> <i>(PDC)</i> <i>(P)</i>	<i>(PDC)</i> <i>(P)</i>
Operational costs in RMB per mu	180 - 240	70 - 100	35 - 70	5 - 15 per year
Operational costs in USD per ha	329 - 438	128 - 183	64 - 128	9 - 27 per year

Data source: Data from 6 case studies in Zhanjiang Prefecture adapted to coastal Guangxi

Legend: If Rqd stands for ‘if required’

Table 4.6: Average operational costs for a 5 -year coppice rotation in Guangxi

	Year 6	Year 7	Year 8 to 10	Year 11
	<i>Land clearing after harvest</i> <i>Of the previous rotation</i> <i>Singling coppices</i> <i>Fertilizer application (FA)</i> <i>Pest & Disease control (PDC)</i> <i>Protection (P)</i>	<i>(FA)</i> <i>(PDC)</i> <i>(P)</i>	<i>(PDC)</i> <i>(P)</i>	<i>Harvest</i> <i>Replanting</i>
Operational costs in RMB per mu	115	105	7.5 per year	
Operational costs in USD per ha	210	192	13.7 per year	

Data source: Data from 2 case studies in Zhanjiang Prefecture adapted to coastal Guangxi

4.4.4 Wood Harvest, extraction and loading

Guangxi forest plantations are predominantly located on hills presenting various levels of difficulty with regard to access and on-site movement. This makes that costs of wood harvest and extraction are highly variable and very site-specific cost inputs.

Wood extraction is the single operation with the highest degree of variability. Logs might be extracted and loaded at low cost (RMB 10 per m³ equiv to USD 1.22 per m³) when hill sites are accessible to trucks. But there are many planted hills with

remote locations where intermediate transport facilities have to be used (such as ox-cart for example) before the wood can be loaded on a truck. Table 4.7 shows that, in slightly more than a quarter of the cases which we have analyzed, wood is being extracted at relatively high cost.

The cost difference between a low-cost extraction (RMB 4 per m³ equiv. to USD 0.48/m³) and a high cost extraction (RMB 55 per m³ equiv. to USD 6.7/m³) equals the hauling cost of one m³ on 90 km of good road.

The overall analysis of the 29 cases studies which were used to compose tables 4.7 and 4.8 show that:

- i. Harvest and extraction can be carried out at low to moderate costs in 16 cases. The average cost from harvest design to loading on truck of these 11 cases is RMB 55.7 per m³, equivalent to USD 6.78 per m³;
- ii. There are 4 cases (13.8 % of the population) where high extraction costs are adding to high harvesting costs, resulting in an average operational cost (from harvest design to loading on truck) of RMB 113 per m³ equiv. to USD 13.75 per m³. In most instances, these expensive operations would amount to somewhere between 40 to 50% of the compounded wood cost on truck. There are obvious risks that compounded wood costs will be above the market price where difficult harvesting and extracting conditions are combined.

Costs shown in tables 4.7 and 4.8 are direct costs. They do not include overheads.

Table 4.7: Average operational costs for harvesting short rotation plantation in Guangxi

Operations:	Harvest design, Felling, Crosscutting and Debarking	
Slope / Level of difficulty to operate on site	Low to moderate (55% of the analyzed cases)	High (45% of the analyzed cases)
Operation Costs		
▪ Range of variation	RMB 23 to 50 per m ³ , equiv to USD 2.80 to 6.09 per m ³	RMB 50 to 86 per m ³ USD 6.09 to 10.47 per m ³
▪ Average	RMB 31 per m ³ , equiv to USD 3.77 per m ³	RMB 71.5 per m ³ , equiv to USD 8.70 per m ³

Data source: 22 State and private enterprises in response to the ‘*Questionnaire for Tree Plantation Enterprises and Individual Tree Growers*’ and 7 plantation profiles surveyed during field visits.

Table 4.8: Average operational costs for small-diameter wood extraction in Guangxi

Operations:	Carrying wood from felling point to wood yard / loading site	
Distance to loading point and level of difficulty to operate on site	Low to moderate (73 % of the analyzed cases)	High (27 % of the analyzed cases)
Operation Costs <ul style="list-style-type: none"> Range of variation Average 	RMB 4 to 24 per m3, equiv to USD 0.49 to 2.92 per m3 RMB 12 per m3, equiv to USD 1.46 per m3	RMB 25 to 55 per m3 in most cases. Can be up to RMB 120 per m3 USD 3.04 to 6.69 per m3. Can go up to USD 14.60 per m3 RMB 37.5 per m3, equiv to USD 4.56 per m3

Data source: 22 State and private enterprises in response to the 'Questionnaire for Tree Plantation Enterprises and Individual Tree Growers' and 7 plantation profiles surveyed during field visits.

Average direct cost for loading on truck is RMB 5.5 per m3 ^{3/}

4.4.5 Transport

The main factors affecting transport costs are:

- Transport distance
- Road conditions
- Payload on the truck⁴

It is common practice in Southern China that contractors apply higher unit costs (calculated in RMB per ton and per km) for shorter distances.

For transport distances in the range of 30 to 70 km, it is common that the unit cost varies between RMB 0.7 and 0.8 / ton / km (USD 0.085 and 0.097 / ton / km). For distances close to 100 km and above, the cost per ton and per km range from RMB 0.55 to 0.6 (USD 0.067 to 0.073 / ton / km). A rate of RMB 0.4 / ton / km (USD 0.048 / ton / km) might be asked for transport distance of 200 km and above.

^{3/} / Data source: 16 State and private enterprises in response to the 'Questionnaire for Tree Plantation Enterprises and Individual Tree Growers' and 7 plantation profiles surveyed during field visits

^{4/} / Section 4.4.2 gives some indications on accessibility to plantation roads for trucks of various payload sizes.

This added to the fact that small diameter plantation wood has low value-to-volume and weight ratios mean that, in most instances, transport costs will make up a significant proportion of the delivered wood cost.

4.4.6 Taxes and fees at harvest

Recent policy measures have been taken, at central level, to reduce the taxes and fees on forest products and streamline both the entire revenue system and the delivery of government services in order to stimulate investments in plantation forestry. Forestry products have been exempted from the Special Agricultural Products Tax. However, there are a number of other charges which are still in place. Some, such as the afforestation fee and the quarantine fee are nation-wide. Others are province-specific. Finally, some charges are levied at local level. Their number and purpose vary greatly between localities. During our survey, a number of respondent have mentioned a fee for 'Flood Prevention and Insurance' and charges being levied for the design of harvest plots and/or forestry administration.

The following table summarizes the information obtained from the Finance Division of Guangxi Forestry Bureau.

Table 4.9: Taxes and Fees for Fast-Growing, High Yielding plantations in Guangxi

	Fast-Growing , High-Yielding Plantations	
	All Enterprises	Plantations Enterprises integrated to a Pulp Industry
Taxes	Abolished in Sept. 2003	Abolished in Sept. 2003
Afforestation Fee	<u>Since 1998</u> <u>Eucalypts</u> : 10% of the sale price (first sale after harvest) <u>Other species</u> : 20% of the sale price (first sale after harvest)	<u>Since 2002</u> 0% Possibility to add RMB 10 to 20 per m3 to their production costs
Forest Quarantine Fee	0.2 % of the sale price (first sale after harvest)	0.2 % of the sale price (first sale after harvest)

Data source: Finance Division of Guangxi Forestry Bureau

The following gives an example of calculation of the *Afforestation Fee* and the *Plant Quarantine Fee* for a first wood sale after harvest amounting to RMB 270/m³

Afforestation Fee: RMB 270/1.1 x 0.1 = RMB 24.5/m³

Forest Quarantine Fee: RMB 270/1.02 x 0.02 = RMB 5.3/m³

The section on taxes and fees of the ‘Plantation Questionnaire’⁵ was answered by 26 State and private enterprises, all involved in the development of eucalypt plantations. Two answers out of three mention that the ‘*Afforestation Fee*’ amounts to 20% of the wood sale. Approximately 30% of the respondent indicates that this 20% fee applies to 2 funds.

4.4.7 Overhead costs

In Guangxi, forest plantation activities involve a number of economic actors whose scale of operation, differ greatly. Some benefit from economies of scale, others don’t. In addition different enterprises have different degree of social obligations and apply different standards in the way they operate. Some have high requirements in terms of cost-efficiency, others don’t. All together these may create significant differences in overhead costs and in turn in the profitability of the overall enterprise.

A difficulty encountered in dealing with overheads is that, in most cases, operational and technical staffs within companies don’t have a clear sense of what overheads include and how they are calculated. This is not specific to Guangxi and even to China.

Overheads are usually calculated in per cent of direct production costs. However there are cases where companies use a ‘per hectare per year’ basis to report these costs.

Our information about overheads of Guangxi plantation enterprises is not sufficient and consistent enough for us to apply different overhead rates to different types of enterprises. Therefore, we have opted for a conservative approach by applying a uniform rate to all government as well as private enterprises. We have assumed that overheads for these large enterprises amount to 8% of their direct cost.

We have also assumed a 3.5% overheads rate for small-scale entrepreneurs whose administrative units are limited to a small number of staff dealing with forestry among other activities.

4.5 Compounded Costs Analysis

4.5.1 Stumpage Cost

Stumpage cost is a mean of measuring, on an m³ basis, the investment allocated to a plantation during the entire growing period. It is a theoretical value of the commercial standing volume of wood at the time of harvest. In other words it is the price at which the investment reaches the zero-Net Present Value threshold. Any market price higher than the calculated stumpage cost plus overheads would lead to economic returns.

⁵ / See Appendix C: Questionnaire for Tree Plantation Enterprises and Individual Tree Growers. Questions C5-1 to C5-18

Stumpage costs are sensitive to the discount rate used as well as to plantation yield and the length of the growing period. The higher the discount rate, the higher the stumpage cost. The lower the productivity the higher the stumpage cost.

The *a priori* discount rate used in stumpage cost calculations must be based on a correct forecast of risks. Discount rates in the order of 8 to 12% are commonly used in forestry projects. High risk forestry projects may use discount rates as high as 25 to 30%.

Stumpage costs shown in tables 4.10 to 4.14 do not include overheads.

Table 4.10: Stumpage Costs of First Rotation

	Labor intensive plantations in hills (Assumed M.A.I is 1 m3/mu, equiv. to 15 m3/ha) ^{1/}		Semi-mechanized in coastal flats (Assumed M.A.I is 1.25 m3/mu equiv. to 18.75 m3/ha) ^{1/}	
Discount Rate	7%	13%	7%	13%
RMB/m3	109.67	145.73	94.80	122.40
Low-cost case				
USD/m3	13.35	17.74	11.54	14.90
RMB/m3	173.09	230.02	130.29	168.74
High-cost case				
USD/m3	21.07	28.00		
RMB/m3	139.08	183.36		
Average-cost case				
USD/m3	16.93	22.32	15.86	20.54

^{1/} M.A.I. is for Recovered Wood

Tables 4.11 and 4.12 compare stumpage costs obtained for the first rotation and the subsequent coppice rotation. The case which is presented is plantation on hills with average operational costs. Cost calculation is based on a M.A.I of 1 m3/mu (15 m3/ha) of recovered wood at the end of the first rotation. Land rental costs during the first rotation is RMB 15/mu/year.

3 scenarios are presented for the coppice rotation.

Scenario C1: Land rental costs and M.A.I. remain the same than during the first rotation;

Scenario C2: Land rental costs have doubled (to RMB 30/mu/year). Coppices grow at same M.A.I. than during the first rotation;

Scenario C3: Land rental costs have increased by 50% as compared to the first rotation (to RMB 22.5/mu/year) while coppice productivity is lower. M.A.I of recovered wood is 0.75 m3/mu (11.25 m3/ha)

Appendix A shows the sensitivity of stumpage costs to variation in M.A.I, discount rate and land lease costs.

Table 4.11: Stumpage Costs (compounded at 7% DR) of first and second rotations in hills

	Labor-intensive plantations on hills <i>Average-cost case</i> DR: 7%	
	First rotation	Coppice rotation
M.A.I. (Recovered Wood): 1 m3/mu (15 m3/ha) Land lease: RMB 15/mu/year (USD27.4/ha/year)	RMB/m3: 139.08 USD/m3: 16.93	<u>Scenario 1</u> RMB/m3: 96.68 USD/m3: 11.77
M.A.I. (Recovered Wood): 1 m3/mu (15 m3/ha) Land lease: RMB 30/mu/year (USD 54.8/ha/year)		<u>Scenario 2</u> RMB/m3: 115.09 USD/m3: 14.01
M.A.I. (Recovered Wood): 0.75 m3/mu (11.25 m3/ha) Land lease: RMB 22.5/mu/year (USD 41.1/ha/year)		<u>Scenario 3</u> RMB/m3: 141.87 USD/m3: 17.27

Table 4.12: Stumpage Costs (compounded at 13% DR) of first and second rotations in hills

	Labor-intensive plantations on hills <i>Average-cost case</i> DR 13%	
	First rotation	Coppice rotation
M.A.I. (Recovered Wood): 1 m3/mu (15 m3/ha) Land lease: RMB 15/mu/year (USD27.4/ha/year)	RMB/m3: 183.36 USD/m3: 22.32	<u>Scenario 1</u> RMB/m3: 121.33 USD/m3: 14.77
M.A.I. (Recovered Wood): 1 m3/mu (15 m3/ha) Land lease: RMB 30/mu/year (USD 54.8/ha/year)		<u>Scenario 2</u> RMB/m3: 143.19 USD/m3: 17.43
M.A.I. (Recovered Wood): 0.75 m3/mu (11.25 m3/ha) Land lease: RMB 22.5/mu/year (USD 41.1/ha/year)		<u>Scenario 3</u> RMB/m3: 177.20 USD/m3: 21.57

Tables 4.13 and 4.14 compare stumpage costs obtained at the end of the first and coppice rotation for a semi-mechanized plantation. The case which is presented is a semi-mechanized plantation with average operational costs. Cost calculation is based on a M.A.I of 1.25 m3/mu (18.75 m3/ha) of recovered wood at the end of the first rotation. Land rental costs during the first rotation is RMB 50/mu/year.

3 scenarios are presented for the coppice rotation.

Scenario C1: Land rental costs and M.A.I. remain the same than during the first rotation;

Scenario C2: Land rental costs have increased by 30% (to RMB 65/mu/year). Coppices grow at same M.A.I. than during the first rotation;

Scenario C3: Land rental costs have increased by 35% as compared to the first rotation (to RMB 67.5/mu/year) while coppice productivity is lower. M.A.I of recovered wood is 1 m3/mu (15 m3/ha)

Table 4.13: Stumpage Costs (compounded at 7% DR) of first and second rotations in flats

	Semi-mechanized plantations on coastal flats <i>Average-High cost case</i> Discount Rate: 7%	
	First rotation	Coppice rotation
M.AI. (Recovered Wood): 1,25 m ³ /mu (18.75 m ³ /ha) Land lease: RMB 50/mu/year (USD 91,3/ha/year)	RMB/m ³ : 130.29 USD/m ³ : 15.86	<u>Scenario 1</u> RMB/m ³ : 105.64 USD/m ³ : 12.86
M.AI. (Recovered Wood): 1.25 m ³ /mu (18.75 m ³ /ha) Land lease: RMB 65/mu/year (USD 118.7/ha/year)		<u>Scenario 2</u> RMB/m ³ : 120.35 USD/m ³ : 14.65
M.AI. (Recovered Wood): 1 m ³ /mu (15 m ³ /ha) Land lease: RMB 77/mu/year (USD 140.6/ha/year)		<u>Scenario 3</u> RMB/m ³ : 153.04 USD/m ³ : 18.63

Table 4.14: Stumpage Costs (compounded at 13% DR) of first and second rotations in flats

	Labor-intensive plantations on hills <i>Average-cost case</i> Discount Rate: 13%	
	First rotation	Coppice rotation
M.AI. (Recovered Wood): 1,25 m ³ /mu (18.75 m ³ /ha) Land lease: RMB 50/mu/year (USD 91,3/ha/year)	RMB/m ³ : 168.74 USD/m ³ : 20.54	<u>Scenario 1</u> RMB/m ³ : 130.12 USD/m ³ : 15.84
M.AI. (Recovered Wood): 1.25 m ³ /mu (18.75 m ³ /ha) Land lease: RMB 65/mu/year (USD 118.7/ha/year)		<u>Scenario 2</u> RMB/m ³ : 147.70 USD/m ³ : 17.98
M.AI. (Recovered Wood): 1 m ³ /mu (15 m ³ /ha) Land lease: RMB 77/mu/year (USD 140.6/ha/year)		<u>Scenario 3</u> RMB/m ³ : 187.71 USD/m ³ : 22.85

4.5.2 Costs of Delivered Wood

The following table gives the compounded wood costs at point of delivery (road side or mill gate) calculated for 7 plantations profiles. These profiles include 6 cases of plantation on hill sites and 1 case of semi-mechanized plantation on flat land.

The profiles for the ‘hill-plantation’ type were constructed with the information and costs data that we collected between January and March 2005, during field visits. The information that we obtained for Guangxi’s semi-mechanized plantations did not contained many detailed cost data. However, it was possible to construct a plantation profile using detailed cost data which we were able to collect from 6 sites of

Zhanjiang Prefecture, during previous surveys. Site conditions and operational costs in coastal Guangxi are very similar to those of Zhanjiang Prefecture.

The 7 plantation profiles are presented in Appendix B. They contain information on:

- Site location and accessibility;
- Land tenure and information on access to the land (type of agreement between the land user and the party investing in the plantation when they are different entities);
- Main plantation technical characteristics;
- Cost data on investment in silviculture, road construction, harvest, extraction, transport and fees;
- Wood prices
- Internal rate of return of the undertaking

Table 4.15: Wood costs at point of delivery compounded at 7 % DR

		Wood Costs Compounded at 7 % DR	
		Road side	Mill gate
Plantation on hill sites	Profile No 1 IRR: 9.4 %		RMB/m3: 283.4 USD/m3: 34.5
	Profile No 2 IRR: 3.1 %	RMB/m3: 298.8 USD/m3: 36.4	
	Profile No 3 IRR: 9.1 %	RMB/m3: 233.9 USD/m3: 28.5	
	Profile No 4 IRR: 4.0 %	RMB/m3: 297.2 USD/m3: 36.2	
	Profile No 5 IRR: 14.4 %		RMB/m3: 268.0 USD/m3: 32.6
	Profile No 6 IRR: 8.1 %		RMB/m3: 301.5 USD/m3: 36.7
Semi-mechanized Plantations	Profile No 7 IRR: 18.0 %		RMB/m3: 214.4 USD/m3: 26.1

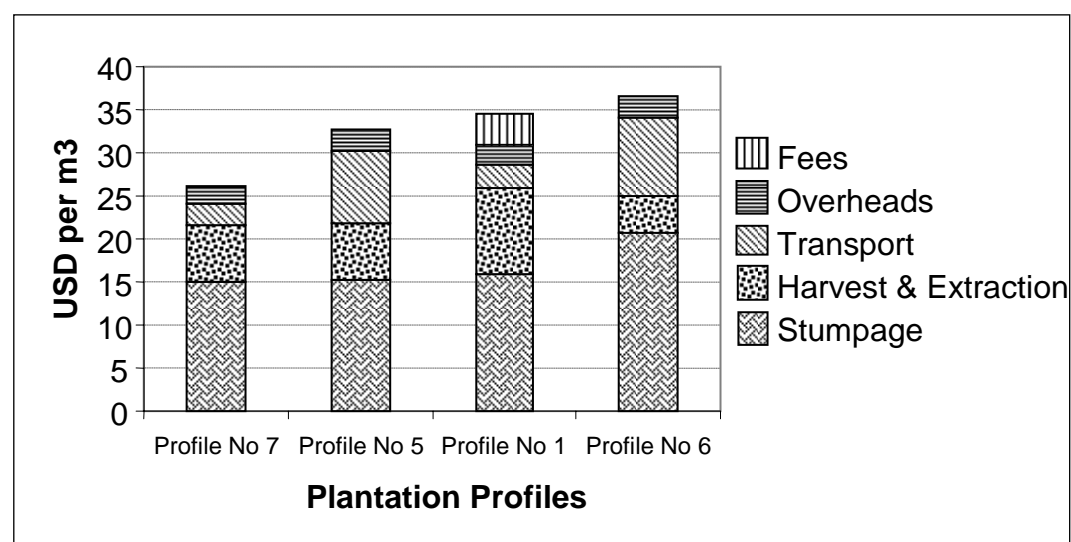
Plantation profiles No 2 and No 4 are delivering wood at road side at costs very close to current market prices. These two operations do not meet the minimum IRR requirements (discount rate) arbitrary set to 7% and therefore are likely to generate slight deficits.

Table 4.16: Wood costs at point of delivery compounded at 13 % DR

		Wood Costs Compounded at 13 % DR	
		Road side	Mill gate
Plantation on hill sites	Profile No 1 IRR: 9.4 %		RMB/m3: 339.1 USD/m3: 41.28
	Profile No 2 IRR: 3.1 %	RMB/m3: 360.6 USD/m3: 43.9	
	Profile No 3 IRR: 9.1 %	RMB/m3: 291.8 USD/m3: 35.5	
	Profile No 4 IRR: 4.0 %	RMB/m3: 372.8 USD/m3: 45.4	
	Profile No 5 IRR: 14.4 %		RMB/m3: 312.5 USD/m3: 38.0
	Profile No 6 IRR: 8.1 %		RMB/m3: 362.4 USD/m3: 44.2
Semi-mechanized Plantations	Profile No 7 IRR: 18.0 %		RMB/m3: 261.6 USD/m3: 31.8

With costs compounded at 13% DR, only 2 operations (Profile No 5 and Profile No 7) continue to produce wood at costs below current market prices. Profitability of the other operations is questionable.

Figure 4.1: Delivered wood cost structure (Costs compounded at 7% DR)



4.6 Wood Grades and Prices

Main Guangxi's users of small-sized plantation wood include: (i) the plywood industry; (ii) the reconstituted panel industry (dominated by MDF); and increasingly (iii) the pulpwood industry;

Small-sized wood and wood residues are also the main source of energy for a number of small-scale industries such as brick factories for example.

Each industry type has different requirements / preference as far as wood quality and diameter size is concerned. Each industry type is also very much characterized by its wood paying capacity (the maximum amount that can be paid for wood supply in order to maintain profitability).

4.6.1 Reconstituted Panel Industry

The 'three residues' is the main source of raw material for the reconstituted panel industry, especially the small to medium-scale mills. 'Three residues' consist of:

- i. Residues generated by other wood processing sectors, primarily sawmills and plywood mills;
- ii. By-products/secondary harvest products such tree tops (large branches and small diameter stems: typically in the 3 to 6 cm range), thinning products (from pine and Chinese fir plantations);
- iii. Logs being declassified (whose length is below standard or for other reasons).

Branches and small-diameter logs entering into the 'three residues' category are being processed into chips without prior debarking. Current mill gate prices for this type of raw material vary typically between RMB 160 and RMB 220 per ton depending on the location.

At the other extreme of the range, some of the recently-built MDF mills with larger production lines and improved technology are specializing in the production of export quality boards. Top-quality MDF products require debarked larger-diameter logs. This is the raw material which is also being used by modern-large scale pulp mills.

The domestic market for reconstituted panels is still dominated by low to medium grade products. Therefore 'three residues' is likely to remain the main source of raw material for this industry segment. However, there might be a limited number of cases, in the future, where moderns MDF mills will compete for their wood raw material supply with the two large pulp mills, being planned in the coastal region.

Wood costs in reconstituted panels account for 30% to 40% of mill operating costs.

4.6.2 Wood Pulp Industry

Modern pulp mills can only be cost-competitive if they specialize in the production of high quality virgin wood pulp. To do so they require high quality chips. It is important that chips are made of debarked wood so that the quantity of chemical being used throughout the “cooking stage” can be kept at a minimum level. Chips made of debarked wood have also more even characteristics. Uniformity in fiber structure, chemical content and size are both important factors:

- Uniform Chip fiber quality is important since digesters are set to process wood chips for the shortest period of time, using a specific quantity of chemicals to achieve maximum output and yield;
- Optimum chip length and thickness ranges respectively from 32 mm to 48 mm and from 4 mm to 8 mm.
- Over sized chip fractions take a longer time to digest when compared with standard chip sizes. This reduces pulp mill efficiency, and depending on the volume, could also impact on chemical consumption;
- Over length chips may cause blockages when discharging the digester, reducing pulp mill efficiency.
- On the other hand, the small under-sized chip fragments (fines and pins) are most often over-cooked during the process, resulting in lower output and yield. These smaller fractions also are first to absorb white liquor, increasing white liquor consumption.

Modern pulp mills use debarked wood with minimum diameter, under bark, of 3 cm. However, logs with diameter (under bark) ranging between 6 and 15 cm form the largest part of their supply. In the tropics, this type of raw material can be grown in fast-growing plantations with growing cycles ranging between 5 and 7 years.

In the conditions of Guangxi, several species of eucalypts and Eucalyptus hybrids are well suited for this type of plantations. In comparison to other species, eucalypts have fast growth and high pulp output per unit area of land. They also produce one of the best quality pulps by international standards. Eucalypts are currently dominating the expansion of short rotation plantations in the entire Southern China. These plantations will, by most accounts, be the main source of raw material of the pulp mills being planned for Guangxi’s coastal region.

Prices at mill gate of pulpwood of the 8 - 12 cm diameter class vary typically between RMB 280 to RMB 370 per ton depending on the location. While the road side price for this wood category can be as high as RMB 350/ton. Mill gate price for the 14 - 18 cm diameter is above RMB 400/ m3. The plywood industry has generally better wood buying capacity for wood with diameter above 14 cm.

At the other extreme of the range, the 'three residues' forms a substantial portion of the wood used by a number of small-capacity pulp mills using out-dated technology / producing lower quality pulp. These mills generally are located in the interior of the province. Locally, these small-scale pulp mills might compete with mills manufacturing reconstituted panels for their wood raw material supply.

Wood costs in modern pulp mills producing BHKP (Bleached Hardwood Kraft Pulp) account for 46% of mill operating costs in most favorable situations (Brazil) but can be as high as 67% (Finland)

4.6.3 Plywood

Key end uses of approximately 43% of Guangxi plywood production is interior decoration and furniture. This sector includes mills which have specialized in niche markets offering relatively high prices such as for example curved panels.

Plywood mills use a wide range of wood types, both hardwood and coniferous. They use logs with diameters ranging from 7-8 cm up to 20 cm and above. Therefore the range of prices that plywood mill pay for their supply of raw material is high. Buyers require that logs are traded with their bark (to keep moisture / slow down the air-drying process after harvest).

Chinese fir can be sold in the range of RMB 550 to RMB 600/m³ for diameters between 14 -18 cm and RMB 750/m³ for diameters above 20 cm. Prices for Pine wood of the same diameter classes are slightly lower than those of Chinese fir but generally higher than the price offered for eucalypts.

Production costs in plywood production are strongly influenced by wood prices representing up to 70% of the manufacturing costs.

4.6.4 Future Pulpwood Prices

This section examines the market forces which logically should exert the strongest pressures on future domestic pulpwood prices.

The two large-scale Chemi-Thermo Mechanical Pulp mills that are being planned in the coastal region will create new important demand for pulpwood. Each project is currently developing its own wood resource made of fast-growing eucalypts plantations. However, access to plantation land is a slow and complex process as most of the land suitable for new plantations is held by communities. Together, the two coastal mills will have a production capacity of 0.8 to 1 million metric tons of pulp, equivalent to 2 to 2.5 million m³/yr of small-diameter pulpwood. It is likely that, in both cases, production of pulp will start before a sustainable wood resource base is secured. This means that part of the wood will have to be sourced from external suppliers.

This new demand should exert upward pressure on future price of pulpwood. On the other hand the cost of growing wood fiber in Southern China is substantially higher than it is in most neighboring countries. The price of imported pulpwood chips would logically set the threshold price for domestic pulpwood. Any domestic market price under this threshold would allow Chinese wood pulp producers to remain competitive in the regional market.

On a longer time-frame, it is possible that the land scarcity plays in favor of those large mills which are already in place by preventing other key players to establish in the Province. The entire Guangxi pulp industry might then be dominated by only very few Companies with the possibility that once these Companies have consolidated their resource base only limited quantity of pulpwood is traded through a formal market.

Such a situation would exert downward pressure on domestic pulpwood prices with the risk of decrease in economic returns for the independent wood producers and communities engaged in pulpwood production.

4.7 Profitability and Competitiveness

Internal rates of return (IRR) were calculated for the 7 plantation profiles presented in Appendix B, using, in most instances, cost and revenue data specific to each case.

Table 4.17: Estimated internal rate of return for 7 plantation profiles^{6/}

		Level of Investment in Silviculture		
		Low	Average	High
Hill sites	Profile No 1	9.4%		
	Profile No 2			3.1%
	Profile No 3			9.1%
	Profile No 4			4.0%
	Profile No 5		14.4%	
	Profile No 6		8.1%	
Flat site	Profile No 7		18%	

Study of the hill-plantation profiles shows the following:

- Low to reasonable returns to investors can be expected where uncertainty and high costs of harvesting and extraction can be avoided, while proper investments are made in silviculture. This can be achieved by giving appropriate attention to specific site conditions - facility of access is of particular importance - and where harvest, extraction and transport costs can be predicted with some accuracy and are given appropriate weight in investment decisions.

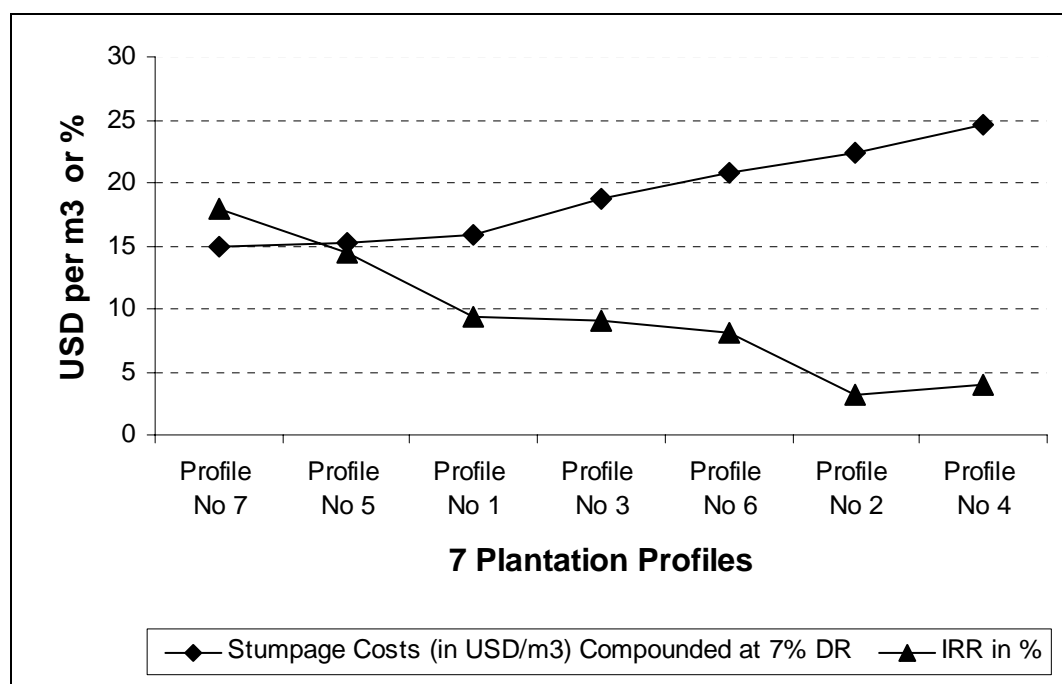
^{6/} See Appendix B for a description of these profiles

- A clear inverse correlation between stumpage costs and IRR exists when the above-mentioned conditions are met. Stumpage costs are sensitive to a number of factors as discussed in Appendix A. Profile No 4 shows that high cost inputs and good care given to a plantation doesn't translate automatically in high productivity, low stumpage costs and high returns. Plantation forestry is a relatively risky and long time-frame undertaking with high exposure to climatic hazards and casualties such as fire.
- Profile No 2 shows that investors may face substantial risks when several factors turn out not to be in their favor, such as for example below-average productivity and high harvesting and extraction costs.

Semi-mechanized plantations in flat parts of Guangxi represent only a small share of the current plantation expansion in the Province. We haven't been able to sample this plantation type in much detail. However, the information we have obtained was enough to conclude that technical characteristics and required amount of investments are similar to those observed in the neighboring Zhanjiang Prefecture. This type of plantation is more likely to display better financial performances since they have clear comparative advantages in several important aspects:

- Plantation costs are lower
- Productivity is generally higher than what it would be in hill sites with soils of same fertility. This is due to the fact that the logistic to bring additional fertilizers and tend after planting is easier to organize, allows more efficient treatments and is cheaper.
- Harvest and extraction present less uncertainties as far as costs are concerned and require less investments since the existing road network is generally more developed and of better quality.

Figure 4.2: Inverse correlation between stumpage costs and internal rates of return



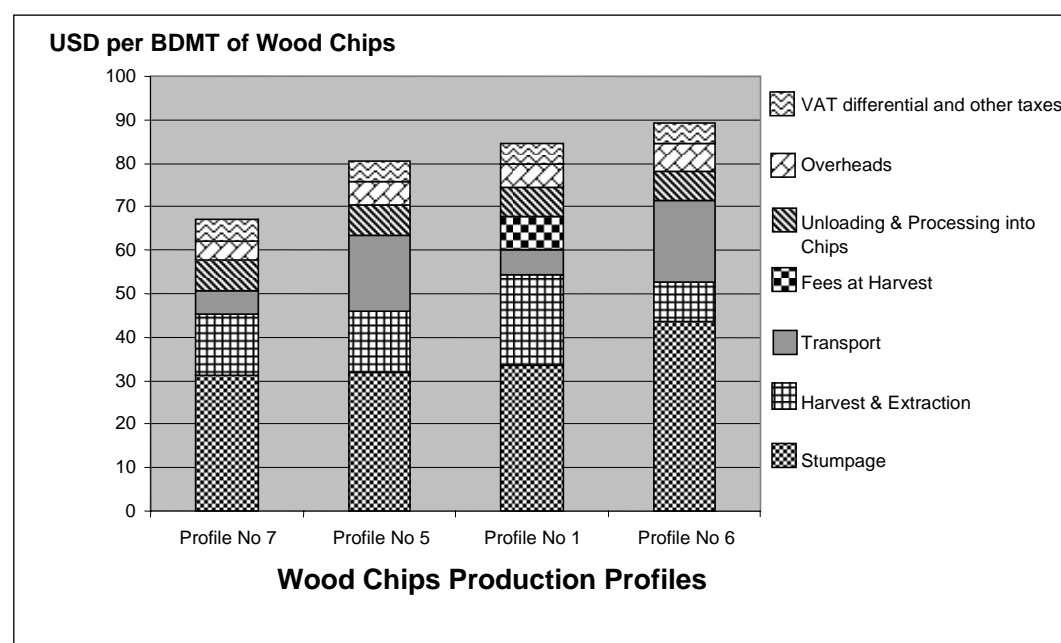
To remain competitive in the regional market, Guangxi plantations will have to be able to deliver wood at costs which lie between the minimum return that producers require (stumpage costs calculated with the level of discount rates they anticipate) and the price of potential substitutes / wood coming from other sources.

We have attempted to assess the current competitiveness margin of the pulpwood plantation sector. To do so we have estimated:

- i. The cost of using domestic plantation wood to produce one bone dry metric ton of chips of the quality required by the pulp industry;
- ii. The delivered costs of imported wood chips

Costs at mill gate of wood produced in four different plantation profiles (see table 4.15 in section 4.5.2) were used to assess the production costs of one Bone Dry Metric Ton (BDMT) of wood chips. These costs compounded at 7% DR vary from: RMB 550.3/ BDMT (USD 67/ BDMT) for profile No 7 to RMB 732.8/ BDMT (USD 89.2) for profile No 6. Profiles No 5 and No 1 give intermediate production costs, respectively RMB 663/ BDMT (USD 80.7/ BDMT) and RMB 695/ BDMT (USD 84.6)

Figure 4.3: Costs involved in the production of one BDMT of chips with domestic wood



Most of the hardwood chips that China has been importing recently come from four countries. China's Custom statistics for 2004 are the following:

Table 4.18: China's imports of hardwood woodchips in 2004

		Share	Metric Bone Dry Tons	Value in USD	Average 2004 delivered costs in USD
Total Imports		100 %	302,473.9	39,875, 194	131.83
Countries of origin	Australia	56.8 %	171,782.3	22,330,369	129.99
	Thailand	19.9%	60,144,320	6,508,893	108.22
	Vietnam	17.36%	52,527.4	6,375,226	121.37
	Malaysia	5.47 %	16,556.2	2,270,682	137.15

Source: China's Custom Administration

The following four charts (figures 4.4 to 4.7) were constructed with Chinese production costs compounded at 7% DR. They show that:

- In the less favorable case (High domestic production costs [Profile no 6]) the domestic production maintains a delivered cost advantage of USD 19.02 per bone dry metric ton of hardwood woodchips over suppliers from Thailand who are the most cost-competitive.
- In the most favorable case ((Low domestic production costs [Profile no 7]) the domestic production has a delivered cost advantage of USD 70.15 per bone dry metric ton of hardwood woodchips over Malaysian suppliers who are the less cost-competitive.
- When average costs for domestic production are compared to delivered costs for the largest import source (Australia) the delivered cost advantage that Chinese producers are currently able to obtain is approximately USD 50 per bone dry metric ton of hardwood woodchips.

Figure 4.4: Domestic hardwood woodchips costs compared to imports from Thailand

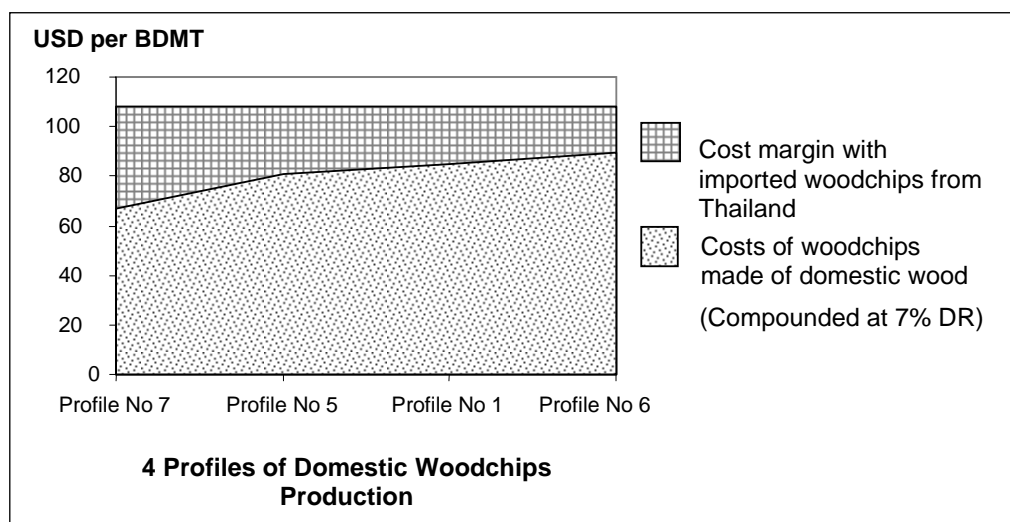


Figure 4.5: Domestic hardwood woodchips costs compared to imports from Vietnam

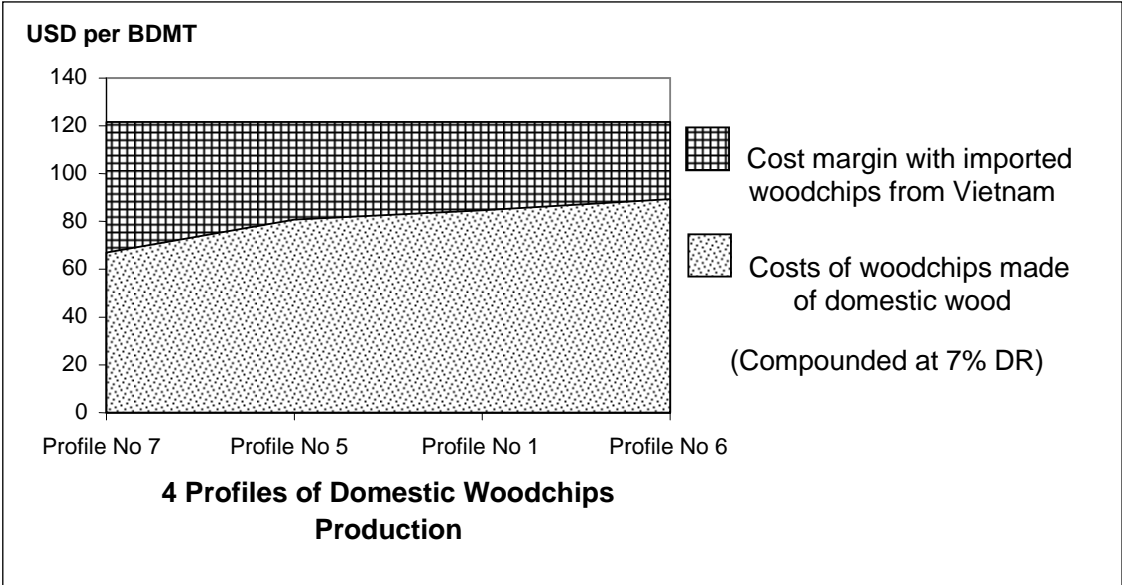


Figure 4.6: Domestic hardwood woodchips costs compared to imports from Australia

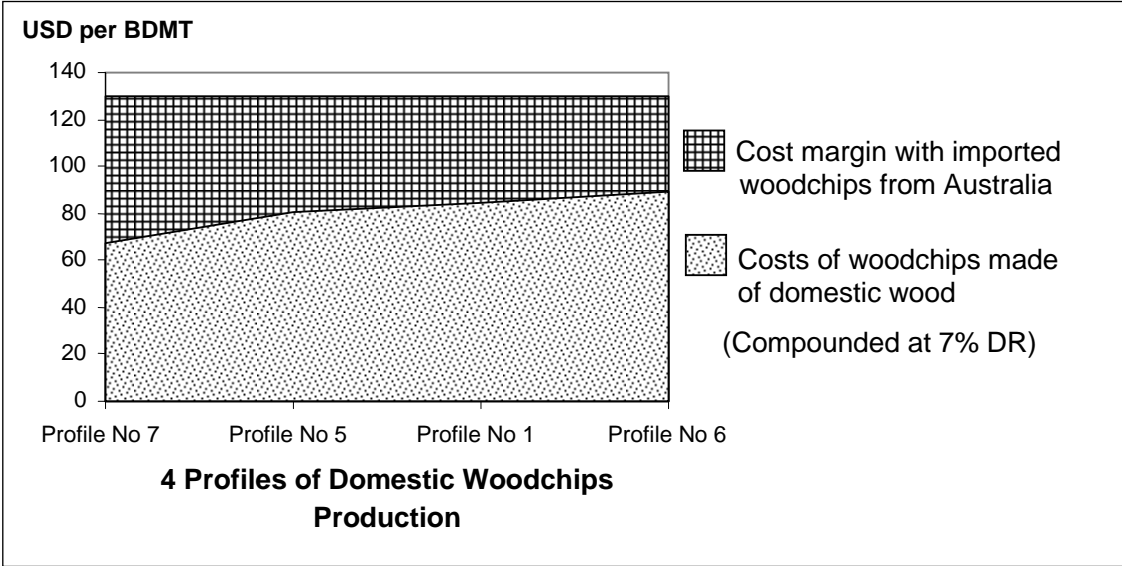
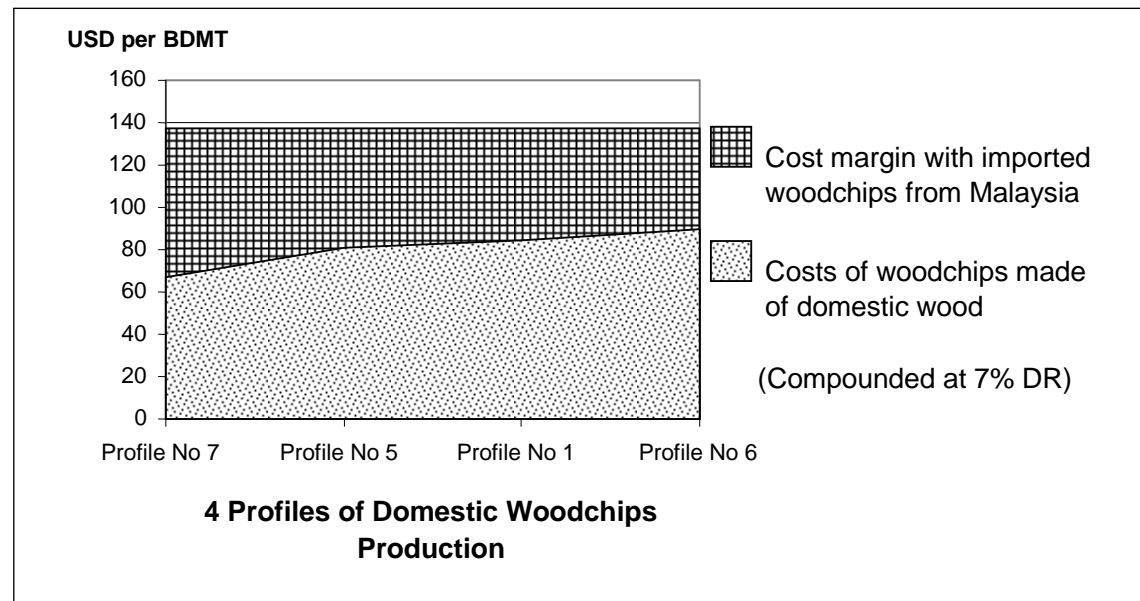


Figure 4.7: Domestic hardwood woodchips costs compared to imports from Malaysia



Using a similar approach for Chinese production costs compounded at 13 % DR gives the following results:

- In the less favorable case (High domestic production costs [Profile no 6]) the domestic production maintains a modest delivered cost advantage of USD 3.23 per bone dry metric ton of hardwood woodchips over suppliers from Thailand who are the most cost-competitive.
- In the most favorable case ((Low domestic production costs [Profile no 7]) the domestic production has a delivered cost advantage of USD 58.2 per bone dry metric ton of hardwood woodchips over Malaysian suppliers who are the less cost-competitive.
- When average costs for domestic production are compared to delivered costs for the largest import source (Australia) the delivered cost advantage that Chinese producers are able to obtain is approximately USD 29 per bone dry metric ton of hardwood woodchips.

Chapter 5: Assessment of Guangxi's Medium-Term Wood Fiber Demand

5.1 Introduction

Guangxi's wood processing sector has expanded rapidly since the late-1990s. By the end of 2004, production capacity in the province's wood panel sector had reached approximately 2.5 million cubic meters per year (m³/yr), and capacity in wood-based pulp production was at least 380,000 air-dried tonnes per year (Adt/yr) across all grades.

In the wood panel sector, growth has been especially pronounced in MDF and HDF production, which currently account for over three-quarters of the province's overall wood panel capacity.¹ In the wood-based pulp sector, production is largely concentrated in four kraft pulp mills with capacities of 50,000 Adt/yr or more. At current capacity levels, total effective wood fiber demand on the part of Guangxi's wood panel and wood-based pulp industries stands at roughly 4.0 million and 1.6 million m³/yr, respectively.

Over the medium term, Guangxi is expected to continue to experience rapid growth in both wood panel and wood-based pulp production. According to a sectoral development plan prepared in 2003, the Provincial Forestry Bureau has established a target for total wood panel capacity to reach 6.0 million m³/yr by 2010. Similarly, the Provincial Development and Reform Committee has announced plans for wood-based pulp production capacity to reach 1.2 million Adt/yr by 2010 and 2.8 million Adt/yr by 2015.

It is anticipated that growth in Guangxi's wood panel and wood-based pulp industries will be supported by both supply-side and demand-side factors over the medium term. On the supply side, the provincial government is currently taking steps to develop large new areas of fast-growing plantations in order to provide a secure raw material base for the province's wood processing industries. It is expected that this process will be enhanced by the proposed World Bank loans. On the demand side, it is anticipated that capacity expansion in Guangxi's wood panel and wood-based pulp industries will be driven by continued growth in key internal markets; most notably, these include Guangdong's furniture industry and construction sector for wood panels, and China's printing and writing paper industry for wood-based pulp.

This chapter briefly reviews the forecasts and capacity expansion plans for Guangxi's wood panel and wood-based pulp industries. To assess the feasibility of the announced expansion plans, the following sections examine the major factors that are likely to drive further growth in both sectors. Potential challenges and risk factors that

¹ This figure is based on the 2003 survey of wood panel industries conducted by the Guangxi Provincial Forestry Bureau, and includes both installed production capacity and capacity then under construction at mills $\geq 2,000$ m³/yr.

could limit such growth are then discussed. Ultimately, this chapter aims to assess the implications of further capacity expansion in Guangxi's wood panel and wood-based pulp industries for wood fiber demand over the medium term.

5.2 Wood Panels

5.2.1 Projected Growth in Wood Panel Production

In 2003, Guangxi's Provincial Forestry Bureau conducted a survey of the province's wood panel sector, which summarized the existing industry structure by major panel type and provided official projections of new mills and capacity expansion projects that were expected to be realized by 2010. At that time, Guangxi's wood panel producers had an aggregate installed capacity of nearly 1.4 million m³/yr across all grades, and some 1.1 million m³/yr of new production capacity was then under construction (see Table 5.1). Taking into account both installed capacity and production lines under construction, MDF and HDF then accounted for 76.3 percent of the province's total wood panel capacity; plywood for 12.5 percent; wood-based particleboard for 6.0 percent; and blockboard for 5.2 percent.

The Provincial Forestry Bureau projected in 2003 that Guangxi's aggregate wood panel production capacity would grow by 140 percent from end-2004 levels to reach 6.0 million m³/yr in 2010.² Of the 3.5 million m³/yr of new capacity that is officially projected to come online during this period, new MDF and HDF production lines are expected to account for some 1.7 million m³/yr – or nearly 50 percent of the total – while new plywood production capacity is expected to account for 1.1 million m³/yr. In proportional terms, it is projected that by 2010 MDF and HDF will account for 60.0 percent of total wood panel capacity and plywood will account for 23.6 percent.

To put these figures in perspective, the Provincial Forestry Bureau's projection of MDF and HDF capacity growth through 2010 represents an 88.3 percent increase over Guangxi's estimated capacity levels at the end of 2004. On an annual basis, this amounts to an average growth rate of 14.7 percent over six years. Although quite substantial, this figure is much smaller than China's national growth rate for MDF and HDF production over the preceding six year period (i.e. 1999-2004), which averaged nearly 40 percent per year. By comparison, a leading private sector study of the global MDF and HDF industry projected in 2003 that China's production would increase by 9.0 percent per annum through 2008 (BIS Shrapnel 2003). It should be noted, however, that approximately 5.5 million m³/yr of new capacity has already come online nationally in the two years since that forecast was made.

The Provincial Forestry Bureau's projected growth rate for Guangxi's plywood industry is even more pronounced than that projected for MDF and HDF, amounting

² This figure represents the sector's projected growth compared to the aggregate of 2003 installed production capacity (i.e. 1,393,000 m³/yr) and capacity that was then under construction (i.e. 1,130,000 m³/yr). If compared to 2003 installed capacity alone, the total capacity projected for 2010 represents an increase of 334 percent.

to an increase of approximately 250 percent over six years. This equates to an average annual growth rate of 23.7 percent per year through 2010. By comparison, China's plywood production increased by an average of 16.7 percent per year on a national scale during 1998-2003. Significantly, most of the projected expansion in Guangxi's plywood capacity is for thin panels (< 6 mm) that can be used for furniture production, with relatively little growth expected for concrete-forming panels.

Table 5.1: Planned Structure of Guangxi's Wood Panel Industry by 2010, as of 2003

Panel Type	No. of Mills	Production Capacity (m3/yr)			Total Capacity (m3/yr)	% of Total
		Installed	Under Construction	Planned		
MDF	29	795,000	830,000	1,250,000	2,875,000	48%
Plywood (incl. thin panels, construction panels, LVL)	72	315,000	0	1,110,000	1,425,000	24%
HDF	4	0	300,000	450,000	750,000	12%
Particleboard (wood-based)	10	151,000	0	500,000	651,000	11%
Blockboard	44	132,000	0	60,000	192,000	3%
Oriented strand board (OSB)	1	0	0	100,000	100,000	2%
Composite panels	1	0	0	50,000	50,000	1%
Wet-process fiberboard	2	15,000	0	0	15,000	0%
Total	161	1,393,000	1,130,000	3,520,000	6,043,000	100%

Data Source: Guangxi Forestry Bureau (2003)

5.2.2 Factors Driving Capacity Expansion

As noted above, the expansion of Guangxi's wood panel sector over the next several years is likely to be driven by both supply-side and demand-side factors. On the supply side, the provincial government has recently taken steps to promote the development of wood processing industries in locations where sufficient areas of fast-growing plantations exist to support such industries. One manifestation of this policy has been an active effort on the part of the Guangxi Gaofeng Forestry Pulp and Paper Industry Group Co. Ltd (hereafter, the Gaofeng Group), a commercial enterprise closely affiliated with the Provincial Forestry Bureau, to secure partnerships with county governments to develop wood panel mills that are integrated with fast-growing plantations.

Under agreements that have been initiated with several county governments, the Gaofeng Group has made a commitment to build a wood processing mill at whatever point the county has secured 120,000 mu (or 8,000 hectares) of tree plantations that can be dedicated to supplying the mill with fiber. According to Gaofeng officers interviewed during this study, the group has agreed to build a wood panel mill with a single production line of 50,000 m3/yr once the initial 120,000 mu has been planted. The group reportedly will install a second production line of 50,000 m3/yr once the planted area has reached 200,000 mu. Under this model, it is up to the county government to secure the agreed upon plantation area for the project. The county

government may do so by contributing land from county forest farms, leasing land from farmers, supporting outgrower schemes, or utilizing any other model it may wish.

On the demand side, the expansion of Guangxi's MDF-HDF and plywood industries over the medium term is likely to be driven, above all else, by continued growth in China's furniture industry. Nationally, wood-based furniture production is estimated to have grown at 15 percent per annum during 1999-2003 to generate US\$ 14.8 billion in total output in 2003 (BIS Shrapnel 2003). Most analysts expect this growth to continue, although it perhaps at a slightly slower pace than that of the last several years. In 2003, for instance, BIS Shrapnel projected that China's wood furniture production would increase by up to 13 percent per year through 2008. Similarly, Jaakko Pöyry (2004) has estimated that China's overall furniture production (both wood and non-wood) will expand at a rate of 11 percent per annum through 2010.

Much of the projected growth in China's furniture industry is expected to be driven by increased domestic demand, particularly for housing furniture. At present, approximately 75 percent of the country's furniture production is consumed domestically, in spite of the fact that per capita expenditures on furniture are still very low by international standards. With disposable income levels rising rapidly, especially among China's growing and increasingly affluent urban populations, there is considerable room for accelerated growth in per capita furniture expenditures. At the same time, China's housing market is expanding rapidly both in terms of numbers of housing starts and average home size, each of which correlate positively with increased furniture demand. One factor encouraging this is the Chinese government's target for living spaces to reach 23-25 m² per capita for urban housing and 25 m² per capita for rural housing by 2010 (Jaakko Pöyry 2004).

China's furniture exports are also expected to continue to grow in both volume and value, although the rate of growth achieved in recent years may slow due to anti-dumping restrictions imposed by the United States. Since the late-1990s, furniture producers from Japan, South Korea, and Taiwan have made substantial investments in China to take advantage of the country's low wages and manufacturing costs. This has led to significant improvements in the overall quality of Chinese furniture, and has pushed furniture exports to reach 25 percent of the industry's total value. In 2002, for instance, the country's international furniture shipments generated US\$ 5.4 billion, while the total value of China's furniture production (wooden and non-wooden) was approximately US\$ 20 billion – or roughly double the US\$ 10 billion generated in 1998. Anticipating this growth to continue, Jaakko Pöyry (2004) projected that by 2005, the overall value of China's furniture production would exceed US\$ 26 billion, and furniture exports would generate US\$ 7.5 billion per year. It is possible exports to the North American market have slowed somewhat in recent months due to US anti-dumping restrictions.

Continued growth in China's furniture industry is likely to have a strong positive effect on the furniture manufacturing centers of Guangdong's Pearl River Delta, which account for over 50 percent of the country's exports. This, in turn, is likely to

mean continued strong demand for MDF, HDF, and irregular plywood from Guangxi, as Guangdong's furniture industry has consumed as much as 70-80 percent of that province's production of these panels in recent years. Wood panel producers in Guangxi are also well-positioned to respond to growing demand from other emerging manufacturing centers in South West and South East China. Some producers interviewed during this study, for instance, reported that they are already selling as much as 30 percent of their panels to buyers in Chengdu and Chongqing. In addition, the rapid growth of Vietnam's wood furniture industry in recent years has created new market opportunities to which panel producers in Guangxi have already started to respond.

In addition to increased demand for wood panels from markets outside Guangxi, there is considerable scope for development of a furniture manufacturing base within the province. In fact, the Provincial Forestry Bureau has already formulated a general plan to promote furniture industry development in Guangxi during 2005-2010. Under this plan, the Provincial Forestry Bureau will seek to triple Guangxi's furniture output from 4.0 million pieces in 2004 to 13.0 million pieces in 2010, which would significantly expand local demand for wood panels. The provincial government's plan is structured around the development of five integrated furniture industry zones in the following locations: Nanning; Liuzhou; Beihai; Yulin; and Guigang. Each of these will have several components to link fast-growing plantations, wood panel production,³ furniture manufacturing, and other types of value-added processing and marketing. As yet, it is not entirely clear where the investment will come from or what policies the provincial government will put in place to promote the development of these integrated furniture zones.

Beyond furniture production, there is also strong potential in China for increased use of MDF and HDF for a variety of building construction applications and interior decoration. At present, some 80-85 percent of the MDF consumed in China is used for furniture production, while only 15-20 percent is used in construction and interior decoration (BIS Shrapnel 2003). This stands in marked contrast to Japan where over 80 percent of MDF demand is from the construction sector, especially for the building of houses. By comparison, nearly 40 percent of MDF demand in South Korea is for construction purposes. It is expected that over time the structure of MDF demand in China will move in the direction of Japan (and, to a lesser extent, South Korea), with substantial volumes of panels being used for a wider and more sophisticated set of end-uses outside the furniture sector (BIS Shrapnel 2003).

Most notably, construction applications include flooring (often in combination with plywood); steps; door jambs; mouldings; panels; doorskins; closet doors; window counters; and kitchen components (BIS Shrapnel 2003). MDF and HDF are increasingly being used as substitutes for sawn timber, plywood, and particleboard in many interior applications, such as the base for laminated flooring, wall linings, and

³ In Nanning, for instance, this will include: 1) home furniture and office furniture production; 2) metal and plastic parts factories; 3) packaging material factories; 4) a factory to produce reinforced wood products; 5) a furniture exhibition center; 6) a wood panel marketplace; 7) a timber market; and 8) a wood flooring factory.

doorskins. In China, demand for laminated flooring and interior decorative paneling has increased quite significantly in recent years, and there continues to be considerable room for further growth in the volumes of MDF and HDF panels being directed to these end-uses. It is also expected that over time, demand will increase – not only in China, but also in Japan and South Korea -- for higher quality MDF and HDF panels, including panels with low formaldehyde emissions, fire resistance, and water resistance.

5.2.3 Challenges and Potential Limiting Factors

There are a number of factors that could potentially limit the development of Guangxi's wood panel industry over the medium term. Briefly summarized, some of the main potential challenges and risk factors include the following:

5.2.3.1 Reduced demand, either in domestic or international markets: Although most analysts expect demand for China's wood panel products to continue to grow over the next several years, it is not difficult to imagine scenarios in which demand could decline – perhaps significantly. Most directly, projections of continued growth in China's domestic market are based on the assumption that the country's GDP will continue to expand at rates of 9.0 percent or more, as it has for much of the last two decades. In recent months, however, there have been growing signs that China's economy could potentially overheat, leading to some sort of market correction or economic slow-down. Whatever its immediate cause, any slow-down in the country's economy would almost certainly be characterized by a decline in the construction sector, particularly in housing starts, and in demand for wood-based furniture – leading to a corresponding drop in demand for wood panels.

There is also a risk that demand for China's wood-based exports could decline in key international markets over the next several years. Currently over 50 percent of China's furniture exports are sent to the United States, where the weakening dollar and growing trade and budget deficits are leading many analysts to warn of a possible recession. Of particular concern for China's wood panel and furniture producers, there are indications that the US housing market could soon experience a sharp contraction, which would inevitably lead to a decline in US demand for imported furniture. In a similar manner, any action taken by the Chinese government to unpeg the Yuan from the US dollar would almost certainly result in reduced demand for Chinese furniture in the US and other markets, as it would become relatively more expensive than it is now. It can be expected that over time Chinese exporters will reduce these risks by expanding their exports to Europe and other non-US markets.

5.2.3.2 Anti-dumping restrictions on China's access to key markets: Over the last couple of years, China's exports of low-priced furniture to the United States have resulted in US-based furniture producers losing a substantial share of their home market and have pushed a significant number of companies out of business. Whether fairly or not, the US government has responded to the growing volume of furniture imports from China by imposing anti-dumping measures under the WTO. In December 2004, the US International Trade Commission issued tariffs of up to 198

percent on over US\$ 1 billion of wood furniture imports from China. Not surprisingly, the legitimacy of such measures has been vigorously challenged by Chinese exporters, and it remains to be seen whether such challenges are upheld by the WTO. However, to the extent that anti-dumping penalties are adopted by governments in other destination markets or applied more broadly by the US, it is conceivable that they could restrict China's access to key markets over the medium term. This, in turn, would create pressures on Chinese furniture producers to increase sales in their domestic market and/or to expand exports to new destination countries.

5.2.3.3 Shortages of low-cost energy: The rapid pace of China's economic growth in recent years has meant that in many regions, industrial expansion has outpaced the development of new energy sources. In Guangxi, this has meant that wood processing industries – like producers in many other sectors – have often faced energy shortages which have either interrupted production or raised production costs, sometimes significantly. Several producers interviewed during the course of this study reported that uncertain energy supplies in Guangxi are a major factor limiting plans for new production capacity expansion. In terms of relative production costs, the availability of low-cost energy sources is far more important for MDF and HDF producers than it is for other types of wood panel producers. For plywood producers, for instance, energy purchases typically account for only 8-10 percent of direct production costs. By comparison, MDF and HDF mills are fairly energy-intensive, with expenditures on energy typically representing 15-21 percent of direct costs.

5.2.3.4 Access to finance and external investment: Most of the capacity expansion that has been planned for Guangxi's wood panel sector is in the relatively capital-intensive MDF and HDF industries, as well as large-scale plywood production. As such, the provincial government's sectoral development strategy will require substantial capital investments to be made over the next several years. This, in turn, will require a significant commitment on the part of China's state banks and other financial institutions, as well as the involvement of investors from outside Guangxi and, perhaps, from outside China.

For MDF, the amount of investment required for any specific capacity expansion project will depend not only on the scale of the mill, but also on whether the mill will utilize a multiple-opening press (which can be produced by machinery suppliers within China) or a continuous press (which must be imported). According to figures published by the Guangxi Forestry Bureau (2003), total investment costs for MDF mills utilizing multiple-opening presses typically range between RMB 45 million and RMB 115 million for mills with capacity of 50,000 m³/yr and 200,000 m³/yr, respectively. By contrast, total investment costs for MDF mills utilizing continuous presses typically range from RMB 210 million for a mill with a capacity of 100,000 m³/yr to RMB 300 million for a mill with a capacity of 200,000 m³/yr.

To obtain a rough estimate of the scale of investment required to meet the Provincial Government's target of 1.9 million m³/yr of new MDF and HDF capacity by 2010, it can be assumed that three quarters of the new expansion will utilize multiple-opening presses with an average capacity of 100,000 m³/yr and that the remaining one-quarter

will utilize continuous presses with an average capacity of 100,000 m³/yr. Under this scenario, approximately RMB 1.2 billion (or US\$ 145 million) of investment would be needed for the multiple-opening press mills and RMB 688 million (or US\$ 83 million) for mills using continuous presses.

Table 5.2: Estimated Total Investment Cost for MDF Mills According to Type of Press and Production Capacity (in RMB)

Type of Press	Production Capacity (m ³ /yr)			
	50,000	100,000	150,000	200,000
Multiple-opening	45,000,000	85,000,000	110,000,000	115,000,000
Continuous		210,000,000	250,000,000	300,000,000

Source: Guangxi Forestry Bureau (2003)

It is noted that the Provincial Forestry Bureau's development plan for the wood panel sector is structured very heavily around investment projects to be carried out by the Gaofeng Group. According to the Forestry Bureau's list of planned capacity expansions in the wood panel sector for the period 2004-2010, Gaofeng is expected to carry out 19 of the 25 expansion projects, accounting for 87 percent of the 3.5 million m³/yr of new capacity that is planned. In interviews conducted during this study, officers from the Gaofeng Group indicated that group has not yet developed a firm plan for meeting the significant capacity expansion target set by the Forestry Bureau, and that the group's investments in wood panel mills over the coming years may ultimately involve a more diverse range of products than that presented in the sectoral development plan. At present, the Gaofeng Group operates three wood panel mills (with a combined capacity of 170,000 m³/yr of MDF and 150,000 m³/yr of HDF) and is in the process of constructing a fourth mill (with a capacity of 150,000 m³/yr of HDF).⁴ If fully implemented, the planned expansions proposed by the Provincial Forestry Bureau would amount to an increase in the group's installed capacity of some 950 percent over the next five years.

5.2.4 Implications for Wood Fiber Demand

This section examines the implications for wood fiber demand of existing and projected capacity in Guangxi's wood panel sector. It focuses first on effective fiber demand at current capacity levels, and then assesses likely demand for wood fiber under two scenarios for projected growth in the sector through 2010. It must be emphasized here that the figures presented are only estimations based on available data and (where necessary) on assumptions about roundwood and dry fiber conversion ratios, and the specific grades of wood fiber consumed by each type of panel production.

⁴ The group's existing mills include the Guangxi Gaofeng Panel Board Co. in Nanning Prefecture (which operates a 2-line MDF mill with a capacity of 90,000 m³/yr); the Guangxi Gaofeng Guanhua Wood Panel Co. (which operates a 2-line MDF mill with a capacity of 80,000 m³/yr); and the Guangxi Gaofeng Rongzhou Wood Panel Co. (which operates a 1-line HDF mill with 150,000 m³/yr capacity). Gaofeng is now in the process of constructing a second HDF mill in Qinzhou.

5.2.4.1 Effective wood demand at current capacity levels: At current levels, Guangxi's wood panel sector has approximately 2.5 million m³/yr of installed production capacity across all grades of panels (Table 5.3). If the province's producers were operating at full capacity, the sector's effective wood demand would total approximately 3.5 million cubic meters of roundwood equivalents per year (m³ RWE/yr).

As Table 5.4 shows, an estimated 40 percent of the total is in the form of greenwood residue obtained from thinning; tops of felled trees and irregular logs (including those with bends, holes, knots, and/or less than 2 meters in length) generated by commercial harvesting activities. Similarly, small-diameter commercial logs (i.e. < 8 cm) account for approximately 15 percent of the total; and commercial logs \geq 8cm account for 17 percent of the sector's effective wood demand. The province's wood panel producers also consume substantial amounts of fiber in dry form, including approximately 154,000 BDMT/yr of commercial wood chips and 357,000 dry tonnes of residual material from other wood processing operations.

The current structure of wood demand in the sector strongly reflects the fact that MDF and HDF producers account for three-quarters of the province's overall wood panel capacity. Indeed, MDF and HDF mills generate nearly 90 percent of the overall demand for greenwood residues; 86 percent of demand for small-diameter logs; and 62 percent of demand for dry mill residues. Demand for larger diameter commercial logs among wood panel mills is dominated by plywood producers, which account for 67 percent of effective demand for this grade. This reflects the fact that plywood mills require commercial-grade logs with diameters that are large enough to peel, while MDF and HDF mills generally consume cheaper sources of fiber as they are able to use a much wider range of qualities and grades.

5.2.4.2 Wood panel scenario #1 – Projected growth according to Provincial Forestry Bureau's sectoral plan: As discussed above, Guangxi's Provincial Forestry Bureau has projected that by 2010, some 3.5 million m³/yr of new production capacity will be installed in the province's wood panel sector (see Table 5.5). Significantly, this includes some 1.7 million m³/yr of capacity in MDF and HDF production; 1.1 million m³/yr of capacity in plywood production; and 500,000 m³/yr of capacity in particleboard production. In addition, the projected expansion includes development of two mills capable of producing grades of panels that have heretofore not been produced in Guangxi: oriented strand board (OSB) (100,000 m³/yr) and composite panels (50,000 m³/yr). Under this scenario, the province's overall wood panel production capacity is projected to reach 6.0 million m³/yr by 2010.

Under this scenario, effective wood demand from Guangxi's wood processing sector is projected to increase from its current level of 3.5 million m³/yr to approximately 8.4 million m³/yr by 2010. As Table 5.6 shows, residual greenwood is expected to account for nearly 34 percent of total fiber demand at that point, while small-diameter commercial logs (< 8 cm) are projected to account for 14 percent and larger commercial logs (\geq 8cm in diameter) are projected to account for nearly 27 percent,

respectively. Annual demand for mill residues is expected to reach 778,000 dry tonnes/yr, while demand for wood chips is expected to reach 304,000 BDMT/yr.

Under this scenario, MDF and HDF are expected to remain the single largest source of fiber demand in the wood panel sector, with those industries' estimated roundwood demand reaching 4.8 million m³/yr by 2010. Together, these industries are projected to account for 84 percent of the sector's overall demand for greenwood residues; 73 percent of demand for small-diameter commercial logs; and 54 percent of demand for dry mill residues.

At the same time, estimated roundwood demand associated with plywood production is projected to reach 2.1 million m³/yr by 2010. At that point, plywood producers are projected to account for 82 percent of the sector's demand for large-diameter commercial logs, and for 27 percent of demand for small-diameter commercial logs. With most of the new plywood capacity coming online projected to be for thin panels to be used in furniture production, it can be anticipated that most of the industry's new fiber demand will be for hardwood peeler logs (most of which will be eucalyptus).

5.2.4.3 Wood panel scenario #2 – Projected growth at 9.0% per annum through 2010: This scenario presents a somewhat more conservative set of projections for growth in Guangxi's wood panel sector than those outlined in the Provincial Forestry Bureau's projections. It assumes that production capacity for each grade of wood panel (except wet-process fiberboard, which appears to be getting phased out) will grow at an average annual rate of 9.0 percent through 2010. This rate matches many projections for China's overall GDP growth over the next several years.

Under this scenario, Guangxi's wood panel capacity is expected to reach 4.2 million m³/yr by 2010, representing an increase of approximately 68 percent over current levels (see Table 5.7). As Table 5.8 shows, effective wood demand from the panel sector is projected to reach nearly 5.8 million m³/yr of roundwood equivalents. Of this, greenwood residue accounts for 41 percent; small-diameter logs for 15 percent; and large-diameter logs for over 17 percent of overall wood demand. Demand for mill residues is projected to reach 595,000 dry tonnes/yr, and demand for wood chips is projected to reach 258,000 BDMT/yr.

As in Scenario #1, MDF and HDF producers are expected to account for a dominant share of the sector's overall wood demand under this scenario, particularly for greenwood residues, small-diameter commercial logs, dry mill residues, and commercial wood chips. Plywood producers are expected to account for approximately two-thirds of the sector's demand for large-diameter commercial logs.

5.3 Wood-based Pulp

5.3.1 Projected Growth in Wood-based Pulp Production

There is a general lack of detailed data on the grades, production capacities, and operational levels of individual mills in Guangxi's pulp and paper sector. However, according to figures provided by the Provincial Development and Reform Committee, Guangxi has over 200 pulp and paper mills with an aggregate annual production capacity of 960,000 tonnes of paper and 320,000 tonnes of commercial pulp, across all product grades. Wood pulp is currently estimated to account for 30 percent of the total fiber consumed by the province's paper industry, and Guangxi reportedly has 14 paper mills with capacities over 10,000 Adt/yr that utilize wood pulp as a raw material source. This project has been able to identify seven mills in Guangxi with wood-based pulp production capacities of 20,000 Adt/yr or more, of various grades (see Table 5.9).

The Guangxi government is actively taking steps to develop the province's wood-based pulp and paper industry. According to the "General Plan for the Development of an Integrated Plantation-based Pulp and Paper Industry in Guangxi for 2005-2015", prepared by the Provincial Development and Reform Committee in November 2004, the provincial government is aiming to expand the province's wood-based pulp production capacity to 1.2 million tonnes/yr by 2010 and to 2.85 million tonnes/yr by 2015. It principally plans to do so by promoting the development and expansion of capacity at six specific mills. Briefly, these include the following:

5.3.1.1 Construction of a greenfield pulp and paper mill project with Asia Pulp & Paper (APP) in Qinzhou Prefecture: According to the provincial development plan, the Guangxi government aims to support the establishment of an integrated pulp and paper mill through the Guangxi Jingui Pulp and Papermaking Co. Ltd. -- a joint venture with APP, China's largest pulp and paper producer -- by 2007. In its first stage of development, according to the provincial government plan, this mill is intended to have an annual capacity of 300,000 tonnes of pulp and 600,000 tonnes of paper. In interviews conducted during March 2005, however, officials at the Provincial Development and Reform Committee stated that plans for the project had been submitted to the central government but had not yet been approved. They indicated that the project would likely be initiated with the construction of a pulp mill with a capacity of 300,000 Adt/yr of chemical thermo-mechanical pulp (CTMP) and that the planned paper mill would produce both packaging paper (50 percent of total output) and art paper (50 percent).

5.3.1.2 Construction of a greenfield pulp and paper mill project with Stora Enso in Beihai Prefecture: According to the provincial development plan, the Guangxi government aims to support the establishment of an integrated pulp and paper mill in Beihai with a combined annual pulp and paper capacity of 600,000 tonnes. As with the Qinzhou mill project, officials at the Provincial Development and Reform Committee stated in interviews in March 2005 that the project is still in the design

phase, and that neither the planned mill's production capacity nor its product grade has not yet been confirmed. They indicated that the project would most likely be initiated with the construction of either a chemical thermo-mechanical pulp (CTMP) mill and/or a BHKP mill, although the capacity level(s) have not yet been determined. They also indicated that there is a possibility that the project would involve construction of a 600,000 tonne paper mill, although this too had not yet been determined.

In June 2004, an official at Stora Enso reported that the company's most recent plan is to develop a pulp mill that will have capacity of 600,000 Adt/yr of BHKP and 300,000 Adt/yr of CTMP.⁵ The company has emphasized, however, that realization of these plans will ultimately depend on the project being able to secure an adequate plantation base to ensure fiber supply at a competitive cost. Stora Enso is reportedly seeking to develop 120,000 ha of plantations to support the planned mill.

5.3.1.3 Capacity expansion at Liujiang Paper Mill in Liuzhou Prefecture:

Currently the Liujiang mill has two production lines of chemical bamboo pulp with a combined capacity of 75,000 Adt/yr and one line of wood-based thermo-mechanical pulp (TMP) with a capacity of 20,000 Adt/yr, each of which are integrated with production of newsprint and printing and writing paper. The mill is now seeking to expand its pulp capacity by adding a bleached chemical bamboo pulp production line with a capacity of 170,000 Adt/yr. According to the provincial government plan, steps will be taken to expand the mill's capacity to 800,000 tonnes/yr pulp and 300,000 tonnes/yr paper. It is not clear whether any of the new pulp capacity that is planned will be wood-based pulp.

5.3.1.4 Capacity expansion at Nanning Phoenix Papermaking Co. in Nanning Prefecture:

In 2004, the Phoenix mill had a production capacity of 100,000 Adt/yr of bleached softwood kraft pulp (BSKP); and the company was reportedly in the process of expanding capacity to 120,000 Adt/yr by 2005. The company has also reported that is in the process of shifting its production from BSKP to BHKP. Until now, the mill has sold all its product as market pulp. By 2008, the provincial government aims to promote expansion of the mill's pulp capacity to 150,000 Adt/yr and to support integrated production through the installation of a paper production line with a capacity of 150,000 Adt/yr.

5.3.1.5 Capacity expansion at Heda Papermaking Co. in Hezhou Prefecture:

Currently the Heda mill has the capacity to produce 70,000 Adt/yr of either BHKP or BSKP, all of which is sold as market pulp. According to the provincial government's plan, the company will expand the mill's pulp capacity to 300,000 Adt/yr and will

⁵ As with the Qinzhou mill, an official at Gaofeng Group -- which reportedly has a 15 percent equity stake in the Beihai mill project -- reported that the Beihai project's first phase will likely involve the development of an integrated pulp and paper mill with an annual capacity of 600,000 tonnes of pulp and 600,000 tonnes of paper. This official estimated that construction of the mill would likely begin in late-2006 at the earliest, and that it would probably only begin operating in 2008 or 2009. Plans reportedly exist to expand the mill's capacity to 1.0 million tonnes of pulp and 1.0 million tonnes of paper during a second phase, the timing of which is still undetermined.

install a paper production line with a capacity of 500,000 Adt/yr of high-grade culture papers.

5.3.1.6 Capacity expansion and construction of an integrated pulp and paper mill in western Guangxi: The provincial development plan indicates that the Guangxi government seeks to expand pulp and paper capacity in the province's western region to reach 500,000 – 800,000 Adt/yr of pulp and 500,000 Adt/yr of paper by 2015. (The western region's current capacity is unclear). To meet this target, it reportedly aims to promote the development of an integrated pulp and paper mill on the Hongshui River with a combined annual capacity of 300,000 – 500,000 tonnes. The provincial government also plans to promote capacity expansions at existing mills, but the plan provides no specifics of what this would involve.

5.3.2 Factors Driving Capacity Expansion⁶

The expansion of wood-based pulp production in Guangxi is being driven, above all else, by China's growing demand for paper and paperboard products. China's domestic paper and board production grew from 13.7 million tonnes across all grades in 1990 to 43.0 million tonnes in 2003 (He and Barr 2004). During this period, China accounted for over 50 percent of global expansion in paper and board capacity, and the country is now the world's second largest producer in this sector, surpassed only by the United States. China's aggregate paper and board production is expected to reach 68.5 million tonnes per year by 2010, as domestic producers modernize their operations and as international producers seek to capture a share of China's growing market (He and Barr 2004).

With this expansion, China's demand for wood-based pulp has also grown substantially in recent years, particularly as domestic production of printing and writing paper and other high-grade papers has increased. A recent forecast projects that by 2010, China's paper and board industry will consume some 60 million tonnes of fiber annually across all types and grades – that is, recovered paper, nonwood pulp, and wood-based pulp (He and Barr 2004). Demand for various grades of wood-based pulp is expected to reach 15.1 million tonnes per year by 2010 -- up from 9.2 million tonnes in 2003 -- at which point wood pulp will account for approximately 25 % of total fiber consumed by Chinese producers. Bleached hardwood kraft pulp (BHKP) and bleached softwood kraft pulp (BSKP) are expected to account for roughly two-thirds of this demand, while unbleached kraft pulp (UKP) and mechanical and semi-mechanical wood pulp account for the remainder.⁷

To meet this growing demand, the Chinese government has promoted the development of a domestic wood-based pulp industry. China's Tenth Five-Year Development Plan, covering the period 2001-2005, prioritized the expansion of projects that integrate fast-growing pulpwood plantations, wood pulp production, and

⁶ Portions of this section have been extracted from Barr and Cossalter (2004).

⁷ Specific projections of demand for the various grades of wood pulp in 2010 are as follows: BHKP -- 6.1 million tonnes; BSKP -- 4.3 million tonnes; UKP -- 2.2 million tonnes; and mechanical/semi-mechanical wood pulp -- 2.3 million tonnes (see He and Barr 2004).

high-grade paper production (SFA 2002b). Specifically, it set a target for paper capacity to increase by 14 million Adt/yr by 2010 and called for domestic wood pulp capacity to triple in size from its 2000 level by reaching 2.2 million Adt/yr by 2005.⁸

To support integrated wood-based pulp and paper projects, the government has streamlined the sector's investment approval process and provided a variety of financial incentives and capital subsidies (Barr and Cossalter 2004). These include several billion dollars worth of loan interest subsidies, discounted credit, and extended repayment periods for loans from state-owned banks. In addition, the Chinese government has sought to encourage foreign investment by promoting joint ventures in the following industry segments:

- Wood base development for pulp and paper processing;
- Chemical pulp with annual capacity over 300,000 Adt/yr;
- Mechanical pulp (CTMP, BCTMP, APMP)⁹ with annual capacity over 100,000 Adt/yr;
- High-grade paper and paperboard (except newsprint).

At the provincial level, the Guangxi government has sought to promote wood-based pulp production by assisting companies that are planning to invest in the industry to secure a plantation resource base. The provincial governments has done so most directly by working closely with Asia Pulp & Paper and with Stora Enso as those companies have sought to develop the plantations that will be needed to supply the Qinzhou and Beihai mill projects, respectively. To prevent direct competition over land from arising between the companies, the Guangxi government has divided the south and south-east parts of the province into fiber supply regions for the two planned mill projects. Specifically, APP has been assigned 23 counties in which it may develop its plantation resource base, while Stora Enso has been assigned 15 counties. In these counties, the provincial government allows the designated company to exercise priority rights to lease land and/or enter into wood supply contracts with land-holders, whether they are households, local collectives, or state forest farms.

To assist the companies in their designated areas, the Gaofeng Group – which has close ties to the Provincial Forestry Bureau – has entered into contractual relationships with both APP and Stora Enso to develop plantations for the two planned mill projects. According to Gaofeng officials interviewed during this study, Gaofeng has entered into an agreement with Stora Enso to secure 650,000 mu (43,333 ha) of plantation land from the group's forest farms in exchange for a 15 percent

⁸ To implement these targets, the National Development and Planning Commission (NDRC) in 2001 issued a list of 42 priority pulp and paper projects which will involve approximately US\$ 24 billion in investment from both domestic and foreign sources by 2010 (AF&PA 2004). The NDRC has scheduled 13 of these projects which involve the integration of high-grade paper production with fast-growing plantations – including three large-scale chemical pulp mills – for fast-track investment approval and government financial incentives.

⁹ CTMP refers to chemi-thermomechanical pulp; BCTMP is bleached chemi-thermomechanical pulp; and APMP is alkaline peroxide mechanical pulp.

equity share in the first phase of the Beihai mill project.¹⁰ Stora Enso reportedly will pay rent to Gaofeng to utilize this land, and Stora Enso will develop and manage the land directly.

By comparison, the Gaofeng Group has entered into an agreement with APP to develop 200,000 mu (13,333 ha), beginning in early 2005. Under this agreement, this entire area will be land leased from farmers, and APP will cover all costs, including the land lease fee paid to the farmers. Gaofeng will do all the work associated with development and management of the site, and the group will be paid a management fee by APP.

5.3.3 Challenges and Potential Limiting Factors

In spite of China's strong demand for wood-based pulp, there are a number of challenges and risk factors that could limit the substantial capacity expansion that is now planned for Guangxi's pulp and paper sector. Some of these factors – such as possible shortages of low-cost energy and the need to secure substantial amounts of finance – have been discussed above in relation to the wood panel sector. For pulp and paper producers, there are additional risks related to the availability and cost of wood fiber supply.

5.3.3.1 Competition for wood fiber: It can be expected that the expansion of pulp capacity in Guangxi will place significant new demands on the province's wood markets (see the following section). While the provincial government is now taking steps to help APP, Stora Enso, and other existing and potential pulp producers to develop plantation resources, it is likely that over the medium term most producers will need to purchase at least a portion of their wood fiber from external sources. In addition to whatever direct competition occurs among pulp producers, it is anticipated that in some regions pulp mills will compete with MDF and HDF producers for at least a portion of their wood fiber. As discussed above, MDF and HDF producers are projected to consume approximately 1.2 million m³/yr of commercial logs (of all diameters) and nearly 280,000 BDMT/yr of commercial wood chips annually by 2010. Within each of these grades, there is likely to be considerable overlap with the types of wood utilized by pulp mills, and the resulting competition could push prices upwards.

To some extent, pulp mills based in Guangxi are also expected to compete for fiber with producers located outside the province. Most immediately, this is likely to be the case with APP's 1.0 million Adt/yr BHKP mill in Hainan Province. To operate at full capacity, that mill requires some 4.15 million m³ of pulpwood annually, which in turn requires a net plantation area of approximately 346,000 ha (assuming an MAI of 15 m³/ha/yr) (see Barr and Cossalter 2004). Through 2003, however, APP had planted only 63,000 ha of eucalyptus plantations in Hainan Province; 27,000 ha in Guangdong Province; and nearly 40,000 ha in Guangxi. It is expected that the mill will face significant fiber shortfalls from its plantation resources for at least the next several

¹⁰ Gaofeng reportedly plans to secure this land from the following forest farms: Qinlian (400,000 mu); Bobai (170,000 mu); and Dongmen (80,000 mu).

years, and the company will rely heavily on purchases of pulp logs and wood chips from Guangxi and elsewhere to meet these shortfalls. APP is currently purchasing large volumes of wood from Guangxi and other external sources to supply the Hainan mill.

It is anticipated that any further pulp capacity expansion at APP's Hainan mill and/or the establishment of other pulp mills in the South China region could potentially place additional demands on Guangxi's wood fiber supply. It is possible, of course, that the Guangxi government would take steps to restrict the sale of pulpwood logs and/or wood chips to buyers outside the province if such sales were creating wood supply problems for pulp producers within the province.

5.3.3.2 Developing effective company-community partnerships: Given the substantial costs involved, pulp producers' investment decisions related to capacity expansion projects – particularly the construction of greenfield pulp mills – will be shaped by their ability to secure an adequate plantation resource base. As noted above, the Guangxi government is currently taking steps to assist both Stora Enso and APP to secure sufficient areas of land to support the planned Beihai and Qinzhou mill projects, respectively. Within this context, plantation development involves both technical and social challenges. While both companies will rely on plantations at state forest farms for a portion of their fiber, each will ultimately need to develop large areas of land that must be leased from farm households or collectives. This will require the companies to negotiate contracts with farmers and collectives which will make the land available for multiple rotations of tree planting.

Over the last few years, the sponsors of each of the planned pulp mills have made significant investments to secure access to plantation land by establishing partnerships with farmer households and collectives, often with the assistance of provincial and municipal governments. In Guangxi, they are using a number of different models to do so, involving a variety of land lease arrangements and outgrower schemes (Cossalter 2004; Lu Wenming *et al.* 2002). To no small degree, the success of these company-community partnerships is critical to the success of the planned mill projects. It will, therefore, be important for the companies involved and local governments to ensure that participating farmers have secure land tenure, clear incentives for growing pulpwood, and fair payment for the use of their land and/or the wood they produce (Lu Wenming *et al.* 2002).

5.3.3.3 Delivered wood cost: With China becoming increasingly integrated with the world economy, it is becoming increasingly important for Guangxi's pulp and paper producers to be cost-competitive vis-à-vis imported products. For hardwood pulp producers, this effectively means that the cost of producing BHKP locally must be cheaper than the delivered price of BHKP from Brasil or Indonesia, two of the world's most efficient pulp producing countries. A critical factor that may limit the competitiveness of wood-based pulp producers in Guangxi is the relatively high cost of pulpwood in the province. This study has found that delivered cost of eucalyptus pulp logs of 8-12 cm in diameter (under bark) generally ranged between RMB 280

and RMB 370 per ton (i.e. between US\$ 33.80 and US\$ 44.70), depending on location and the distance to the mill.

These costs are significantly higher than the delivered wood costs reported by producers in Indonesia and in Brasil. Pulp producers in Indonesia are reported to pay US\$ 12-25 per tonne for ‘mixed tropical hardwoods’ harvested from the natural forest and for plantation-grown *Acacia mangium*. In Brazil, where highly efficient eucalyptus plantations have been developed near the major mill sites, some producers report delivered wood costs as low as US\$ 5-15 per tonne.¹¹ The relatively higher wood costs in Guangxi (and other parts of southern China) can generally be attributed to the substantial cost involved in leasing land; high transport costs resulting from poor infrastructure and the dispersed nature of small-holder plantation sites; and the need, in many areas, for heavy fertilizer inputs to compensate for poor soil conditions (Cossalter 2004a).

This study has not assessed in detail the cost structures associated with various grades of wood pulp production in Guangxi or how they relate to the cost of pulp imports; and this is clearly an area where further analysis is needed.

5.3.4 Implications for Wood Fiber Demand

This section examines the implications for wood fiber demand of existing and projected capacity in Guangxi’s wood-based pulp industry. It focuses first on effective fiber demand at current capacity levels, and then assesses likely demand for wood fiber under three scenarios for projected growth in the sector through 2010 and 2015.

As with the scenarios presented for the wood panel sector, it must be emphasized here that the figures presented are only estimations based on both available data and (in some cases) on assumptions about the specific grades of pulp to be produced by individual mills; rates of capacity expansion; and the timing of particular expansion projects. Calculations of effective fiber demand are based on the projected volumes of fiber that would be consumed if the mills were operating at full capacity. It must be noted that producers frequently operate at levels somewhat below their actual capacities and, therefore, actual wood consumption can often fall below effective wood demand.

5.3.4.1 Effective wood demand at current capacity levels: At current levels, Guangxi’s wood-based pulp industry has approximately 380,000 Adt/yr of installed production capacity at mills with scales of 20,000 Adt/yr or more (see Table 5.10). This includes both mechanical and chemical wood-based pulps of various grades, which are produced at seven different mills. At least one producer also generates substantial volumes of bamboo pulp. Using standard fiber conversion factors for the specific grades of pulp, it is estimated that the industry’s effective demand for

¹¹ The figures for fiber costs in Indonesia were reported by pulp and plantation companies in Riau, Jambi, and South Sumatra during company visits by the authors in February and March 2003. Those for Brazil were reported by pulp and plantation companies in Bahia, São Paulo, and Paraná states during March 2004.

softwood fiber amounts to 1.1 million m³/yr and effective demand for hardwood fiber totals 477,000 m³/yr at current capacity levels.

5.3.4.2 Wood pulp scenario #1 – Projected growth according to Provincial Government’s sectoral development plan: As described earlier, the Provincial Development and Reform Committee projects that Guangxi’s aggregate wood pulp capacity will expand to reach 1.2 million Adt/yr by 2010 and 2.5 million Adt/yr by 2015. This scenario has been structured to reflect the capacity expansion plans that have been outlined by the Provincial Government both through the development of new greenfield mill projects and through the installation of new production lines at existing pulp mills.

Under this scenario, the following assumptions have been made:

- APP will install 300,000 Adt/yr of CTMP at the planned Qinzhou mill site by 2010 and that the mill’s capacity will remain at that level through 2015;
- Stora Enso will install a CTMP mill with 300,000 Adt/yr of capacity at the planned Beihai mill site by 2010, and the company will subsequently develop a BHKP mill with 600,000 Adt/yr of capacity by 2015;
- A greenfield mill will be developed in West Guangxi with a capacity of 500,000 Adt/yr by 2015, and this mill will produce either BSKP or UKP;
- Nanning Phoenix will shift towards producing equal volumes of BSKP and BHKP by 2010;
- The Guangxi Heda mill currently produces equal volumes of BSKP and BHKP, but 87 percent of the 230,000 tonnes of new capacity planned for 2015 will be for BHKP.

In addition, it is assumed that existing mills which have not been specifically scheduled for expansion by the Provincial Government will grow at an average annual rate of 9 percent per annum.

As Table 5.11 shows, softwood fiber demand under Scenario #1 is projected to increase from 1.1 million m³/yr at present, to 1.3 million m³/yr by 2010 and to 4.0 million m³/yr by 2015. By contrast, hardwood fiber demand is project to increase much more dramatically, climbing from 477,000 m³/yr at present, to 2.6 million m³/yr by 2010 and to 6.0 million by 2015.

Most of the increased demand for hardwood pulp fiber stems from the planned APP mill project in Qinzhou and the planned Stora Enso mill project in Beihai. It is likely that most of the wood consumed by these mills will be in the form of eucalyptus logs ranging in diameter between 6 cm and 18 cm, and commercial wood chips. It can be expected that this increased demand for fiber will lead to growing competition for wood supplies between pulp mills, on the one hand, and MDF and plywood producers, on the other.

5.3.4.3 Wood pulp scenario #2 – Projected growth much slower than Provincial Government’s sectoral plan: This scenario assesses the implications for fiber demand if Guangxi’s wood pulp industry grows at a rate that is substantially slower

than that projected by the Provincial Development and Reform Committee. In particular, it examines what will happen if Stora Enso and APP decide to focus their investments on mechanical pulp production, and no new investment is made to develop greenfield mill projects for chemical pulp production before 2015.

Under this scenario, the following assumptions have been made:

- APP and Stora Enso each build CTMP mills with 300,000 Adt/yr of capacity by 2010, and these facilities are expanded to 600,000 Adt/yr of CTMP by 2015;
- Neither APP nor Stora Enso invest in BHKP production by 2015;
- The planned greenfield mill for western Guangxi is not built before 2015;
- Nanning Phoenix will shift towards producing equal volumes of BSKP and BHKP by 2010;
- The Guangxi Heda mill currently produces equal volumes of BSKP and BHKP, but 87 percent of the 230,000 tonnes of new capacity planned for 2015 will be for BHKP;
- Existing mills which have not been specifically scheduled for expansion by the Provincial Government will grow at an average annual rate of 7 percent per annum.

As Table 5.12 shows, softwood fiber demand under Scenario #2 is projected to increase from 1.1 million m³/yr at present, to 1.3 million m³/yr by 2010 and to 1.5 million m³/yr by 2015. Hardwood fiber demand is projected to increase significantly (although somewhat more modestly than in Scenario #1), climbing from 477,000 m³/yr at present, to nearly 2.6 million m³/yr by 2010 and to 4.9 million by 2015.

5.3.4.4 Wood pulp scenario #3 – Accelerated development of BHKP mills: This scenario assesses the implications for fiber demand if Guangxi's wood pulp industry grows at a rate that is substantially faster than that projected by the Provincial Development and Reform Committee. In particular, it examines what will happen if Stora Enso decides to focus its investment in the Beihai mill project on the production of bleached hardwood kraft pulp, and if APP were to develop a new BHKP production line – either at the site of the planned Qinzhou pulp mill or at the group's Hainan pulp mill – which would source its fiber from Guangxi.

Under this scenario, the following assumptions have been made:

- APP will install 300,000 Adt/yr of CTMP at the planned Qinzhou mill site by 2010 and that the mill's capacity will remain at that level through 2015;
- APP will also install a new BHKP production line with a capacity of 600,000 Adt/yr (either at Qinzhou or in Hainan) which would source its fiber entirely from Guangxi;
- Stora Enso will install a BHKP mill with 600,000 Adt/yr of capacity at the planned Beihai mill site by 2010, and the company will subsequently expand this mill's capacity to 1.0 million Adt/yr of BHKP by 2015;
- A greenfield mill will be developed in West Guangxi with a capacity of 500,000 Adt/yr by 2015, and this mill will produce either BSKP or UKP;

- Nanning Phoenix will shift towards producing equal volumes of BSKP and BHKP by 2010;
- The Guangxi Heda mill currently produces equal volumes of BSKP and BHKP, but 87 percent of the 230,000 tonnes of new capacity planned for 2015 will be for BHKP.

Under Scenario #3, the province's aggregate wood pulp capacity across all grades is projected to increase from 380,000 Adt/yr at present, to nearly 1.5 million Adt/yr in 2010 and to 3.3 million Adt/yr in 2015 (see Table 5.13). Softwood fiber demand is projected to grow from 1.1 million m³/yr at present, to 1.3 million m³/yr in 2010 and to 4.0 million m³/yr in 2015. Hardwood fiber demand is projected to increase far more dramatically than in either of the previous scenarios, increasing from 477,000 m³/yr at present to 4.3 million m³/yr in 2010 and to 9.4 million m³/yr in 2015.

Table 5.3: Estimated Wood Panel Capacity in Guangxi, as of end-2004

Type of Panel	2003 Panel Capacity (m3/yr)		Estimated Current Capacity (m3/yr)
	Installed	Under Construction	
MDF	795,000	830,000	1,625,000
Plywood (incl. thin panels, construction panels, LVL)	315,000	0	315,000
HDF	0	300,000	300,000
Particleboard (wood-based)	151,000	0	151,000
Blockboard	132,000	0	132,000
Wet-process fiberboard	15,000	0	15,000

Table 5.4: Estimated Wood Fiber Demand in Guangxi's Wood Panel Sector, as of end-2004

Type of Panel	Current Panel Capacity (m3/yr)	Roundwood Conversion Factor (m3 RWE per 1.0 m3 of panels)	Estimated Roundwood Demand (m3 RWE/yr)	Estimated Fiber Demand by Wood Type									
				Residual Greenwood		Commercial Logs < 8cm		Commercial Logs ≥ 8cm		Commercial Wood Chips		Mill Residues	
				%	m3/yr	%	m3/yr	%	m3/yr	%	BDMT/yr	%	tonnes/yr
MDF and HDF	1,925,000	1.33	2,580,200	50	1,280,125	18	460,485	7	179,218	10	148,225	15	222,338
Plywood (incl. thin panels, construction panels, LVL)	315,000	1.53	480,375	0	0	15	72,056	85	408,319	0	0	0	0
Particleboard (wood-based)	151,000	1.42	214,420	40	85,768	0	0	5	10,721	5	5,814	50	58,135
Blockboard	132,000	1.42	187,440	25	46,860	0	0	5	9,372	0	0	70	71,148
Wet-process fiberboard	15,000	1.42	21,300	50	10,650	0	0	0	0	0	0	50	5,775
Total	2,538,000		3,483,735		1,423,403		532,541		607,630		154,039		357,396

Table 5.5: Projected Wood Panel Capacity in Guangxi by 2010, Under Scenario #1

Panel Type	Current Capacity (m3/yr)	Projected Capacity Expansion by 2010 (m3/yr)	Projected Total Capacity in 2010 (m3/yr)
MDF and HDF	1,925,000	1,700,000	3,625,000
Plywood (incl. thin panels, construction panels, LVL)	315,000	1,110,000	1,425,000
Particleboard (wood-based)	151,000	500,000	651,000
Blockboard	132,000	60,000	192,000
Oriented strand board (OSB)	0	100,000	100,000
Composite panels	0	50,000	50,000
Wet-process fiberboard	15,000	0	15,000
Total	2,538,000	3,520,000	6,058,000

Table 5.6: Projected Wood Fiber Demand in Guangxi's Wood Panel Sector by 2010, Under Scenario #1

Type of Panel	Total Panel Capacity (m3/yr)	Roundwood Conversion Factor (m3 RWE per 1.0 m3 of panels)	Estimated Roundwood Demand (m3 RWE/yr)	Estimated Fiber Demand by Wood Type									
				Residual Greenwood		Commercial Logs < 8cm		Commercial Logs ≥ 8cm		Commercial Wood Chips		Mill Residues	
				%	m3/yr	%	m3/yr	%	m3/yr	%	BDMT/yr	%	tonnes/yr
MDF and HDF	3,625,000	1.33	4,821,250	50	2,410,750	18	867,870	7	337,488	10	279,125	15	418,688
Plywood (incl. thin panels, construction panels, LVL)	1,425,000	1.53	2,180,250	0	0	15	327,038	85	1,853,213	0	0	0	0
Particleboard (wood-based)	651,000	1.42	924,420	40	369,768	0	0	5	46,221	5	25,064	50	250,635
Blockboard	192,000	1.42	272,640	25	68,160	0	0	5	13,632	0	0	70	103,488
Oriented strand board (OSB)	100,000	1.45	145,000	n.a.	¾	n.a.	¾	n.a.	¾	n.a.	¾	n.a.	¾
Composite panels	50,000	1.45	72,500	n.a.	¾	n.a.	¾	n.a.	¾	n.a.	¾	n.a.	¾
Wet-process fiberboard	15,000	1.42	21,300	50	10,650	0	0	0	0	0	0	50	5,775
Total	6,058,000		8,437,360		2,859,328		1,194,908		2,250,554		304,189		778,586

Table 5.7: Projected Wood Panel Capacity in Guangxi by 2010, Under Scenario #2

Type of Panel	Current Capacity (m3/yr)	Projected Capacity Expansion by 2010 (m3/yr)	Projected Total Capacity in 2010 (m3/yr)
MDF	1,925,000	1,303,418	3,228,418
Plywood (incl. thin panels, construction panels, LVL)	315,000	213,287	528,287
Particleboard (wood-based)	151,000	102,242	253,242
Blockboard	132,000	89,377	221,377
Wet-process fiberboard	15,000	0	15,000
Total	2,538,000	1,708,324	4,246,324

Table 5.8: Projected Wood Fiber Demand in Guangxi's Wood Panel Sector by 2010, Under Scenario #2

Type of Panel	Total Panel Capacity (m3/yr)	Roundwood Conversion Factor (m3 RWE per 1.0 m3 of panels)	Estimated Roundwood Demand (m3 RWE/yr)	Estimated Fiber Demand by Wood Type									
				Residual Greenwood		Commercial Logs < 8cm		Commercial Logs ≥ 8cm		Commercial Wood Chips		Mill Residues	
				%	m3/yr	%	m3/yr	%	m3/yr	%	BDMT/yr	%	tonnes/yr
MDF and HDF	3,228,418	1.33	4,293,796	50	2,146,898	18	772,883	7	300,566	10	248,588	15	372,882
Plywood (incl. thin panels, construction panels, LVL)	528,287	1.53	808,278	0	0	15	121,242	85	687,036	0	0	0	0
Particleboard (wood-based)	253,242	1.42	359,604	40	143,842	0	0	5	17,980	5	9,750	50	97,498
Blockboard	221,377	1.42	314,356	25	78,589	0	0	5	15,718	0	0	70	119,322
Wet-process fiberboard	15,000	1.42	21,300	50	10,650	0	0	0	0	0	0	50	5,775
Total	4,246,324		5,797,333		2,379,979		894,125		1,021,300		258,338		595,477

Table 5.9: Current Capacity of Wood Pulp Producers in Guangxi Province, 2005

No	Company Name	Type of Enterprise	Location		Start Date	Paper & Paperboard		Wood Pulp		Comments on Fiber Supply
			County	Prefecture		Major Grades	Capacity (Adt/yr)	Major Grades	Capacity (Adt/yr)	
1	Guangxi Nanning Phoenix Paper	SOE	Nanning	Nanning	1996			BSKP	120,000	Co. uses 500-600,000 m3/yr of southern pine and masson pine; 40% sourced as pulpwood logs, 60% as woodchips. Co. has 80,000 mu plantations.
2	Guangxi Guofa Forestry Paper Co. Ltd.	SOE	Luzhai	Liushou	1971			BHKP	80,000	
3	Guangxi Heda Pulp & Paper Co.	SOE	Hezhou	Hezhou	1996			BSKP, BHKP	70,000	Co. uses masson pine & eucalyptus; now establishing 100,000 mu plantation base
4	Guangxi Forestry Lipu Paper Industry	Collective	Lipu	Liuzhou	1970	Linerboard		UKP	50,000	Planned expansion: 50,000 Adt/yr UKP, pine furnish
5	Zhaoping County Hexing Paper Industry	Private	Zhaoping	Hezhou	2002	Packaging	35,000	TMP	est. 20,000	Co. also produces chemical bamboo pulp
6	Guangxi Liujiang Paper-making Mill	SOE	Liuzhou	Liuzhou	1975	Newsprint; P&W paper		TMP	20,000	Also has 2 lines of chemical bamboo pulp (total capacity = 75,000 Adt/yr); plans to add 170,000 Adt/yr bleached chemical bamboo pulp
7	Guangxi Rong County Wanli Paper Mill	Private	Rongxian	Yulin	1992	Kraft paper; packaging; mosaic paper	25,000	UKP	est. 20,000	Currently almost 100% pine furnish, but moving towards 50% eucalyptus

Note: Adt = air-dried tonnes; BSKP = bleached softwood kraft pulp; BHKP = bleached hardwood kraft pulp; UKP = unbleached kraft pulp; TMP = thermo-mechanical pulp

Table 5.10: Current Capacity and Fiber Demand in Guangxi's Wood-base Pulp Industry

Company Name	Wood Pulp Capacity		Softwood Fiber Demand		Hardwood Fiber Demand	
	Major Grades	Capacity (Adt/yr)	Conversion Factor* (m3/Adt)	Volume (m3/yr)	Conversion Factor* (m3/Adt)	Volume (m3/yr)
Guangxi Nanning Phoenix Paper	BSKP	120,000	4.7	564,000		
Guangxi Guofa Forestry Paper Co. Ltd.	BHKP	80,000			4.15	332,000
Guangxi Heda Pulp & Paper Co.	BSKP**	35,000	4.7	164,500		
	BHKP	35,000			4.15	145,250
Guangxi Forestry Lipu Paper Industry	UKP	50,000	4.7	235,000		
Zhaoping County Hexing Paper Industry	TMP	20,000	2.5	50,000		
Guangxi Liujiang Paper-making Mill	TMP	20,000	2.5	50,000		
Guangxi Rong County Wanli Paper-making Factory	UKP	20,000	4.7	84,600		
Total		380,000		1,157,500		477,250

Table 5.11: Projected Wood Pulp Capacity and Wood Fiber Demand Under Scenario #1

Name of Company or Project	Wood Pulp Capacity				Softwood Fiber Demand				Hardwood Fiber Demand			
	Major Grades	Current Capacity (Adt/yr)	Projected Capacity in 2010 (Adt/yr)	Projected Capacity in 2015 (Adt/yr)	Conversion Factor* (m3/Adt)	Current Volume (m3/yr)	Projected Volume in 2010 (m3/yr)	Projected Volume in 2015 (m3/yr)	Conversion Factor* (m3/Adt)	Current Volume (m3/yr)	Projected Volume in 2010 (m3/yr)	Projected Volume in 2015 (m3/yr)
Planned Greenfield Mill Projects												
Qinzhou mill (APP)	CTMP	0	300,000	300,000					2.5	0	750,000	750,000
Beihai mill (Stora Enso)	CTMP	0	300,000	300,000					2.5	0	750,000	750,000
	BHKP	0	0	600,000					4.15	0	0	2,490,000
Western Guangxi mill	UKP/BSKP	0	0	500,000	4.7	0	0	2,350,000				
Planned Expansions at Existing Mills												
Guangxi Nanning Phoenix Paper	BSKP	120,000	75,000	75,000	4.7	564,000	352,500	352,500				
	BHKP		75,000	75,000					4.15	0	311,250	311,250
Guangxi Heda Pulp & Paper Co.	BSKP**	35,000	75,000	75,000	4.7	164,500	352,500	352,500				
	BHKP	35,000	75,000	225,000					4.15	145,250	311,250	933,750
Projected Expansion at Existing Mills (at 9% per annum)												
Guangxi Guofa Forestry Paper Co. Ltd.	BHKP	80,000	123,000	189,000					4.15	332,000	510,450	784,350
Guangxi Forestry Lipu Paper Industry	UKP	50,000	77,000	118,000	4.7	235,000	361,900	554,600				
Guangxi Rong County Wanli Paper-making Factory	UKP	20,000	31,000	47,000	4.7	94,000	145,700	220,900				
Guangxi Liujiang Paper-making Mill	TMP	20,000	31,000	47,000	2.5	50,000	77,500	117,500				
Zhaoping County Hexing Paper Industry	TMP	20,000	31,000	47,000	2.5	50,000	77,500	117,500				
Total		380,000	1,193,000	2,598,000		1,157,500	1,367,600	4,065,500		477,250	2,632,950	6,019,350

Table 5.12: Projected Wood Pulp Capacity and Wood Fiber Demand Under Scenario #2

Name of Company or Project	Wood Pulp Capacity				Softwood Fiber Demand				Hardwood Fiber Demand			
	Major Grades	Current Capacity (Adt/yr)	Projected Capacity in 2010 (Adt/yr)	Projected Capacity in 2015 (Adt/yr)	Conversion Factor* (m3/Adt)	Current Volume (m3/yr)	Projected Volume in 2010 (m3/yr)	Projected Volume in 2015 (m3/yr)	Conversion Factor* (m3/Adt)	Current Volume (m3/yr)	Projected Volume in 2010 (m3/yr)	Projected Volume in 2015 (m3/yr)
Planned Greenfield Mill Projects												
Qinzhou mill (APP)	CTMP	0	300,000	600,000					2.5	0	750,000	1,500,000
Beihai mill (Stora Enso)	CTMP	0	300,000	600,000					2.5	0	750,000	1,500,000
	BHKP	0	0	0					4.15	0	0	0
Western Guangxi mill	UKP/BSKP	0	0	0	4.7	0	0	0				
Planned Expansions at Existing Mills												
Guangxi Nanning Phoenix Paper	BSKP	120,000	75,000	75,000	4.7	564,000	352,500	352,500				
	BHKP		75,000	75,000					4.15	0	311,250	311,250
Guangxi Heda Pulp & Paper Co.	BSKP**	35,000	75,000	75,000	4.7	164,500	352,500	352,500				
	BHKP	35,000	75,000	225,000					4.15	145,250	311,250	933,750
Projected Expansion at Existing Mills (at 7% per annum)												
Guangxi Guofa Forestry Paper Co. Ltd.	BHKP	80,000	112,204	157,372					4.15	332,000	465,647	653,094
Guangxi Forestry Lipu Paper Industry	UKP	50,000	70,128	98,358	4.7	235,000	329,602	462,283				
Guangxi Rong County Wanli Paper-making Factory	UKP	20,000	28,051	39,343	4.7	94,000	131,840	184,912				
Guangxi Liujiang Paper-making Mill	TMP	20,000	28,051	39,343	2.5	50,000	70,128	98,358				
Zhaoping County Hexing Paper Industry	TMP	20,000	28,051	39,343	2.5	50,000	70,128	98,358				
Total		380,000	1,166,485	2,023,759		1,157,500	1,306,696	1,548,910		477,250	2,588,147	4,898,094

Table 5.13: Projected Wood Pulp Capacity and Wood Fiber Demand Under Scenario #3

Name of Company or Project	Wood Pulp Capacity				Softwood Fiber Demand				Hardwood Fiber Demand			
	Major Grades	Current Capacity (Adt/yr)	Projected Capacity in 2010 (Adt/yr)	Projected Capacity in 2015 (Adt/yr)	Conversion Factor* (m3/Adt)	Current Volume (m3/yr)	Projected Volume in 2010 (m3/yr)	Projected Volume in 2015 (m3/yr)	Conversion Factor* (m3/Adt)	Current Volume (m3/yr)	Projected Volume in 2010 (m3/yr)	Projected Volume in 2015 (m3/yr)
Planned Greenfield Mill Projects												
Qinzhou mill (APP)	CTMP	0	300,000	300,000					2.5	0	750,000	750,000
New BHKP line for APP (at either Qinzhou or Hainan)	BHKP	0	0	600,000					4.15	0	0	2,490,000
Beihai mill (Stora Enso)	CTMP	0	0	0					2.5	0	0	0
	BHKP	0	600,000	1,000,000					4.15	0	2,490,000	4,150,000
Western Guangxi mill	UKP/BSKP	0	0	500,000	4.7	0	0	2,350,000				
Planned Expansions at Existing Mills												
Guangxi Nanning Phoenix Paper	BSKP	120,000	75,000	75,000	4.7	564,000	352,500	352,500				
	BHKP		75,000	75,000					4.15	0	311,250	311,250
Guangxi Heda Pulp & Paper Co.	BSKP**	35,000	75,000	75,000	4.7	164,500	352,500	352,500				
	BHKP	35,000	75,000	225,000					4.15	145,250	311,250	933,750
Projected Expansion at Existing Mills (at 9% per annum)												
Guangxi Guofa Forestry Paper Co. Ltd.	BHKP	80,000	123,000	189,000					4.15	332,000	510,450	784,350
Guangxi Forestry Lipu Paper Industry	UKP	50,000	77,000	118,000	4.7	235,000	361,900	554,600				
Guangxi Rong County Wanli Paper-making Factory	UKP	20,000	31,000	47,000	4.7	94,000	145,700	220,900				
Guangxi Liujiang Paper-making Mill	TMP	20,000	31,000	47,000	2.5	50,000	77,500	117,500				
Zhaoping County Hexing Paper Industry	TMP	20,000	31,000	47,000	2.5	50,000	77,500	117,500				
Total		380,000	1,493,000	3,298,000		1,157,500	1,367,600	4,065,500		477,250	4,372,950	9,419,350

Chapter 6: Guangxi's Current and Projected Wood Supply-Demand Balance to 2010

6.1 Introduction

This chapter assesses the volumes of commercial timber and green residue which could, theoretically, become available in 2010 in each of Guangxi's prefectures. It then provides a forecast of the projected wood demand by prefecture, based on projections of likely growth in capacity within each segment of the wood processing sector under various wood demand scenarios. These figures are then used to obtain preliminary estimates of both the current and future wood supply-demand balance within each prefecture, as well on a regional and provincial scale, based on the different wood demand scenarios. In doing this assessment due attention was given to the sustainability of Guangxi forest resources.

6.2 Source and Relevance of the Data Provided to the Study

This analysis is entirely based on data provided by Guangxi Forestry Bureau (G.F.B). The source of data provided to us is briefly described here below:

- A selection of data extracted from GFB's Forest Resources data base: This data collected in 1999 for the purpose of the provincial forest inventory became available - for internal use - in 2000. Data in GFB's data base is given for each individual Prefecture (14 in total) as well as for the 15 State forest farms under the direct supervision of G.F.B. In this chapter this distinct network of State forest farms is being referred to as 'Provincial forest farms'. Within each Prefecture data is further disaggregated by County. Data on standing volume and area of Guangxi's commercial forests was further disaggregated by species or species groups (seven in total) and five age classes: 'Young', 'Middle Age', 'Nearly Mature', 'Mature' and 'Over Mature'. Among the seven forest species or species groups, five consisted of native species. These include: '*Pinus massoniana* (Masson pine)', '*Pinus yunnanensis* (Yunnan pine)', '*Cunninghamii lanceolata* (Chinese fir)', 'Other Softwoods', and 'Other Hardwoods'. Two groups were made of exotic species 'Eucalypts' and 'Pinus elliottii (Slash pine)'. Further information on the organization that G.F.B has put in place to inventory its forests as well as on the main features of Guangxi forest resources can be found in Chapter 2. This chapter summarizes in the form of tables (tables II.2 to II.8 and maps (maps II.3 to II.26) the data which was made available to the World Bank study;
- Data about the implementation of the Fast Growing High Yielding plantation programme within the 14 Prefectures of Guangxi and the 'Provincial Forest

Farms': This data set gave the area that each company and institution has planted every year, between 2001 and 2005;

- The area planted every year between 2001 and 2005 by the 'Provincial Forest Farms';
- The logging quota for Guangxi province during the 2001-2005 period of the tenth Five-Year Plan: Individual quota was given for each county under the 14 Prefectures as well as for the network of 'Provincial forest farms' and for four categories of products: commercial timber, timber self-consumed by farmers, green residue and bamboos.
- Actual timber harvest: The total timber volume harvested within the 14 Prefectures and the network of 'Provincial forest farms' was provided for 2001, 2003, and 2004. 2004 data also included harvest data for green residue and a further desegregation between hardwood and softwood for both commercial timber and green residue.
- A GFB's forecast of the supply capacity of Guangxi commercial forests in 2010. G.F.B's assessment was disaggregated by product categories (timber, green residue and bamboos), individual Prefecture, and for the network of 'Provincial forest farms' as a single entity. The forecast of green residue supply consisted of one aggregated figure for each individual Prefecture and for the network of 'Provincial forest farms'. The forecast of timber supply was further disaggregated by species and species groups.

There were also a number of data which we requested, at different occasions, but that was not made available. These are as follows:

- The 1999 Provincial forest inventory data on commercial forests did not disaggregated plantations and natural forests. For important native species such as Masson pine and for other groups made of native species such as 'Other Softwoods' or 'Other Hardwoods' forecasting future timber and green residue outputs could not be done without knowing the relative importance, within each production unit, between single-species plantations under relatively intensive management and other forest types including old plantations with natural forest re-growth and mixed stands largely retaining the natural forest structure;
- The 2000 provincial forest inventory (based on 1999 field data) was updated in 2005 on the basis of new field data collected in 2004. However, this updated information was not made available to the World Bank study;
- Data showing the achievement of the 2001-2005 Fast Growing High Yielding plantation programme contained only part of the information that we requested. Obtaining disaggregated data by species or species groups would have enable us to forecast future production from these plantations with a

higher degree of confidence. Assumptions had to be made on the relative importance of plantation species within each production unit;

- Data on actual timber harvest were reduced to its simplest expression. It would have been useful to obtain, as requested, harvest data with a minimum of details and in particular the breakdown per forest type (production forest, economic forest, forest for special purpose, etc.), per type of harvest (thinning, clear felling) per type of product (small diameter wood for fiber, timber, etc);

6.3 Trends in Timber Supply Based on Guangxi Forestry Bureau Data

Table 6.1 presents a summary of the various sets of data which were made available to the study.

Table 6.1: Summary of timber supply data made available to the World Bank study

	Actual Harvest (m3)		2001-2005 Yearly Logging Quota (m3)			2010 Supply Forecast by GFB (m3)		
	2001	2003	self-consumed	commercial	Total	Softwood	Hardwood	Total
Nanning	168,957	272,699	225,896	285,673	511,569	323,330	533,378	856,708
Liuzhou	392,677	378,249	357,590	419,520	777,110	534,683	150,950	685,633
Guilin	420,902	412,168	427,000	465,000	892,000	747,310	43,230	790,540
Wuzhou	414,633	397,520	239,000	524,000	763,000	580,426	234,544	814,970
Beihai	44,164	82,981	30,000	66,900	96,900	5,841	187,322	193,163
Fangchengang	66,957	83,637	78,000	110,000	188,000	121,658	239,047	360,705
Qinzhou	70,663	85,347	192,000	137,000	329,000	179,275	386,798	566,073
Guiguang	100,247	158,918	187,000	133,000	320,000	329,921	357,469	687,390
Yulin	122,852	195,016	268,000	222,000	490,000	228,314	681,089	909,403
Baise	432,164	491,838	441,000	440,000	881,000	531,398	353,843	885,241
Hezhou	291,313	306,851	210,000	369,000	579,000	375,080	231,487	606,567
Hechi	468,197	505,519	241,000	452,000	693,000	524,725	197,023	721,748
Laibin	204,987	181,721	95,400	254,700	350,100	211,598	227,972	439,570
Chongzuo	141,703	152,684	147,095	202,713	349,808	260,308	160,459	420,767
Provincial F. F.	801,636	763,976	0	675,000	675,000	205,450	812,228	1,017,678
Others	65,324	43,352	5,669	509,699	515,368			
Guangxi	4,207,376	4,512,476	3,144,650	5,266,205	8,410,855	5,159,317	4,796,839	9,956,156

GFB foresees a rather contrasted timber supply situation in 2010 compared to today's situation (see Table 6.2). A very substantial increase in timber supply is expected in the six Prefectures and in the Provincial forest farms of Guangxi's South East quadrant. At the opposite, 2010 commercial timber production in Liuzhou and Guilin Prefectures is expected to be lower as compared to today's level.

Table 6.2: 2010 GFB's forecast for commercial timber production expressed in percent of today's production and comments

	2001-05 Logging Quota / 2010 timber supply forecast by GFB	Comments: To what extent GFB' forecast of 2010 timber supply matches the prevailing trends which could be observed by analyzing the 1999 Provincial Forest Inventory data and the 2001-05 FGHY data
Guiguang	114.8%	The largest and very substantial growth occurs in the six Prefectures and in the Provincial forest farms of Guangxi's South East quadrant. Not surprisingly, this is where the plantation programme has been the most active since 2001. With the exception of Fangchenggang, a prevailing trend towards expansion was already apparent from the 1999 Provincial Forest Inventory data, albeit on a much smaller scale (see Chapter 2, section 2.5)
Beihai	99.3%	
Fangchenggang	91.9%	
Yulin	85.6%	
Qinzhou	72.1%	
Nanning	67.5%	
Provincial F. F.	50.8%	
Laibin	25.6%	A moderate growth which could already be predicted from the 1999 Provincial Forest Inventory data,
Chongzuo	20.3%	The rapid expansion of the FGHY plantations since 2001 has inversed the trend which could be observed in the 1999 Provincial Forest Inventory data. A moderate growth is now expected rather than a temporary decrease in production
Wuzhou	6.8%	The moderate expansion of the FGHY plantations since 2001 was enough to offset the forecast of a temporary decline that was made by analyzing the 1999 Provincial Forest Inventory data
Hezhou	4.8%	
Hechi	4.1%	The rapid expansion of plantations during the 1990s does not translate yet into substantial raise of production. This is probably due to the fact that the two Prefectures have primarily invested in medium to long-rotation plantations
Baise	0.5%	
Guilin	-11.4%	A decline in production which could be predicted from the analysis of the 1999 Provincial Forest Inventory data and is now being exacerbated by the relative low rate of plantation during the last five years
Liuzhou	-11.8%	An expected decrease in production as a result of the very moderate plantation rate of the recent years. This trend could not be foreseen by the sole analysis of the 1999 Provincial Forest Inventory data
Guangxi	18.4%	

6.4 Trends in Green Residue Supply Based on Guangxi Forestry Bureau Data and 2010 Supply Forecast

Table 6.3: 2010 forecast for green residue production and changes expressed in percent of current production

	2001-05 logging quota	Green residue 2010 forecast by GFB	2001-05 Logging Quota / 2010 supply forecast by GFB
Nanning	373,092	208,717	-44.1%
Liuzhou	468,351	288,162	-38.5%
Guilin	717,000	304,959	-57.5%
Wuzhou	526,000	241,523	-54.1%
Beihai	44,000	22,302	-49.3%
Fangchenggang	123,000	52,058	-57.7%
Qinzhou	171,000	82,519	-51.7%
Guigang	182,000	133,610	-26.6%
Yulin	269,000	144,853	-46.2%
Baise	768,000	409,808	-46.6%
Hezhou	430,000	200,311	-53.4%
Hechi	354,000	231,028	-34.7%
Laibin	124,680	104,354	-16.3%
Chongzuo	246,889	111,556	-54.8%
Provincial FF	59,030	15,518	-73.7%
Others	359		-100.0%
Total Guangxi	4,856,401	2,551,278	-47.5%

At this stage it is difficult to comment / provide a logical explanation over what seems to be a downward trend for green residue supply since a clear definition / description of what is called 'fire wood' or 'waste wood' in both situations is still missing.

6.5 CIFOR's 2010 Supply Forecast for Timber and Green Residue

6.5.1 Method

Chinese fir, slash pine and Yunnan pine: The best we could do with the data we had for these three important timber species was to give a gross estimate of future supply capacities. As already mentioned earlier in this chapter, the 1999 Provincial Forest Inventory did not give the detail we requested in order to assess future supply with a high degree of confidence. When important data was missing we had to make assumptions. In this context we treated the commercial timber resource for Chinese fir and Yunnan pine, two native species in Guangxi's forests, as if this resource was entirely made of artificial plantations. In the case of Chinese fir, we believe that our assumption is likely to be close to the true since Chinese fir has been the lead reforestation species of southern China, during several decades. We had not such dilemma with Slash pine since it is a non-native species and therefore artificial plantation is the only mode of propagation.

Eucalypts: We had access to a data set recording the area of FGHY planted year per year between 2001 and 2005. At the provincial level, this programme is dominated by eucalypt. However, there are important variations among Prefectures with some planting more than others. The range of variation could not be captured since the data we have obtained was not disaggregated by species. Here again we had to use assumptions. For plantation made outside the network of Provincial Forest Farms, we have assumed that eucalypts accounted for:

- 90% of the area planted in the six Prefectures of Guangxi's South East quadrant, namely: Beihai, Fangchenggang, Guigang, Nanning, Qinzhou and Yulin;
- 50% of the area planted in Bai Se and Gui Lin Prefectures;
- 80% of the area planted in the six other Prefectures.

Similarly we had to make assumptions about the part taken by eucalypts in the FGHY plantations established by the Provincial Forest Farms. These are mentioned in Table 6.4.

'Masson pine', 'Other Softwoods' and 'other Hardwoods': The data for these three species groups, were, by all means, insufficient / had too many important gaps and uncertainties to make any prediction. In this case we had no other choice than relying on GFB's forecast.

Further information on the approach we have used in these three situations is given in what follows.

Table 6.4: Assumed share of eucalypt in the overall FGHY Programme established by the Provincial forest farms between 2001-2005

Provincial Forest Farms	Location (Prefecture)	Assumed share of eucalypt in overall 2001-2005 FGHY Programme
Liuwan Forest Farm	Yulin	60%
Qipo Forest Farm	Nanning	
Qinlian Forest Farm	Beihai	
Weidu Forest Farm	Laibin	
Bobai Forest Farm	Yulin	45%
Daguishan Forest Farm	Hezhou	
Dongmen Forest Farm	Chonzuo	
Huangmian Forest Farm	Liuzhou	
Sanmenjian Forest Farm	Liuzhou	
Gaofeng Forest Farm	Nanning	25%
Paiyangshan Forest Farm	Chongzuo	10%
Tropical Forest Center	Chongzuo	
Liangfengjiang National Forest Park	Nanning	
Shatang Forest Farm	Liuzhou	
Yachang Forest Farm	Baise	

6.5.2 Chinese fir, slash pine and Yunnan pine

According to GFB's estimates, these three species pooled together accounts for approximately 23% of the overall future supply capacity of Guangxi commercial forests

The timber and green residue production models that we have developed for the three species were based on the following silvicultural characteristics:

Chinese fir

Rotation length / Final harvest: 32 years, identical across the entire province. We have assumed that one eighth of the 'Nearly Mature' age class of the 1999 provincial forest survey will be clear felled in 2010.

First thinning: age 10 with a **thinning intensity** of 30%, identical across the entire province. We have assumed that one eighth of the ‘Young’ age class of the 1999 provincial forest survey will be thinned in 2010.

Second thinning: age 18 with a **thinning intensity** of 25%, identical across the entire province. We have assumed that one eighth of the ‘Middle-age’ age class of the 1999 provincial forest survey will be thinned in 2010.

Growth and yield (over an entire rotation): Within each Prefecture we have applied the growth and yield value given in the 1999 Forest Inventory for the age-class reaching maturity;

Recovery rate (Commercial timber output / Total standing volume): 70%, identical across the entire province.

Slash pine

Rotation length / Final harvest: 20 years, identical across the entire province. We have assumed that one fifth of the ‘Middle-age’ age class of the 1999 provincial forest survey will be clear felled in 2010.

First thinning: age 10 with a **thinning intensity** of 30%, identical across the entire province. We have assumed that one fifth of the ‘Young’ age class of the 1999 provincial forest survey will be thinned in 2010.

Growth and yield (over an entire rotation): Within each Prefecture we have applied the growth and yield value given in the 1999 Forest Inventory for the age-class reaching maturity;

Recovery rate (Commercial timber output / Total standing volume): 70%, identical across the entire province.

Yunnan pine

Rotation length / Final harvest: 28 years, identical across the entire province. We have assumed that one seventh of the ‘Nearly Mature’ age class of the 1999 provincial forest survey will be clear felled in 2010.

First thinning: age 10 with a **thinning intensity** of 30%, identical across the entire province. We have assumed that one seventh of the ‘Young’ age class of the 1999 provincial forest survey will be thinned in 2010.

Second thinning: age 16 with a **thinning intensity** of 25%, identical across the entire province. We have assumed that one seventh of the ‘Middle-age’ age class of the 1999 provincial forest survey will be thinned in 2010.

Growth and yield (over an entire rotation): Within each Prefecture we have applied the growth and yield value given in the 1999 Forest Inventory for the age-class reaching maturity;

Recovery rate (Commercial timber output / Total standing volume): 70%, identical across the entire province.

Table 6.5 shows that, as far as timber supply is concerned our forecast is, for the most part, consistent with the figures provided by GFB.

Table 6.5: 2010 timber supply forecasts by Guangxi Forestry Bureau and CIFOR for 3 major softwood forest species (in m3)

	Chinese fir		Slash pine		Yunnan pine	
	<i>GFB 2010 forecast</i>	<i>CIFOR 2010 forecast</i>	<i>GFB 2010 forecast</i>	<i>CIFOR 2010 forecast</i>	<i>GFB 2010 forecast</i>	<i>CIFOR 2010 forecast</i>
Nanning	24,835	26,498	21,488	28,666	0	
Liuzhou	311,684	380,915	36,945	18,198	0	
Guilin	266,204	272,975	57,637	32,812	0	
Wuzhou	40,008	76,065	74,642	47,210	0	
Beihai	0	5	5,723	3,900	0	
Fangchengang	1,019	2,153	19,627	14,219	0	650
Qinzhou	25,579	32,316	59,731	50,383	0	
Guiguang	55,957	70,372	62,027	44,864	0	
Yulin	37,717	58,387	87,446	122,334	0	
Baise	362,803	156,528	1,844	368	7,119	9,534
Hezhou	131,561	153,983	30,742	32,415	0	
Hechi	387,051	392,548	13,022	4,849	0	
Laibin	66,500	105,970	20,922	13,831	0	
Chongzuo	13,012	10,159	19,086	9,766	0	
Provincial Forest Farms	25,885	38,844	80,076	121,699	0	14,678
Total Guangxi (m3)	1,749,815	1,777,718	590,958	545,514	7,119	24,862

6.5.3 Eucalypts

According to GFB's estimates, eucalypt accounts for approximately 44% of the overall future supply capacity of Guangxi commercial forests

Eucalypts are non-native to China and are only propagated through artificial plantations. Since the early 1990s eucalyptus has become the leading plantation species and currently continues to dominate in the form of short rotation plantations. Due to the importance of this group we are providing a twofold forecast of future supply capacity for the medium-term:

- i. 2010 forecast
- ii. Forecast of average yearly supply between 2008 and 2012

Our timber and green residue production models for eucalypts holds the following characteristics.

Eucalypts: 2010 forecast

Rotation length / Final harvest: 7 years, identical across the entire province. We have assumed that:

- The ‘Middle age’ age class of the 1999 provincial forest survey will produce a crop of coppices. Half of the area of this age class will be clear felled in 2010.
- Plantations established in 2003 will be clear felled for the first time in 2010.

Growth and yield:

- Coppice crop (at age 7): Within each Prefecture we have applied 90% of the growth and yield value given in the 1999 Forest Inventory for the age-class reaching maturity;
- First harvest: equal to 1m³/mu/year (equivalent to 15 m³/ha/year) in 5 Prefectures, namely: Bei Hai, Chongzuo, Fang Cheng Gang, Qin Zhou, Yu Lin and in the network of Provincial Forest Farms.
- First harvest: equal to 0.8 m³/mu/year (equivalent to 12 m³/ha/year) in the 9 other Prefectures

Recovery rate (Commercial timber output / Total standing volume): 80%, identical across the entire province.

Eucalypts: forecast of average yearly supply between 2008 and 2012

Rotation length / Final harvest: 7 years, identical across the entire province. We have assumed that:

- The ages classes of the 1999 provincial forest survey will be managed to produce a coppice crop. The ‘Nearly mature’ age class, the ‘Middle age’ age class and half of the area of the ‘Young’ age class will be clear felled between 2008 and 2012.
- Plantations established between 2001 and 2005 will be clear felled for the first time between 2008 and 2012.

Growth and yield:

- Coppice crop (at age 7): Within each Prefecture we have applied 90% of the growth and yield value given in the 1999 Forest Inventory for the age-class reaching maturity
- First harvest: equal to 1m³/mu/year (equivalent to 15 m³/ha/year) in 5 Prefectures, namely: Bei Hai, Chongzuo, Fang Cheng Gang, Qin Zhou, Yu Lin and in the network of Provincial Forest Farms.
- First harvest: equal to 0.8 m³/mu/year (equivalent to 12 m³/ha/year) in the 9 other Prefectures

Recovery rate (Commercial timber output / Total standing volume): 80%, identical across the entire province.

Table 6.6 shows that, in most situations, our forecast of eucalypt timber supply is consistent with that provided by GFB. However, there are three cases, where there are strong divergences between the two assessments. CIFOR assessment shows that Bei Hai Prefecture, Qinzou Prefectures and the network of Provincial Forest Farms should be able to produce substantially more eucalypt round wood than forecasted by GFB. These divergences became apparent in spite of the rather conservative assumptions we made for eucalypt productivity in Bei Hai Prefecture, Qinzou Prefectures and the network of Provincial Forest Farms.

Table 6.6: 2010 forecast for supply of eucalypts timber by Guangxi Forestry Bureau and CIFOR (in m3)

	<i>GFB 2010 forecast</i>	CIFOR forecast	
		<i>2010</i>	<i>Yearly average 2008 - 2012</i>
Nanning	510,563	568,433	653,012
Liuzhou	149,545	73,942	80,396
Guilin	41,963	34,335	18,747
Wuzhou	112,063	148,768	198,301
Beihai	173,053	466,094	433,269
Fangchengang	234,497	289,253	239,085
Qinzhou	383,153	877,607	610,359
Guiguang	355,490	502,929	361,417
Yulin	631,847	1,081,500	696,133
Baise	332,636	645,498	326,235
Hezhou	228,481	190,523	300,488
Hechi	196,956	295,036	218,563
Laibin	227,794	205,859	206,300
Chongzuo	147,269	353,283	357,451
Total Prefecture incl. PFF cooperation	3,725,310	5,733,060	4,699,757
Provincial Forest Farms - own land	650,195	1,617,081	1,217,702
Total Guangxi (m3)	4,375,505	7,350,141	5,917,459

6.5.4 ‘Masson pine’, ‘Other Softwoods’ and ‘Other Hardwoods’

These three species groups combined together accounts for approximately one third of Guangxi’s future timber and green residue supply capacity. These three groups are characterized by a high degree of heterogeneity in the sense that they hold both single species plantations under relatively intensive management and low productivity forest types made of a mixture of species. We assume that the distribution between low productivity and more intensively managed stands varies among Prefectures, although no information was available in this respect. The data which was provided for

‘Masson pine’, ‘Other Softwoods’, and ‘Other Hardwoods’ was not enough to allow the construction of models for production forecast purpose.

For this later group we had no other choice than to integrate GFB’s figure into our own forecast.

Table 6.7: 2010 Supply Forecast for Masson Pine, Other Softwoods and Other Hardwoods by Guangxi Forestry Bureau (in m3)

	Masson Pine	Other Softwoods	Other Hardwoods
Nanning	263,157	13,850	22,815
Liuzhou	176,751	9,303	1,177
Guilin	402,296	21,173	1,267
Wuzhou	442,487	23,289	122,481
Beihai	112	6	14,269
Fangchengang	95,961	5,051	4,550
Qinzhou	89,267	4,698	3,645
Guiguang	201,340	10,597	1,979
Yulin	97,994	5,158	49,242
Baise	140,537	19,095	15,307
Hezhou	202,138	10,639	3,006
Hechi	104,281	20,371	67
Laibin	117,967	6,209	178
Chongzuo	216,799	11,411	13,190
Provincial Forest Farms - own land	93,220	6,269	162,033
Total Guangxi (m3)	2,644,307	167,119	415,206

6.5.5 Summary of CIFOR's 2010 Wood Supply Forecast

6.5.2.1 Timber Supply in 2010

Table 6.8: CIFOR 2010 Timber Supply Forecast (in m3)

	Chinese fir (1)	Slash Pine (1)	Yunnan Pine (1)	Masson Pine (2)	Other Softwoods (2)	Eucalypts (1)	Other Hardwoods (2)
Nanning	26,498	28,666	0	263,157	13,850	653,012	22,815
Liuzhou	380,915	18,198	0	176,751	9,303	80,396	1,177
Guilin	272,975	32,812	0	402,296	21,173	18,747	1,267
Wuzhou	76,065	47,210	0	442,487	23,289	198,301	122,481
Beihai	5	3,900	0	112	6	433,269	14,269
Fangchengang	2,153	14,219	650	95,961	5,051	239,085	4,550
Qinzhou	32,316	50,383	0	89,267	4,698	610,359	3,645
Guiguang	70,372	44,864	0	201,340	10,597	361,417	1,979
Yulin	58,387	122,334	0	97,994	5,158	696,133	49,242
Baise	156,528	368	9,534	140,537	19,095	326,235	15,307
Hezhou	153,983	32,415	0	202,138	10,639	300,488	3,006
Hechi	392,548	4,849	0	104,281	20,371	218,563	67
Laibin	105,970	13,831	0	117,967	6,209	206,300	178
Chongzuo	10,159	9,766	0	216,799	11,411	357,451	13,190
Prov. F F- own land	38,844	121,699	14,678	93,220	6,269	1,217,702	162,033
Total Guangxi (m3)	1,777,718	545,514	24,862	2,644,307	167,119	5,917,459	415,206

(1) CIFOR's forecast

(2) Guangxi Forestry Bureau's forecast

6.5.2.2 Green Residue Supply in 2010

Table 6.9: CIFOR's 2010 Green residue Supply Forecast (in tonne)

	Chinese fir	Slash Pine	Yunnan Pine	Masson Pine	Other Softwoods	Eucalypts	Other Hardwoods
Nanning	8,840	9,022	0	92,105	4,155	104,568	6,845
Liuzhou	108,990	6,481	0	61,863	2,791	12,449	353
Guilin	71,583	9,206	0	140,804	6,352	2,868	380
Wuzhou	20,095	12,167	0	154,870	6,987	29,790	36,744
Beihai	2	1,338	0	39	2	74,591	4,281
Fangchengang	636	4,934	272	33,586	1,515	36,450	1,365
Qinzhou	9,620	15,554	0	31,243	1,409	96,665	1,094
Guiguang	19,675	13,203	0	70,469	3,179	54,720	594
Yulin	16,266	32,564	0	34,298	1,547	106,514	14,773
Baise	48,311	109	2,858	49,188	5,729	50,263	4,592
Hezhou	41,559	9,207	0	70,748	3,192	45,075	902
Hechi	119,904	1,324	0	36,498	6,111	32,864	20
Laibin	29,689	4,495	0	41,288	1,863	33,374	53
Chongzuo	3,149	3,133	0	75,880	3,423	59,108	3,957
Prov. F F- own land	11,708	32,443	3,750	32,627	1,881	190,328	48,610
Total Guangxi (t)	510,027	155,178	6,880	925,507	50,136	929,628	124,562

6.5.2.3 Importance of Provincial Forest Farms in Future Supplies

Table 6.10: Summary of CIFOR 2010 Forecast for Timber and Green Residue Supply (in m3)

	Timber		Fuelwood	
	Softwood	Hardwood	Softwood	Hardwood
Production on the land managed by Provincial Forest Farms	274,710	1,379,735	82,409	238,938
Production on land under other types of tenures	4,884,810	4,952,930	1,565,320	815,251
Total Guangxi (m3)	5,159,520	6,332,665	1,647,728	1,054,189

Detail by Prefecture and species group of the data summarized in Table 6.10 is presented Annex 1.

In recent years, Provincial forest farms have been very active in establishing plantations, especially FGHY plantations, outside their own estate through partnership with other entities. In the plantation established between 2001 and 2005 we have identified 21 cooperation arrangements of this kind involving most Provincial forest farms. Future timber outputs of these cooperation arrangements are counted in the Prefecture's timber output figures shown in Table 6.10.

We calculated that, between 2008 and 2012 and for eucalypt alone, plantations established in cooperation with Provincial forest farms are expected to produce approximately 850,000 m³ yearly out of an average eucalyptus timber production of nearly 4.7 million m³ for all prefectures. In total, in the case of eucalypts, Provincial forest farms are expected to control some 35% of the future timber and firewood production of the entire Province ($850,000 + 1,217,00 \text{ m}^3 / 5,917,459 \text{ m}^3$. See table 6).

The main players in the plantation sector were graded in seven groups, namely:

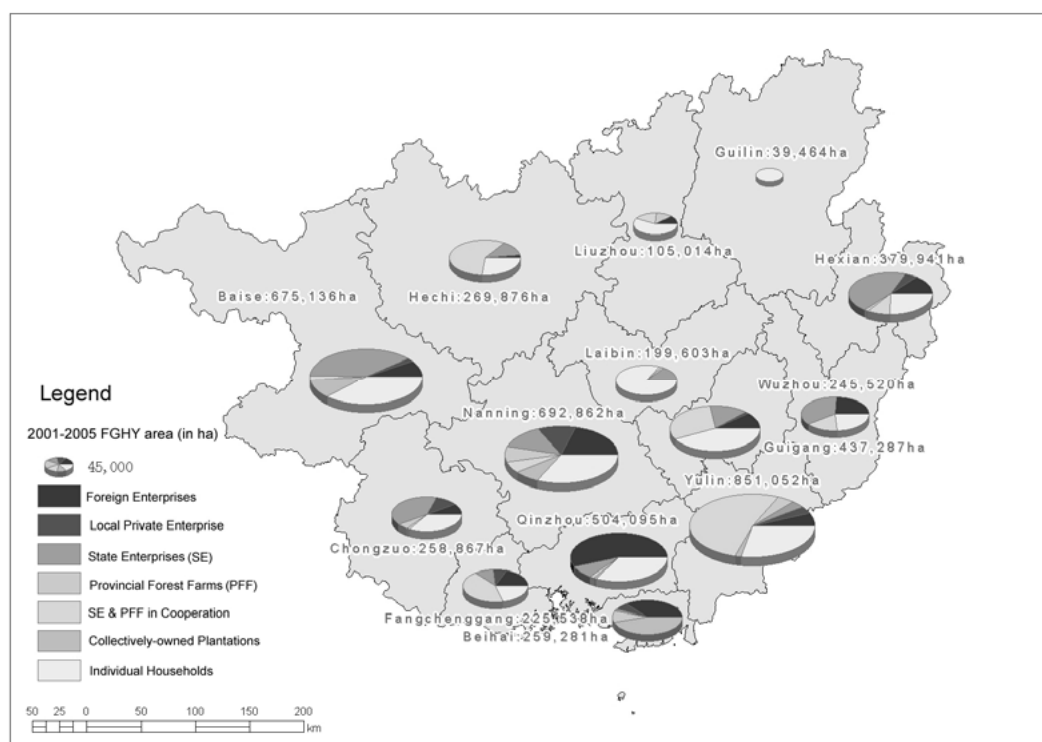
- Foreign Enterprises;
- Local Private Enterprises;
- State Enterprises;
- Provincial Forest Farms,;
- State Enterprises or Provincial Forest Farms in cooperation with others;
- Collectively-owned plantations;
- Individual Household Plantations

Table 6.11 and Map 6.1 give further details on the relative weight that these different players will have on future timber and green residue productions within each Prefecture.

Table 6.11: Area of FGHY plantations established by main groups of stakeholders between 2001 and 2005 (in hectares)

	Sub-total (in ha)	Foreign Enterprises	Local Private Enterprises	State Enterprises (SE)	Provincial Forest Farms (PFF)	SE or PFF in cooperation with others	Collectively- owned Plantations	Individual Household Plantations
Nanning	46,190.8	8,889.6	6,893.7	5,739.9	2,998.3	2,313.1	3,496.5	15,859.7
Liuzhou	7,000.9	666.7	0.0	0.0	980.5	1,437.7	0.0	3,916.0
Guilin	2,630.9	0.0	0.0	0.0	0.0	0.0	0.0	2,630.9
Wuzhou	16,368.0	3,949.9	80.0	5,477.2	0.0	3,007.8	0.0	3,853.1
Beihai	17,285.4	6,608.1	1,026.7	316.7	1,329.0	0.0	8,005.0	0.0
Fangchengang	15,035.9	2,564.6	1,427.6	1,784.6	0.0	6,273.7	0.0	2,985.4
Qinzhou	33,606.3	18,360.5	0.0	2,570.5	0.0	486.7	400.0	11,788.7
Guiguang	29,152.5	2,663.2	365.3	5,045.5	0.0	8,164.9	0.0	12,913.5
Yulin	56,736.8	2,742.5	1,637.3	1,856.4	2,799.3	29,973.9	1,244.7	16,482.8
Baise	45,009.1	3,174.5	753.1	18,241.2	280.3	951.7	3,827.0	17,781.3
Hezhou	25,329.4	2,910.1	1,443.1	11,278.5	417.0	2,800.2	0.0	6,480.5
Hechi	17,991.7	266.7	0.0	2,082.1	0.0	10,743.3	120.0	4,779.6
Laibin	13,306.9	0.0	0.0	1,669.9	229.2	200.0	0.0	11,207.8
Chongzuo	17,257.8	1,291.3	1,933.3	6,715.8	878.7	224.0	0.0	6,214.7
Total in ha	342,902.4	54,087.5	15,560.1	62,778.3	9,912.4	66,577.0	17,093.1	116,894.0

Map 6.1: Implementation of the FGHY Plantation Programme in Guangxi between 2001 and 2005



6.6 Guangxi's Current Wood Supply-Demand Balance

According to data supplied by the Guangxi Provincial Forestry Bureau, total wood supply in the province in 2004 amounted to some 4.8 million m³ of commercial timber and 1.2 million m³ of greenwood residue. As Table 6.12 shows, commercial timber supply was distributed fairly evenly among the province's four regions, ranging from 939,000 m³ in the North West to 1.4 million m³ in the South East. Similarly, reported supply of greenwood residue ranged from a low of 211,000 m³ in the South to a high of 367,000 m³ in the North West.

To estimate the effective wood demand by prefecture for 2004, wood industry profiles identifying the numbers of mills and installed capacity for each grade of processed wood products were prepared for each prefecture (see Appendix E). The installed capacity for each grade of product was then multiplied by an assumed roundwood conversion factor to determine the aggregate volume of roundwood that would be consumed if the mills in each grade were running at full capacity.

The aggregate volume of roundwood demand for each grade was then disaggregated among five types of wood consumed: 1) residual greenwood; 2) commercial logs < 8 cm; 3) commercial logs > 8 cm; 4) commercial wood chips; and 5) mill residues.

Within each grade of processed wood product, the volume of demand for each type of raw material was estimated by multiplying an assumed percentage factor by the aggregate demand in roundwood equivalents. These assumed percentage factors for each grade were applied consistently across all prefectures, both for the estimated current demand in 2004 and for subsequent projections of wood demand in 2010 under various scenarios.

Table 6.12 shows the distribution of effective wood demand (for greenwood only) by prefecture in 2004. Overall, Guangxi's wood industries require an aggregate of 2.9 million m³/yr of green residue and 8.2 million m³/yr of commercial timber. Most of this demand is distributed among the province's South and South East regions. The four prefectures in the South region have an aggregate demand of 1.0 million m³/yr for green residue and 2.8 million m³/yr for commercial timber. The five prefectures in the South East region have an aggregate demand of 1.3 million m³/yr for green residue and 2.4 million m³/yr for commercial timber.

In spite of the general concentration of wood demand in the South and South East, some select prefectures in the North and North East also have high levels of demand. In the North, for example, Liuzhou has an aggregate demand of 377,000 m³/yr of green residue and 1.4 million m³/yr of commercial timber, reflecting the prefecture's substantial sawnwood, wood panels, and wood pulp industries. Similarly, Hechi prefecture in the North West region has an aggregate demand of 931,000 m³/yr for commercial timber, due to the prefecture's large sawnwood industry.

The 2004 wood supply-demand balance for each of Guangxi's 14 prefectures was calculated by dividing reported wood supply volumes by estimated effective wood demand levels (for green residue and commercial timber, respectively) (see Table 6.12). On aggregate, Guangxi's commercial timber supply is estimated to amount to 66 percent of total demand, while supply of green residue amounts to only 41 percent of the province's overall demand for this grade of fiber. It is possible that the calculated supply-demand ratios are systematically low either because the official statistics for wood supply underestimate the actual volumes of wood harvested in the province; or because the estimates of effective wood demand are not based on actual production levels, which could be expected to be somewhat lower than installed capacity.

For commercial timber, Guangxi's North and North West regions come closest to meeting effective wood demand with local supplies of timber. In the North, commercial timber supply amounts to 71 percent of effective timber demand; while in the North West, the supply-demand ratio is 77 percent. In part, this is a reflection of the more limited wood processing capacity located in those regions, as compared to the South and South East. In the South region, local wood supply amounts to 41 percent of effective demand; while in the South East, the supply-demand balance is 62 percent.

For green residue, Guangxi's South and South East regions show substantial supply deficits, with local supply amounting to 20 and 24 percent, respectively, of total

demand for green residue in those regions. By contrast, the North West region shows a net surplus of green residue, with supply amounting to 2.81 percent of demand. It is believed that much of this surplus is consumed by wood processing mills located in Nanning.

Table 6.12: Estimated Wood Supply/Demand Balance by Prefecture in 2004

Region	Prefecture	Wood Supply (m3/yr)						Wood Demand (m3/yr)		Supply/Demand Balance	
		Green Residue			Commercial Timber			Green Residue	Commercial Timber	Green Residue	Commercial Timber
		Hardwood	Softwood	Total	Hardwood	Softwood	Total				
South East	Beihai	6,400	200	6,600	66,041	2,059	68,100	139,485	224,688	0.05	0.30
	Guigang	21,842	20,158	42,000	70,465	65,035	135,500	185,143	143,828	0.23	0.94
	Hezhou	47,628	77,172	124,800	161,508	261,692	423,200	122,908	862,569	1.02	0.49
	Wuzhou	18,131	44,869	63,000	153,624	380,176	533,800	457,039	318,968	0.14	1.67
	Yulin	60,215	20,185	80,400	239,961	80,439	320,400	436,988	850,858	0.18	0.38
	<i>Subtotal</i>	<i>154,216</i>	<i>162,584</i>	<i>316,800</i>	<i>691,599</i>	<i>789,401</i>	<i>1,481,000</i>	<i>1,341,563</i>	<i>2,400,911</i>	<i>0.24</i>	<i>0.62</i>
South	Chongzuo	16,474	26,726	43,200	136,545	221,513	358,058	294,992	228,259	0.15	1.57
	Fangchenggang	11,531	5,869	17,400	74,224	37,776	112,000	103,040	74,850	0.17	1.50
	Nanning	88,906	53,894	142,800	310,876	188,451	499,327	579,898	2,176,811	0.25	0.23
	Qinzhou	5,330	2,470	7,800	126,000	58,400	184,400	69,449	363,830	0.11	0.51
	<i>Subtotal</i>	<i>122,241</i>	<i>88,959</i>	<i>211,200</i>	<i>647,645</i>	<i>506,140</i>	<i>1,153,785</i>	<i>1,047,379</i>	<i>2,843,750</i>	<i>0.20</i>	<i>0.41</i>
North	Guilin	1,903	32,897	34,800	25,904	447,796	473,700	36,555	124,818	0.95	3.80
	Laibin	62,235	57,765	120,000	146,408	135,892	282,300	15,170	232,423	7.91	1.21
	Liuzhou	33,156	117,444	150,600	113,630	402,490	516,120	376,965	1,439,862	0.40	0.36
	<i>Subtotal</i>	<i>97,294</i>	<i>208,106</i>	<i>305,400</i>	<i>285,942</i>	<i>986,178</i>	<i>1,272,120</i>	<i>428,690</i>	<i>1,797,103</i>	<i>0.71</i>	<i>0.71</i>
North West	Baise	94,252	141,548	235,800	191,382	287,418	478,800	85,939	291,407	2.74	1.64
	Hechi	36,033	95,967	132,000	125,707	334,793	460,500	45,052	931,887	2.93	0.49
	<i>Subtotal</i>	<i>130,285</i>	<i>237,515</i>	<i>367,800</i>	<i>317,089</i>	<i>622,211</i>	<i>939,300</i>	<i>130,991</i>	<i>1,223,294</i>	<i>2.81</i>	<i>0.77</i>
Total		504,037	697,163	1,201,200	1,942,275	2,903,930	4,846,205	2,948,623	8,265,058	0.41	0.66

6.7 Projection of Supply-Demand Balance to 2010

To estimate the wood supply-demand balance by prefecture over the next several years, growth in installed capacity for each grade of processed wood product has been projected through 2010 under three different scenarios for aggregate wood demand in Guangxi. The resulting estimates of 2010 installed capacity for each product grade have then been used to generate estimates of future demand for each type of wood-based raw material. These estimates are based on the same assumptions about roundwood conversion and the percentage of each grade's wood demand that will be supplied by the various types of raw material as were used to estimate effective wood demand for 2004.

The three wood demand scenarios used to project supply-demand balance to 2010 can be described briefly as follows:

- Demand Scenario #1: Wood panel and wood pulp industry development according to provincial government plan;
- Demand Scenario #2: Distributed wood panel growth and wood pulp industry development slower than provincial government plan;
- Demand Scenario #3: Wood panel growth according to provincial plan and accelerated BHKP growth.

Details of each scenario are presented in the following sections.

6.7.1 Wood Supply-Demand Balance under Demand Scenario #1

Demand Scenario #1 is based on the following assumptions about projected growth in wood demand through 2010:

- 1) Wood panel industries grow according to the sectoral development plan prepared by the provincial government, which outlines the locations and capacity of planned new mills and expansions at existing mills. It is assumed that no wood panel expansion occurs outside of that included in the provincial plan. (This corresponds to Wood Panel Scenario #1 presented in Chapter 5).
- 2) Wood pulp industries grow according to the sectoral development plan prepared by the provincial government. As with wood panels, the provincial plan outlines the locations and capacity of planned new mills and expansions at existing mills. It is assumed that no wood pulp expansion occurs outside of that included in the provincial plan. (This corresponds to Wood Pulp Scenario #1 presented in Chapter 5).
- 3) Capacity growth in sawnwood, veneer, and wood chips occurs at an average rate of 9.0 % per annum across all prefectures.

Table 6.13 show the projected wood supply-demand balance by each prefecture and region in 2010 under Demand Scenario #1. At the provincial level, aggregate wood demand is projected to reach 5.3 million m³/yr for green residue and 15.5 million m³/yr for commercial timber of all sizes. When compared to the projected wood supply volume for 2010, these figures suggest that Guangxi will have a supply deficit for both green residue and commercial timber. Specifically, it is projected that green residue supply will meet only 51 % of the projected demand, and commercial timber supply will meet 74 % of the projected demand.

Table 6.13: Projected 2010 Wood Supply/Demand Balance by Prefecture under Demand Scenario #1

Region	Prefecture	Wood Supply (m3/yr)						Wood Demand (m3/yr)		Supply/Demand Balance	
		Green Residue			Commercial Timber			Green Residue	Commercial Timber	Green Residue	Commercial Timber
		Hardwood	Softwood	Total	Hardwood	Softwood	Total				
South East	Beihai	116,707	14,905	131,612	686,775	51,784	738,559	156,451	847,089	0.84	0.87
	Guigang	55,314	106,526	161,840	363,396	327,173	690,569	298,503	237,837	0.54	2.90
	Hezhou	53,431	128,330	181,761	351,988	410,334	762,322	406,788	1,611,242	0.45	0.47
	Wuzhou	66,534	194,119	260,653	320,782	589,051	909,833	610,643	415,354	0.43	2.19
	Yulin	183,433	100,286	283,719	1,146,535	340,068	1,486,603	713,964	1,880,531	0.40	0.79
	<i>Subtotal</i>	<i>475,419</i>	<i>544,166</i>	<i>1,019,585</i>	<i>2,869,476</i>	<i>1,718,410</i>	<i>4,587,886</i>	<i>2,186,348</i>	<i>4,992,052</i>	<i>0.47</i>	<i>0.92</i>
South	Chongzuo	85,106	102,193	187,299	491,841	298,506	790,347	462,633	342,571	0.40	2.31
	Fangchenggang	37,815	40,943	78,758	243,635	118,034	361,669	169,712	125,523	0.46	2.88
	Nanning	151,310	129,941	281,251	934,007	382,936	1,316,943	801,752	3,198,092	0.35	0.41
	Qinzhou	97,759	57,826	155,585	614,004	176,664	790,668	301,854	1,203,479	0.52	0.66
	<i>Subtotal</i>	<i>371,990</i>	<i>330,903</i>	<i>702,893</i>	<i>2,283,487</i>	<i>976,140</i>	<i>3,259,627</i>	<i>1,735,952</i>	<i>4,869,666</i>	<i>0.40</i>	<i>0.67</i>
North	Guilin	3,248	227,945	231,193	20,014	729,256	749,270	205,077	239,632	1.13	3.13
	Laibin	40,541	84,706	125,247	250,712	256,775	507,487	15,170	384,521	8.26	1.32
	Liuzhou	35,238	188,553	223,791	211,887	612,206	824,093	892,394	2,427,012	0.25	0.34
	<i>Subtotal</i>	<i>79,027</i>	<i>501,204</i>	<i>580,231</i>	<i>482,613</i>	<i>1,598,237</i>	<i>2,080,850</i>	<i>1,112,641</i>	<i>3,051,165</i>	<i>0.52</i>	<i>0.68</i>
North West	Baise	94,871	107,619	202,490	478,460	344,685	823,145	119,418	881,483	1.70	0.93
	Hechi	32,884	163,837	196,721	218,630	522,049	740,679	172,379	1,750,990	1.14	0.42
	<i>Subtotal</i>	<i>127,755</i>	<i>271,456</i>	<i>399,211</i>	<i>697,090</i>	<i>866,734</i>	<i>1,563,824</i>	<i>291,797</i>	<i>2,632,473</i>	<i>1.37</i>	<i>0.59</i>
Total		1,054,191	1,647,729	2,701,920	6,332,666	5,159,521	11,492,187	5,326,738	15,545,356	0.51	0.74

6.7.2 Wood Supply-Demand Balance under Demand Scenario #2

Demand Scenario #2 is based on the following assumptions about projected growth in wood demand through 2010:

- 1) Wood panel industries grow at 9.0 % per annum, and growth is distributed across all prefectures in direct proportion to existing capacity for each grade of wood panels. (This corresponds to Wood Panel Scenario #2 presented in Chapter 5).
- 2) Wood pulp industries grow more slowly than projected under the provincial government's development plan. In particular, it is assumed that the planned CTMP mill in Beihai (300,000 Adt/yr) does not come online, while the planned CTMP mill in Qinzhou (300,000 Adt/yr) does. Capacity levels at the Nanning Phoenix and Guangxi Heda pulp mills are projected to grow according to the Provincial Government plan. Existing mills which have not been specifically scheduled for expansion by the Provincial Government will grow at an average annual rate of 7 percent per annum. (This corresponds to Wood Pulp Scenario #2 presented in Chapter 5).
- 3) Capacity growth in sawnwood, veneer, and wood chips occurs at an average rate of 9.0 % per annum across all prefectures.

Table 6.14 show the projected wood supply-demand balance by each prefecture and region in 2010 under Demand Scenario #2. At the provincial level, aggregate wood demand is projected to reach 4.8 million m³/yr for green residue and 12.9 million m³/yr for commercial timber of all sizes. When compared to the projected wood supply volume for 2010, these figures suggest that Guangxi will have a supply deficit for both green residue and commercial timber, however these deficits will be smaller than those projected for Demand Scenario #1. Specifically, it is projected that green residue supply will meet only 56 % of the projected demand, and commercial timber supply will meet 89 % of the projected demand.

Table 6.14: Projected 2010 Wood Supply/Demand Balance by Prefecture under Demand Scenario #2

Region	Prefecture	Wood Supply (m3/yr)						Wood Demand (m3/yr)		Supply/Demand Balance	
		Green Residue			Commercial Timber			Green Residue	Commercial Timber	Green Residue	Commercial Timber
		Hardwood	Softwood	Total	Hardwood	Softwood	Total				
South East	Beihai	116,707	14,905	131,612	686,775	51,784	738,559	150,388	333,845	0.88	2.21
	Guigang	55,314	106,526	161,840	363,396	327,173	690,569	305,157	241,163	0.53	2.86
	Hezhou	53,431	128,330	181,761	351,988	410,334	762,322	214,984	1,544,789	0.85	0.49
	Wuzhou	66,534	194,119	260,653	320,782	589,051	909,833	760,651	532,829	0.34	1.71
	Yulin	183,433	100,286	283,719	1,146,535	340,068	1,486,603	725,319	1,415,512	0.39	1.05
	<i>Subtotal</i>	<i>475,419</i>	<i>544,166</i>	<i>1,019,585</i>	<i>2,869,476</i>	<i>1,718,410</i>	<i>4,587,886</i>	<i>2,156,498</i>	<i>4,068,138</i>	<i>0.47</i>	<i>1.13</i>
South	Chongzuo	85,106	102,193	187,299	491,841	298,506	790,347	488,633	381,703	0.38	2.07
	Fangchenggang	37,815	40,943	78,758	243,635	118,034	361,669	169,712	125,523	0.46	2.88
	Nanning	151,310	129,941	281,251	934,007	382,936	1,316,943	869,415	2,799,483	0.32	0.47
	Qinzhou	97,759	57,826	155,585	614,004	176,664	790,668	173,704	621,399	0.90	1.27
	<i>Subtotal</i>	<i>371,990</i>	<i>330,903</i>	<i>702,893</i>	<i>2,283,487</i>	<i>976,140</i>	<i>3,259,627</i>	<i>1,701,465</i>	<i>3,928,108</i>	<i>0.41</i>	<i>0.83</i>
North	Guilin	3,248	227,945	231,193	20,014	729,256	749,270	60,831	208,070	3.80	3.60
	Laibin	40,541	84,706	125,247	250,712	256,775	507,487	25,208	387,439	4.97	1.31
	Liuzhou	35,238	188,553	223,791	211,887	612,206	824,093	619,738	2,343,593	0.36	0.35
	<i>Subtotal</i>	<i>79,027</i>	<i>501,204</i>	<i>580,231</i>	<i>482,613</i>	<i>1,598,237</i>	<i>2,080,850</i>	<i>705,777</i>	<i>2,939,102</i>	<i>0.82</i>	<i>0.71</i>
North West	Baise	94,871	107,619	202,490	478,460	344,685	823,145	165,796	445,233	1.22	1.85
	Hechi	32,884	163,837	196,721	218,630	522,049	740,679	74,061	1,553,581	2.66	0.48
	<i>Subtotal</i>	<i>127,755</i>	<i>271,456</i>	<i>399,211</i>	<i>697,090</i>	<i>866,734</i>	<i>1,563,824</i>	<i>239,857</i>	<i>1,998,814</i>	<i>1.66</i>	<i>0.78</i>
Total		1,054,191	1,647,729	2,701,920	6,332,666	5,159,521	11,492,187	4,803,597	12,934,162	0.56	0.89

6.7.3 Wood Supply-Demand Balance under Demand Scenario #3

Demand Scenario #3 is based on the following assumptions about projected growth in wood demand through 2010:

- 1) Wood panel industries grow according to the sectoral development plan prepared by the provincial government, which outlines the locations and capacity of planned new mills and expansions at existing mills. It is assumed that no wood panel expansion occurs outside of that included in the provincial plan. (This corresponds to Wood Panel Scenario #1 presented in Chapter 5).
- 2) Wood pulp industries grow much more rapidly than projected under the provincial government's development plan. In particular, it is assumed that two BHKP production lines, are installed each with an annual capacity of 600,000 tonnes: one in Beihai, and the other either in Qinzhou or at APP's pulp mill in Hainan but sourcing its fiber entirely from Guangxi. Capacity levels at other existing pulp mills are projected to grow according to the provincial government's plan. Existing mills which have not been specifically scheduled for expansion by the Provincial Government will grow at an average annual rate of 9 percent per annum. (This corresponds to Wood Pulp Scenario #3 presented in Chapter 5).
- 3) Capacity growth in sawnwood, veneer, and wood chips occurs at an average rate of 9.0 % per annum across all prefectures.

Table 6.15 show the projected wood supply-demand balance by each prefecture and region in 2010 under Demand Scenario #3. At the provincial level, aggregate wood demand is projected to reach 5.7 million m³/yr for green residue and 19.1 million m³/yr for commercial timber of all sizes. When compared to the projected wood supply volume for 2010, these figures suggest that Guangxi will have a supply deficit for both green residue and commercial timber, and this deficit will be substantially larger than those projected under either Demand Scenario #1 or Demand Scenario #2. Specifically, it is projected that green residue supply will meet only 47 % of the projected demand, and commercial timber supply will meet 60 % of the projected demand.

Table 6.15: Projected 2010 Wood Supply/Demand Balance by Prefecture under Demand Scenario #3

Region	Prefecture	Wood Supply (m3/yr)						Wood Demand (m3/yr)		Supply/Demand Balance	
		Green Residue			Commercial Timber			Green Residue	Commercial Timber	Green Residue	Commercial Timber
		Hardwood	Softwood	Total	Hardwood	Softwood	Total				
South East	Beihai	116,707	14,905	131,612	686,775	51,784	738,559	355,651	2,639,889	0.37	0.28
	Guigang	55,314	106,526	161,840	363,396	327,173	690,569	298,503	237,837	0.54	2.90
	Hezhou	53,431	128,330	181,761	351,988	410,334	762,322	406,788	1,611,242	0.45	0.47
	Wuzhou	66,534	194,119	260,653	320,782	589,051	909,833	610,643	415,354	0.43	2.19
	Yulin	183,433	100,286	283,719	1,146,535	340,068	1,486,603	713,964	1,880,531	0.40	0.79
	<i>Subtotal</i>	<i>475,419</i>	<i>544,166</i>	<i>1,019,585</i>	<i>2,869,476</i>	<i>1,718,410</i>	<i>4,587,886</i>	<i>2,385,548</i>	<i>6,784,853</i>	<i>0.43</i>	<i>0.68</i>
South	Chongzuo	85,106	102,193	187,299	491,841	298,506	790,347	462,633	342,571	0.40	2.31
	Fangchenggang	37,815	40,943	78,758	243,635	118,034	361,669	169,712	125,523	0.46	2.88
	Nanning	151,310	129,941	281,251	934,007	382,936	1,316,943	801,752	3,198,092	0.35	0.41
	Qinzhou	97,759	57,826	155,585	614,004	176,664	790,668	503,122	2,996,279	0.31	0.26
	<i>Subtotal</i>	<i>371,990</i>	<i>330,903</i>	<i>702,893</i>	<i>2,283,487</i>	<i>976,140</i>	<i>3,259,627</i>	<i>1,937,219</i>	<i>6,662,465</i>	<i>0.36</i>	<i>0.49</i>
North	Guilin	3,248	227,945	231,193	20,014	729,256	749,270	205,077	239,632	1.13	3.13
	Laibin	40,541	84,706	125,247	250,712	256,775	507,487	15,170	384,521	8.26	1.32
	Liuzhou	35,238	188,553	223,791	211,887	612,206	824,093	892,394	2,427,012	0.25	0.34
	<i>Subtotal</i>	<i>79,027</i>	<i>501,204</i>	<i>580,231</i>	<i>482,613</i>	<i>1,598,237</i>	<i>2,080,850</i>	<i>1,112,641</i>	<i>3,051,165</i>	<i>0.52</i>	<i>0.68</i>
North West	Baise	94,871	107,619	202,490	478,460	344,685	823,145	119,418	881,483	1.70	0.93
	Hechi	32,884	163,837	196,721	218,630	522,049	740,679	172,379	1,750,990	1.14	0.42
	<i>Subtotal</i>	<i>127,755</i>	<i>271,456</i>	<i>399,211</i>	<i>697,090</i>	<i>866,734</i>	<i>1,563,824</i>	<i>291,797</i>	<i>2,632,473</i>	<i>1.37</i>	<i>0.59</i>
Total		1,054,191	1,647,729	2,701,920	6,332,666	5,159,521	11,492,187	5,727,206	19,130,956	0.47	0.60

Chapter 7: Assessment of Strengths, Weaknesses, Opportunities, and Threats (SWOT) for Guangxi's Forestry Sector

7.1 Introduction

This chapter examines the strengths, weaknesses, opportunities, and threats associated with the development of fast-growing plantations and wood-based industries in Guangxi Zhuang Autonomous Region. The SWOT analysis is intended to support a more informed discussion about steps that can be taken to promote more sustainable and equitable development of Guangxi's plantation resource and wood processing sector.

7.2 Strengths

7.2.1 The development of fast-growing tree plantations and integrated wood processing industries is an important policy priority at both the national and provincial levels. With the adoption of China's Tenth Five Year Development Plan (2001-2005), the State Forest Administration (SFA) prioritized the establishment of a fast-growing high-yielding (FGHY) plantation resource base by including this as one of six core initiatives in the National Forest Protection Program. The central aim of the FGHY plantation initiative is to expand the country's commercial wood supply to support domestic forest industries, especially new capacity for wood pulp production. The State Council and the National Development and Reform Commission (NDRC) have also adopted a series of measures to stimulate investments in a new generation of priority projects in the pulp and paper sector, as well as in the wood panel sector. These include: (i) devolving substantial authority to provincial governments over the investment approval process, and (ii) allowing provincial governments to offer preferential conditions above and beyond those stipulated in national policies (i.e. the authority to set tax rates, tax holidays, and fee waivers offered to investors). Integrating forest plantation development with industry production is one of the basic criteria for qualifying as a priority project. The Chinese government is also providing significant financial incentives and capital subsidies to priority pulp and paper projects. Discounted loans from the China Development Bank, one of four government policy banks, and the Agricultural Bank of China, a state-owned commercial bank, have been an important source of financing for many producers.

7.2.2 Guangxi has substantial ecological and geo-morphological advantages with respect to intensive plantation forestry. The subtropical monsoon climate of southern Guangxi is well-suited to tree growth and particularly to some of the fastest growing eucalypts. In the northern half of the province where the climate is more contrasted - with winter frosts and hot, humid summers - a number of local fast-growing species and introduced pine species dominate the plantation forestry landscape. These include: *Quercus sp.*, *Betula sp.*, Slash pine, Chinese fir and a

number of bamboo species. In Guangxi, approximately 80% of the annual precipitation occurs between April and September within the range of 1,250 to 1,800 mm, in most areas. This seasonal distribution of rain may occasionally evolve in periods of drought which reduce the length of the growing season and increase exposure to fire hazards. Since Guangxi's foresters have already developed a fair amount of knowledge and experience in matching species to plantation sites, there is little risk of massive plantation dieback due to climatic hazards - either due to frost or periodic drought. The variations in rain distribution and temperatures which have been observed so far are very much within the range of what each of the above-mentioned species is able to withstand. It is essential, however, that plantations are established at the right time of the year and that each site is planted with the right species. Topography in the coastal strip consists of plains and gently undulating tablelands easily accessible to vehicles and heavy machinery. These are the sites with best comparative advantages in terms of plantation operational costs, management logistics, and in most cases, productivity. In addition, the coastal region has a network of national and secondary roads which are in relatively better condition compared to the rest of the province. Transport distance to the future main delivery points of roundwood (Behai and Qinzhou) will also be shorter.

7.2.3 Plantation development, particularly in hilly areas, offers important opportunities for rural employment and household income generation. The development of plantations in hilly areas is labor-intensive, and rural households in Guangxi have benefited from plantation forestry through increased employment and income opportunities. This has been the case in spite of the fact that the demand is largely for seasonal and unskilled jobs. The impacts of plantation forestry on employment are relatively easy to assess in the sense that there are often no other development options for the land being utilized for plantations; and in many areas where plantations are being developed, there are few other job opportunities. Indeed, economic decline has been the prevailing trend over the last several years in much of the hilly areas of Guangxi. This has forced a large portion of the rural population between the ages of 18 and 45 to work outside the region. Migration towards large cities of the south and east coasts of China is still continuing. Plantations also have the potential to provide rural villages with improved public infrastructure, financed through taxes raised on plantation sales. By comparison, plantation development on flat lands in the coastal region of Guangxi generally provide the best sites for production of wood fiber at competitive costs. However, many of these areas are being managed mechanically and, therefore, they provide relatively fewer employment opportunities per hectare (or mu).

7.2.4 Guangxi's wood industries are generally labor-intensive compared to those in other countries in the region, employing large numbers of people. A substantial portion of the province's wood processing industries are small- and medium-scale enterprises with production processes that are often only semi-mechanized. In this way, the sector provides jobs for large numbers of people. This may change over time, however, as increasingly the provincial government is promoting a shift towards more capital-intensive forms of wood-processing – namely, large-scale MDF-HDF and wood-based pulp production.

7.2.5 Reconstituted panels and wood-based pulp utilize wood residues and small-diameter logs. Over the medium term, growth in Guangxi's MDF-HDF and wood-based pulp industries is projected to account for the vast majority of new roundwood demand in the province. A major competitive advantage of these industries is that most of the fiber they consume is either residual wood (which is often classified as the 'three wastes') or small-diameter (< 8 cm) commercial logs. It is estimated that Guangxi's MDF and HDF producers, for instance, get approximately 50 percent of their fiber from greenwood residues obtained from thinning, tops of felled trees, and irregular logs (including those with bends, holes, knots, and/or less than 2 meters in length) generated by commercial harvesting activities; 15 percent from dry mill residues; and 18 percent from small-diameter commercial logs. Similarly, most wood-based pulp mills obtain the bulk of their fiber from small-diameter commercial logs. This strong demand for residual wood and small-diameter logs has several advantages: On the one hand, the heavy use of residual wood means that MDF and HDF mills play a critical role in the efficient utilization of Guangxi's wood resources; indeed, they produce a value-added product from raw materials that might otherwise be wasted. On the other hand, these industries' use of small-diameter logs means that they can be supported by fast-growing short-rotation plantations. In contrast to plywood and sawnwood production, which generally require larger diameter logs, Guangxi's pulp and MDF mills can utilize plantation eucalyptus wood grown on rotations of 3-6 years.

7.2.6 Guangxi's proximity to Guangdong has meant ready access to China's largest furniture industry and a major construction market. Over the last several years, the special economic zones of the Pearl River Delta region in Guangdong Province have been the engine of growth in China's US\$ 26 billion per year furniture industry, and they currently account for over 50 percent of that industry's total exports. Guangxi's physical proximity has given the province's wood panel producers a strong competitive advantage to supply a substantial portion of the panels consumed by Guangdong's furniture producers and construction sector. With the two provinces linked by road, rail, and waterways, wood panel producers in Guangxi have generally been able to deliver their products to the Guangdong market much more cost-effectively than producers either in other provinces or in other countries. Virtually all of the irregular plywood and approximately 70 percent of the MDF and HDF produced in Guangxi is purchased by buyers in Guangdong. It is anticipated that the furniture and construction industries will continue to grow over the next several years, and wood panel producers in Guangxi are well-positioned to supply a substantial portion of Guangdong's growing demand.

7.3 Weaknesses

7.3.1 The system of fees related to fast-growing, high-yielding (FGHY) plantations still requires further innovations to make it fully transparent. Recent policy measures have been adopted, at central level, to reduce the taxes and fees on forest products and streamline both the entire revenue system and the delivery of

government services. The purpose is to stimulate investments in plantation forestry. Forestry products have been exempted from the Special Agricultural Products Tax. However, there are a number of other charges which are still in place. Some, such as the afforestation fee and the quarantine fee are nation-wide. Others are province-specific. Finally, some charges are levied at local level. Their number and purpose vary greatly between localities. The overall system of fees is still very complex and relatively un-transparent.

7.3.2 The system of annual allocation of cutting permits still contains uncertainties for independent tree growers which might have disincentive effects on investors. Forest management inventories carried out by provincial forestry bureaus provide the basis for calculation of logging quotas. Logging quotas are assigned to each province by the State Forestry Administration. Provinces, in turn, assign quotas to prefectures and prefectures to counties. When quotas are tight, cutting permits might be difficult to obtain. Recently, projects integrating industrial processing facilities and fast-growing, high-yielding plantations were exempted from the logging quota system and allowed to conduct harvest in their own plantations on the basis of a forest management plan approved by the relevant provincial forestry administration. The State Forestry Administration foresees the need for further moves in this direction that would address concerns of independent and small-scale tree growers.

7.3.3 Relatively high wood costs undermine international competitiveness of Guangxi's wood-based industries. The cost of growing wood fiber in Southern China is substantially higher in comparison to many other countries in the Asia-Pacific region. This is particularly the case of plantations on hilly sites which represent by far the largest portion of Guangxi's forest plantations. In the case of pulpwood plantations, we have compared the delivered costs of several sources of overseas supplies with the range of delivered wood costs currently obtained in Guangxi. Our study shows that plantations of the high-cost category still maintain a modest delivered wood cost advantage over foreign suppliers. When comparing 2004 average production costs of wood chips made of locally-grown eucalypts with average 2004 delivered costs of Australian eucalypt chips it was found that Guangxi's producers were able to maintain a cost advantage of approximately USD 50 per bone dry metric ton of chips. This cost advantage is more or less equal to the on-site costs (silviculture, harvesting and extraction) needed to produce the wood which is contained in one bone dry metric ton of chips. In hilly sites, on-site production costs are made essentially of labor (approximately 50%), fertilizers, seedlings, and supervision and transport costs. Bringing the base daily wage of unskilled workers up to USD 10 – with all other parameters remaining equal – would offset the current cost advantage that Guangxi's producers have over imported Australian wood chips. The future is uncertain as for manpower availability and labor costs in remote parts of Guangxi since several rural areas in southern China already experience difficulties in hiring local labor for seasonal unskilled jobs. The labor availability issue might be lessened to some extent by the adoption of less labor-intensive practices, especially during harvest and extraction. However, in the context of Guangxi's hills, a higher resort to mechanization might very well translate into higher operational costs

considering the modest size of each individual plantation block and their relatively dispersion. High delivered wood costs represent a critical factor that may limit the competitiveness of wood-based pulp producers in Guangxi, which ultimately must be cost-competitive with pulp imports from more efficient producer countries, such as Brasil and Indonesia.

7.3.4 For plantation companies, access to new plantation land is a slow and complex process as most of the land suitable for new plantations is held by farmer households or collectives. In Guangxi like in all other southern provinces, the forest estate is, to a very large extent, under collective tenure. According to the last-published provincial forest inventory data, in 1999, Guangxi had 91% of its area of commercial forests on collectively-owned lands. The same source indicated that approximately 92% of the land which could be used for new plantations was also held by local communities, farmers' cooperatives and individual households. These recognized land user groups are central when it comes to plantation development. Both private companies and government forest farms are therefore seeking to establish partnerships with them, often with the assistance of provincial and municipal governments, and they are using a number of different models to do so. Land classified as 'wasteland' has been and, to a large extent continues to be, targeted for plantation expansion. In most sites visited during the course of this study, areas classified as 'wasteland' reportedly have been of little or no use to generations of farmers or others. (In some provinces, however, areas formally classified as 'waste land' have encompassed important open-access areas for local communities and, at times, have held locally utilized forest resources). In potential plantation sites close to existing or potential markets, land speculation might cause additional difficulties and delays, and ultimately could push wood costs upwards.

7.3.5 Limited access to low-cost sources of energy has kept some mills from operating at full capacity and/or from expanding operations. The rapid pace of China's economic growth in recent years has meant that in many regions, industrial expansion has outpaced the development of new energy sources. In Guangxi, this has meant that wood processing industries – like producers in many other sectors – have often faced energy shortages which have either interrupted production or raised production costs, sometimes significantly. Several producers interviewed during the course of this study reported that uncertain energy supplies in Guangxi are a major factor limiting plans for new production capacity expansion. In terms of relative production costs, the availability of low-cost energy sources is far more important for MDF and HDF producers than it is for other types of wood panel producers. For plywood producers, for instance, energy purchases typically account for only 8-10 percent of direct production costs. By comparison, MDF and HDF mills are fairly energy-intensive, with expenditures on energy typically representing 15-21 percent of direct costs.

7.4 Opportunities

7.4.1 Depending on the model used, plantation development can offer substantial potential economic benefits for farmers, particularly for low productivity areas classified as ‘wasteland’. A large proportion of rural households in the hills and mountains of Guangxi are living in poverty. The spectacular plantation development of the last ten years has occurred - to a very large extent - on collective lands, in hilly regions with both domestic and foreign companies providing most of the cash investment. Statistics show that this development has primarily taken place on lands that have previously been of little use to farmers or others. Plantation ownership on these collective lands has now taken various forms which reflect the wide array of agreements between those who have user rights on the land - communities or individual households - and investors. Land leasing to domestic and foreign companies is becoming a common practice. This type of agreement gives full ownership of the wood crop to plantation companies while ‘land owners’ enjoy minimum uncertainty and risk. Beside this, there are a number of partnership models by which ‘land owners’ and investors share profits or eventually risks and losses related to plantation development. In a more limited number of cases, communities or individual households invest on their own land with the intention to trade their wood on the open market. In sum, rural households can potentially benefit from growing trees either on their own or in partnership with industrial partners or private investors. However, it is still premature to provide an accurate analysis of the real likelihood and magnitude of profits for communities and individual households. In most cases, plantations outside the government sector have not yet reached maturity and it is therefore difficult to assess what the trends will be regarding real profitability.

7.4.2 There is strong potential for higher value-added processing in Guangxi’s wood products sector, particularly through investment in furniture production. Until now, Guangxi’s wood panel producers have sold most of their product to furniture producers in Guangdong Province. The expansion of furniture production within Guangxi could potentially enable the province’s panel producers to capture greater value-added through secondary processing done locally. The Provincial Forestry Bureau has already formulated a general plan to promote furniture industry development in Guangxi during 2005-2010. Under this plan, the Provincial Forestry Bureau will seek to triple Guangxi’s furniture output from 4.0 million pieces in 2004 to 13.0 million pieces in 2010, which would significantly expand local demand for wood panels. The provincial government’s plan is structured around the development of five integrated furniture industry zones in the following locations: Nanning; Liuzhou; Beihai; Yulin; and Guigang. It is anticipated that demand for furniture will increase sharply over the medium term, both within China’s domestic market and in key export markets. Compared to producers in Guangdong and many other provinces, wood-based furniture producers located within Guangxi would have a cost advantage in being located close to their wood panel supply.

7.4.3 There is considerable potential for higher value-added processing of wood panels for applications in construction and interior design. At present, some 80-85 percent of the MDF consumed in China is used for furniture production, while only

15-20 percent is used in construction and interior decoration. It is expected that over time the structure of MDF demand in China will move in the direction of Japan, with substantial volumes of panels being used for a wider and more sophisticated set of end-uses outside the furniture sector (BIS Shrapnel 2003). Most notably, construction applications include flooring (often in combination with plywood); steps; door jambs; mouldings; panels; doorskins; closet doors; window counters; and kitchen components. MDF and HDF are increasingly being used as substitutes for sawntimber, plywood, and particleboard in many interior applications, such as the base for laminated flooring, wall linings, and doorskins. In China, demand for laminated flooring and interior decorative paneling has increased quite significantly in recent years, and there continues to be considerable room for further growth in the volumes of MDF and HDF panels being directed to these end-uses. It is also expected that over time, demand will increase – not only in China, but also in Japan and South Korea -- for higher quality MDF and HDF panels, including panels with low formaldehyde emissions, fire resistance, and water resistance. To the extent that producers in Guangxi can position themselves to respond to growing demand in these areas over the medium term, they have significant opportunities to capture increased value-added from their products.

7.4.4 Guangxi is well-positioned to access new markets both in South West China, and in Vietnam and other parts of ASEAN. At present, emerging manufacturing centers in Sichuan and elsewhere are consuming increasingly large volumes of wood panels and pulp and paper products, and this demand is projected to grow sharply over at least the medium term. Some producers interviewed during this study reported that they are already selling as much as 30 percent of their panels to buyers in Chengdu and Chongqing. In addition, the rapid growth of Vietnam's wood furniture industry in recent years has created new market opportunities to which panel producers in Guangxi have already started to respond. In addition to Guangxi's physical proximity, trade opportunities with Vietnam and other Southeast Asian countries are perhaps further enhanced by the fact that Nanning serves as the permanent host for the China-ASEAN free trade agreement.

7.5 Threats

7.5.1 Limited genetic resource base and suboptimal species-site matching may pose risks to fast-growing plantations and/or limit productivity gains. Guangxi's fast-growing plantations are making extensive use of recently developed eucalyptus clones. Since the early-1980s, Guangxi Forestry Research Institute and Dongmen Provincial forest farm have made substantial investments to develop tree breeding and clonal forestry. More recently Qinzhou City Research Institute and Bobai forest farm have followed the same path. This research started with the testing of a large number of eucalyptus species and provenances and the establishment of seed orchards and progeny trials. Currently, the aim is to clone genotypes with superior genetic traits. Advanced breeding and propagation strategies are being used to do so. In spite of this important research effort, only a limited number of eucalyptus clones is available for mass distribution. At present, no more than 20 clones are mass propagated every year

over some 50,000 ha of plantation. Plantations stands are monoclonal. Southern Guangxi, has areas spreading over thousands of hectares, where landscapes are dominated by small to average-sized eucalypts wood lots, all made of the same single clone.

7.5.2 Low profits and/or potential losses from some plantation sites may lead to disappointing results for farmers: Our study shows that wood costs are sensitive to a number of factors including: plantation productivity, harvesting and extraction costs, land lease costs to name only those factors which are the most site-dependent and therefore might display high variability. Investors may face substantial risks when several factors turn out not to be in their favor. Risk of financial losses can be minimized when investment decisions give appropriate attention to site conditions - facility of access is of particular importance - and where harvest, extraction and transport costs can be predicted with some accuracy. Post-planting silvicultural work must also be properly funded and carried out in a timely manner. It must also be stressed that high cost inputs and good care given to a plantation doesn't translate automatically in high productivity, low stumpage costs and high returns. Plantation forestry is a relatively risky and long time-frame undertaking with high exposure to climatic hazards and casualties such as fire

7.5.3 Economic viability of small to medium-scale panel mills might locally be threatened as they loose access to cheap raw material sources following excessive conversion of pines and Chinese fir plantation into eucalypt plantations: Pine and Chinese fir plantations provide thinning products and harvest residues such as large branches which are used to feed - at low costs - a large number of mills which are competing for supplying the domestic market with cheap reconstituted panels. Short-rotation eucalypt plantations do not provide thinning products. The amount of residue that they produce at harvest is less than for pine and Chinese fir. The price of eucalypt round wood is more or less double than that of residues from pine and Chinese fir. We estimate that conversion of Guangxi's pine and Chinese fir plantations into eucalypt plantations amount to some 10,000 to 15,000 hectares every year. Plantation conversion is the second most important source of land for the development of the fast-growing, high-yielding (FGHY) plantations. The above illustrate one possible impact of plantation conversion. There are many others with respect to the environment, in particular.

7.5.4 Rapid expansion of both the MDF/HDF and wood pulp industries may lead to competition among producers for land and/or fiber resources. Over the medium term, much of the new processing capacity that is projected to come online in Guangxi's wood processing sector will be in the MDF and HDF industries and in wood-based pulp production. In principle, these industries rely on very different raw material sources, with MDF and HDF mills utilizing the 'three wastes' -- either in the form of residual greenwood or mill residues -- while wood-based pulp mills use small- and medium- diameter commercial logs. In practice, however, it appears that there is at least partial overlap in the raw materials utilized by MDF-HDF and wood pulp mills. This study estimates that approximately 25 percent of the fiber used by MDF producers comes from commercial logs of various sizes and another 10 percent comes

in the form of commercial wood chips. Each of these categories overlaps directly with the types of fiber utilized by wood pulp producers. Direct competition for fiber between MDF mills and wood pulp producers is likely to push fiber costs upwards and to result in increased competition for land.

7.5.5 Inequitable and/or inflexible land lease contracts or share agreements may result in tensions between plantation companies and collective land-owners.

There is currently growing competition among plantation companies in Guangxi to secure leases with collective land owners for large areas that can be developed into plantations. Under these contracts, many companies are leasing land for periods ranging between 30 and 50 years and/or entering into various types of share-cropping arrangement with farmer households or collectives. In negotiating these leases, it is clear that some companies have sought to minimize the amount they pay to utilize the land and/or to lock in a low land rental fee for the duration of the contract. Experience from other countries and from other parts of China have shown that company-community agreements often do not last in situations where the contract is perceived to be inequitable by one or both parties. Moreover, it is generally the case that market prices for land rental tend to rise – sometimes dramatically – as plantation companies compete with one another to secure the available land within a limited area. Within such a context, it can be anticipated that collective land-owners that had leased their land before such a price increase occurred would want to have a mechanism for adjusting the amount of the land lease fee over time. Among the companies surveyed, only 40 percent of contracts have a clause for revising land rental price within the first 3 -10 years. Even with such a clause, it would appear that there is often considerable ambiguity about how such an adjustment can be made once the contract has been signed.

7.5.6 Potential decline in demand for Chinese products in key export markets – either due to market downturn or anti-dumping measures – could negatively affect demand for primary wood products from Guangxi.

Although most analysts expect demand for China's wood panel products to continue to grow substantially over the next several years, it is entirely possible that demand could drop off for some types of products and in some markets. This could result, for instance, from a sharp decline in China's furniture exports to the US market, which currently consumes over 50 percent of the country's exports in that sector. Of particular concern for China's wood panel and furniture producers, there are indications that the US housing market could soon experience a contraction, which would inevitably lead to a decline in US demand for imported furniture. In a similar manner, any action taken by the Chinese government to unpeg the Yuan from the US dollar would almost certainly result in reduced demand for Chinese furniture in the US and other markets, as it would become relatively more expensive than it is now. In addition, the US government has responded to China's growing volume of furniture exports by imposing anti-dumping measures under the WTO, including tariffs of up to 198 percent on over US\$ 1 billion of wood furniture. To the extent that anti-dumping penalties are adopted by governments in other destination markets or applied more broadly by the US, it is conceivable that they could restrict China's access to key markets over the medium term. This, in turn, would create pressures on Chinese furniture producers to increase

sales in their domestic market and/or to expand exports to new destination countries. It can be expected that over time Chinese exporters will reduce these risks by expanding their exports to Europe and other non-US markets. It must also be emphasized that China's internal market is growing very rapidly and can be expected to consume a growing portion of the country's wood products over the medium- to long-term.

Sources Cited

Barr, C. and Cossalter, C. (2004) "China's Development of a Plantation-Based Wood Pulp Industry: Government Policies, Financial Incentives, and Investment Trends," *International Forestry Review*, vol. 6 (3-4).

BIS Shrapnel (2004) "Medium Density Fibreboard in the Pacific Rim, 2004-2008: Market Opportunities, Strategies, and Prospects for Trade and Investment," North Sydney: BIS Shrapnel Pty Limited, February.

Cossalter, C. (2004) "Does China have a comparative advantage for growing pulpwood?" Presentation prepared for the International Forum on Investment and Finance in China's Forestry Sector, Beijing, September 22-23.
[http://www.forest-trends-ftp.org/resources/meetings.htm#Beijing_2004].

Guangxi Provincial Forestry Bureau (2003) "Survey of Wood Panel Industries in Guangxi," unpublished report.

Guangxi Provincial Forestry Bureau (2005) "General Plan for the Promotion of a Furniture Industry in Guangxi, 2005-2010", unpublished draft report.

Hawkins Wright (2004) "Defining the China Market for Pulp, Paper, and Board," Multi-client study.

He, D. and Barr, C. (2004) "China's Pulp and Paper Sector: An Analysis of Supply-Demand and Medium Term Projections," *International Forestry Review*, vol. 6 (3-4).

Jaakko Pöyry Consulting (2001) "China – Forest Industries: Opportunities and Challenges," Multi-client study.

Jaakko Pöyry Consulting (2004) "Review of Sino-Wood Partners Limited & Sino-Panel Holdings Limited," Report prepared for Sino-Forest Corporation, dated February 24, 2004.

Lu Wenming, Landell-Mills, N., Jinlong, L., Xu, J., and Can, L. (2002) *Getting the Private Sector to Work for the Public Good: Instruments for Sustainable Private Sector Forestry in China*. International Institute for Environment and Development, London, 168 pp.

APPENDIX A: Sensitivity of Stumpage Costs to Discount Rate (DR), Mean Annual Increment (M.A.I) and Increases in Land Rental Prices

Variations are being analyzed for two DR values (7% and 13%) and two types of short-rotation plantations:

- Labor-intensive plantations on hills
- semi-mechanized plantations on flat land

The cost curves presented here show the potential range of variation of stumpage costs for each plantation profile.

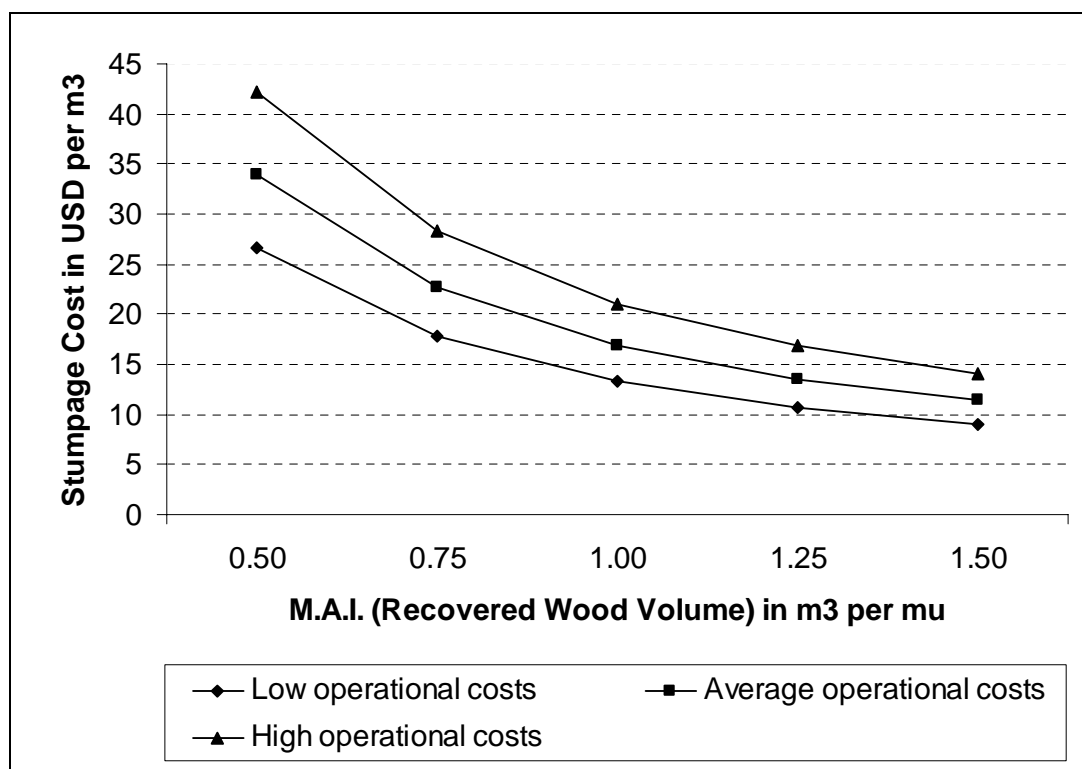
Labor-intensive plantations on hills (First rotation)

Sensitivity of Stumpage Cost to M.A.I.

Stumpage costs are calculated for 3 plantation profiles with respectively: low, average and high operational costs. Operational costs consist of:

- Land rental: RMB 20/mu/year for the high operational costs case; RMB 15/mu/year for the two other cases
- Costs of on-site infrastructure (see Table 4.2 section 4.4.2)
- Plantation operational costs (see Table 4.3 of section 4.4.3.1)

DR: 7% First rotation, labor-intensive plantations on hills



Compounded plantation operational costs (DR: 7%) at the end of the first rotation (at year 5, before harvest) are:

- Low case: RMB 523 per mu equivalent to USD 955 per ha
- Average case: RMB 700 per mu equivalent to USD 1,278 per ha
- High case: RMB 867 per mu equivalent to USD 1,583 per ha

Labor-intensive plantations on hills (First & Coppice rotation)

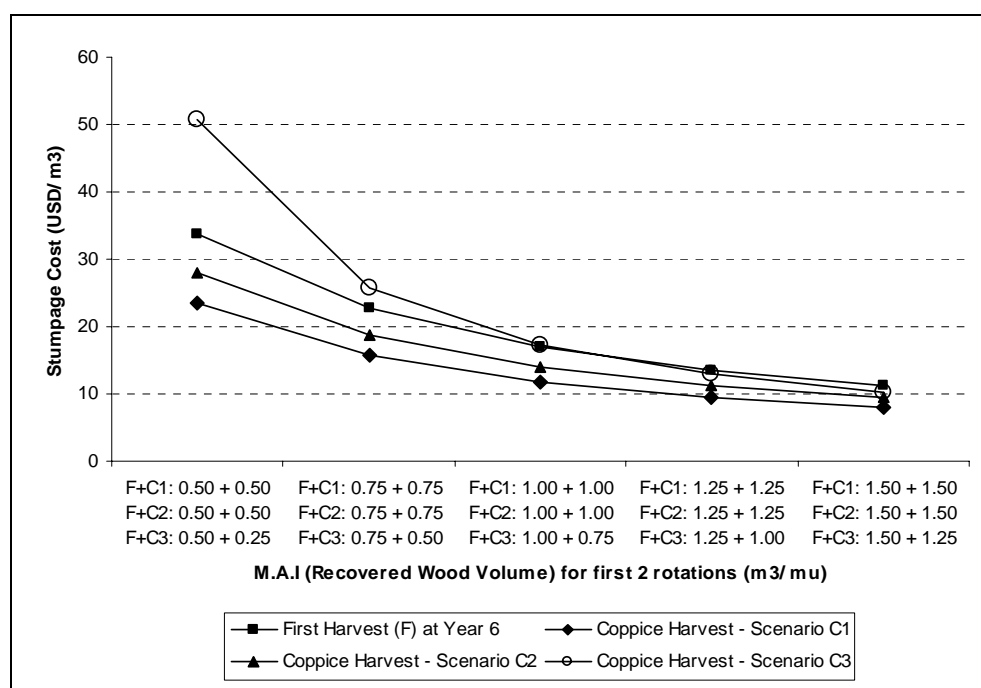
Sensitivity of Stumpage Cost to M.A.I. and increase in land rental price

Stumpage costs are calculated for the first and coppice rotation of the plantation profiles with average operational costs. Stumpage cost of the first rotation is compared to stumpage costs of the coppice rotation (starting year 6 and harvested year 11). 3 scenarios are presented:

- **Scenario C1:** Land rental costs remain the same than in the first rotation (RMB 15/mu/year) and coppices grow at same M.A.I. than during the first rotation;
- **Scenario C2:** Land rental costs are doubled (to RMB 30/mu/year) and coppices grow at same M.A.I. than during the first rotation;
- **Scenario C3:** Land rental costs have increased by 50% (to RMB 22.5/mu/year) and coppice productivity is consistently lower than as compared to that of first rotation. Difference of M.A.I (for recovered wood volume) between the first rotation and the subsequent coppice rotation is 0.25 m³/mu.

Operational costs used in this calculation consists of: (i) Land rental; (ii) Plantation operational costs (see Tables 4.3 and 4.4 of section 4.4.3.1).

DR: 7% First and coppice rotation, labor-intensive plantations on hills



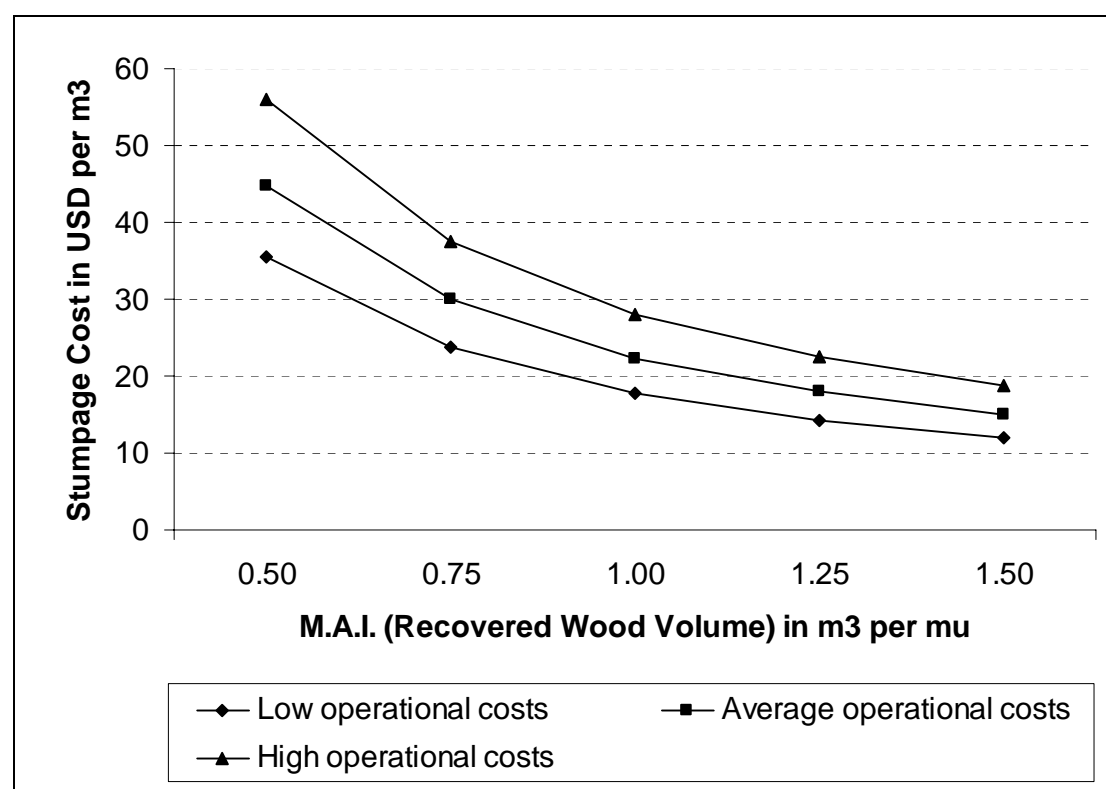
Labor-intensive plantations on hills (First rotation)

Sensitivity of Stumpage Cost to M.A.I.

Stumpage costs are calculated for 3 plantation profiles with respectively: low, average and high operational costs. Operational costs consist of:

- Land rental: RMB 20/mu/year for the high operational costs case; RMB 15/mu/year for the two other cases
- Costs of on-site infrastructure (see Table 4.2 section 4.4.2)
- Plantation operational costs (see Table 4.3 of section 4.4.3.1)

DR: 13% First rotation, labor-intensive plantations on hills



Compounded plantation operational costs (DR: 13%) at the end of the first rotation (at year 5, before harvest) are:

- Low case: RMB 705 per mu equivalent to USD 1,287 per ha
- Average case: RMB 932 per mu equivalent to USD 1,702 per ha.
- High case: RMB 1,166 per mu equivalent to USD 2,129 per ha

Labor-intensive plantations on hills (First & Coppice rotation)

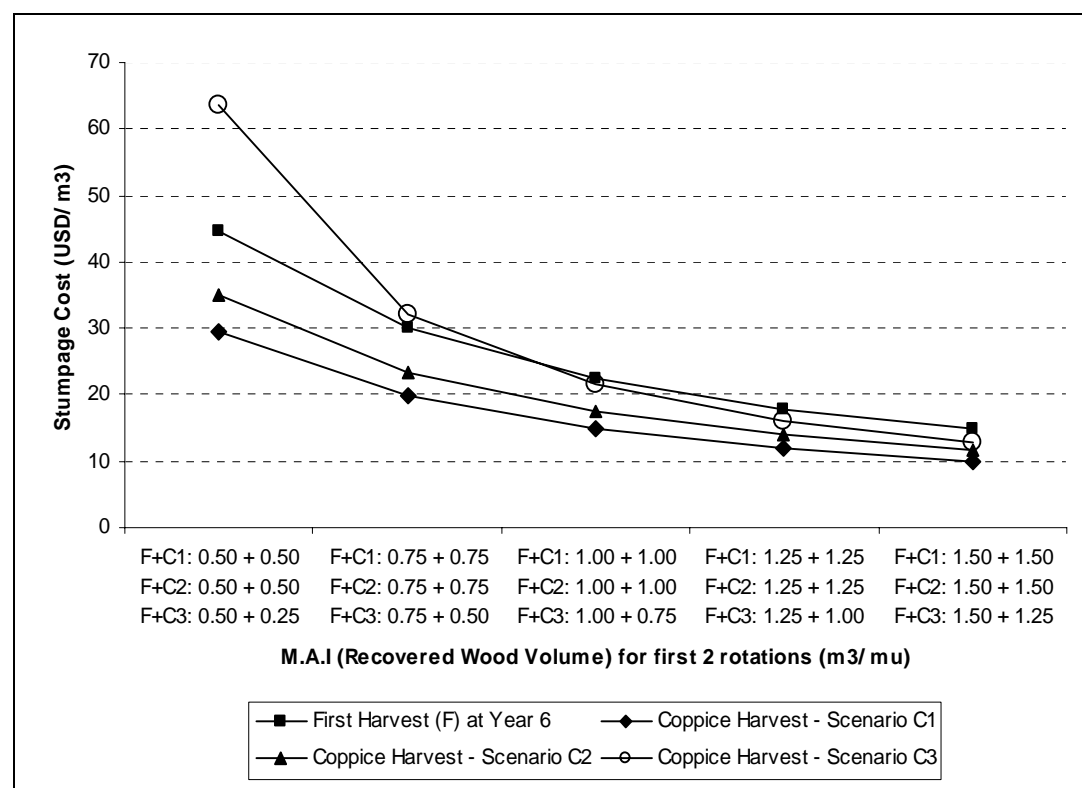
Sensitivity of Stumpage Cost to M.A.I. and increase in land rental price

Stumpage costs are calculated for the first and coppice rotation of the plantation profiles with average operational costs. Stumpage cost of the first rotation is compared to stumpage costs of the coppice rotation (starting year 6 and harvested year 11). 3 scenarios are presented:

- Scenario C1:** Land rental costs remain the same than in the first rotation (RMB 15/mu/year) and coppices grow at same M.A.I. than during the first rotation;
Scenario C2: Land rental costs are doubled (to RMB 30/mu/year) and coppices grow at same M.A.I. than during the first rotation;
Scenario C3: Land rental costs have increased by 50% (to RMB 22.5/mu/year) and coppice productivity is consistently lower than as compared to that of first rotation. Difference of M.A.I (for recovered wood volume) between the first rotation and the subsequent coppice rotation is 0.25 m³/mu

Operational costs used in this calculation consists of: (i) Land rental; (ii) Plantation operational costs (see Table 4.3 and Table 4.4 of section 4.4.3.1).

DR: 13% First and coppice rotation, labor-intensive plantations on hills



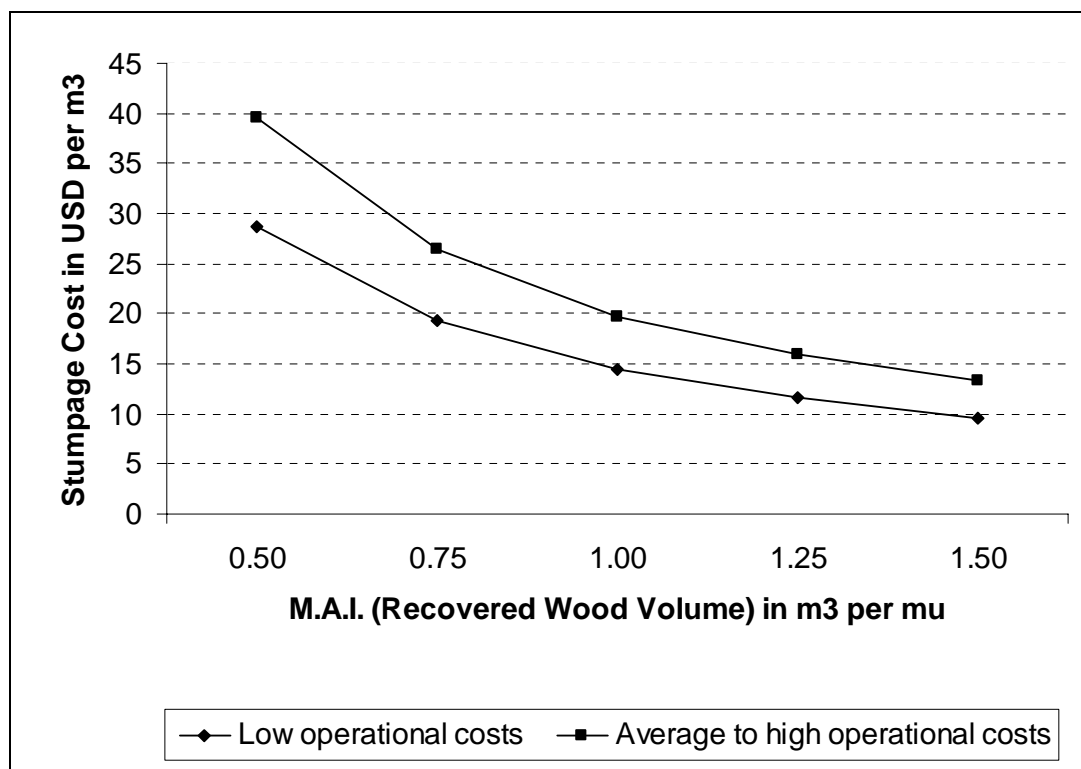
Semi-mechanized plantations on flat land (first rotation)

Sensitivity of Stumpage Cost to M.A.I.

Stumpage costs are calculated for 2 plantation profiles with respectively: low, and average to high operational costs. Operational costs consist of:

- Land rental: RMB 50/mu/year for the average to high operational costs case; RMB 40/mu/year for the low operational cost case
- Costs of on-site infrastructure (see Table 4.2 section 4.4.2)
- Plantation operational costs (see Table 4.5 of section 4.4.3.2)

DR: 7% First rotation, semi-mechanized plantations on flat land



Compounded plantation operational costs (DR: 7%) at the end of the first rotation (at year 5, before harvest) are:

- Low case: RMB 383 per mu equivalent to USD 699 per ha
- Average / High case: RMB 573 per mu equivalent to USD 1,046 per ha.

Semi-mechanized, plantations on flat land (first and coppice rotation)

Sensitivity of Stumpage Cost to M.A.I. and increase in land rental price

Stumpage costs are calculated for the first and coppice rotation of the plantation profiles with average to high operational costs. Stumpage cost of the first rotation is compared to stumpage costs of the coppice rotation (starting year 6 and harvested year 11). 3 scenarios are presented:

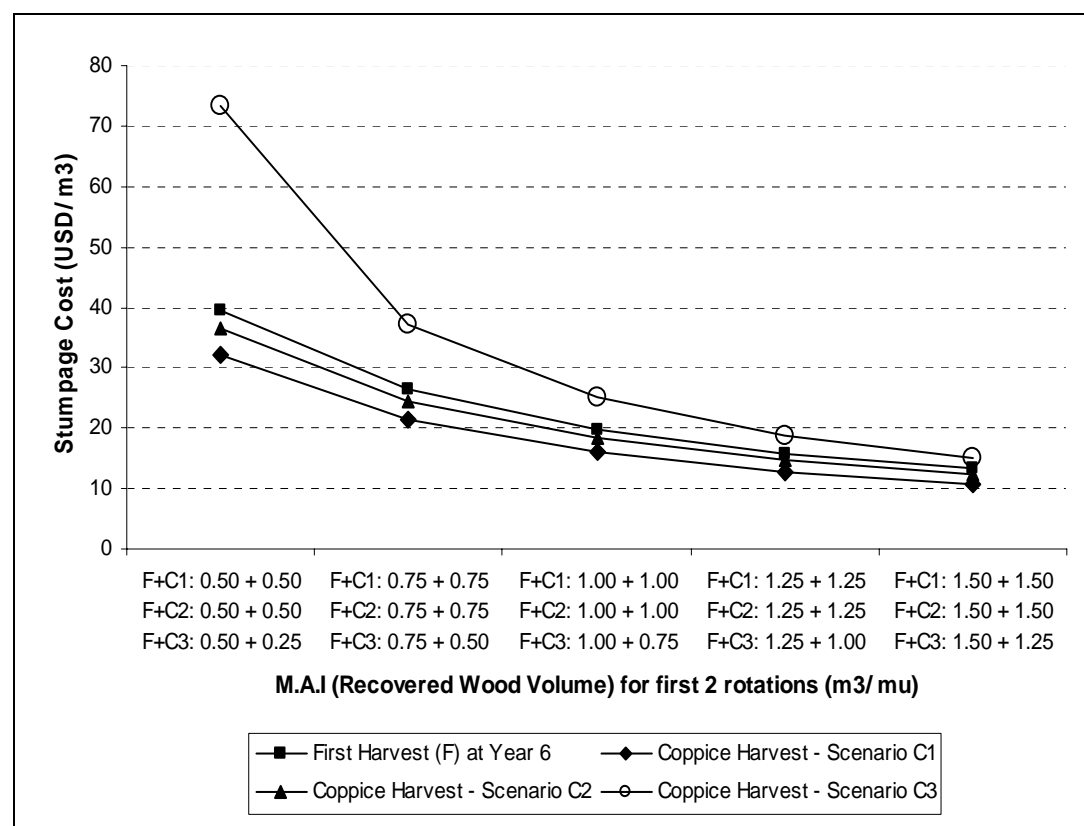
Scenario C1: Land rental costs remain the same than in the first rotation (RMB 50/mu/year) and coppices grow at same M.A.I. than during the first rotation;

Scenario C2: Land rental costs have increased by 30 % (to RMB 65/mu/year) and coppices grow at same M.A.I. than during the first rotation;

Scenario C3: Land rental costs have increased by 35% (to RMB 67.50/mu/year) and coppice productivity is consistently lower than as compared to that of first rotation. Difference of M.A.I (for recovered wood volume) between the first rotation and the subsequent coppice rotation is 0.25 m³/mu

Operational costs used in this calculation consists of: (i) Land rental; (ii) Plantation operational costs (see Table 4.5 and Table 4.6 of section 4.4.3.2).

DR: 7% First and coppice rotations, semi-mechanized plantations on flat land



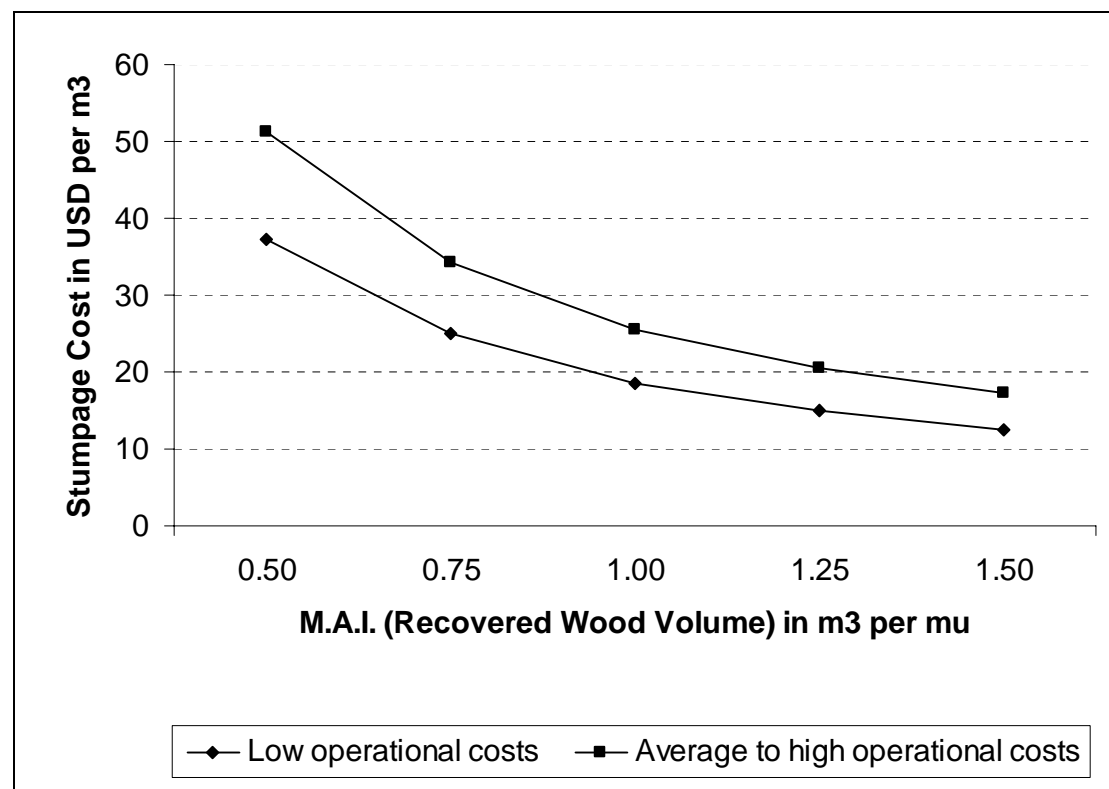
Semi-mechanized plantations on flat land (first rotation)

Sensitivity of Stumpage Cost to M.A.I.

Stumpage costs are calculated for 2 plantation profiles with respectively: low, and average to high operational costs. Operational costs consist of:

- Land rental: RMB 50/mu/year for the average to high operational costs case; RMB 40/mu/year for the low operational cost case
- Costs of on-site infrastructure (see Table 4.2 section 4.4.2)
- Plantation operational costs (see Table 4.5 of section 4.4.3.2)

DR: 13% First rotation, semi-mechanized plantations on flat land



Compounded plantation operational costs (DR: 7%) at the end of the first rotation (at year 6, before harvest) are:

- Low case: RMB 511 per mu equivalent to USD 933 per ha
- Average / High case: RMB 765 per mu equivalent to USD 1,397 per ha.

Semi-mechanized plantations on flat land (first and coppice rotation)

Sensitivity of Stumpage Cost to M.A.I. and increase in land rental price

Stumpage costs are calculated for the first and coppice rotation of the plantation profiles with average to high operational costs. Stumpage cost of the first rotation is compared to stumpage costs of the coppice rotation (starting year 6 and harvested year 11). 3 scenarios are presented:

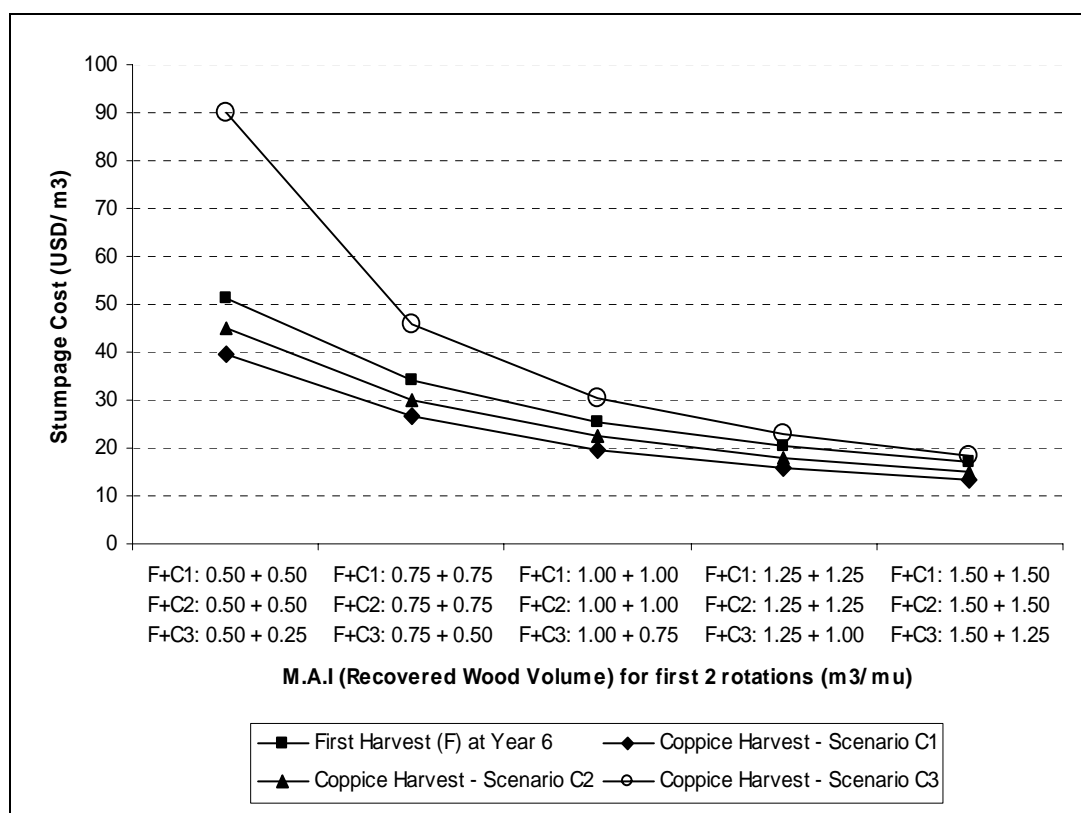
Scenario C1: Land rental costs remain the same than in the first rotation (RMB 50/mu/year) and coppices grow at same M.A.I. than during the first rotation;

Scenario C2: Land rental costs have increased by 30 % (to RMB 65/mu/year) and coppices grow at same M.A.I. than during the first rotation;

Scenario C3: Land rental costs have increased by 35% (to RMB 67.5/mu/year) and coppice productivity is consistently lower than as compared to that of first rotation. Difference of M.A.I (for recovered wood volume) between the first rotation and the subsequent coppice rotation is 0.25 m³/mu

Operational costs used in this calculation consists of: (i) Land rental; (ii) Plantation operational costs (see Table 4.5 and Table 4.6 of section 4.4.3.2).

DR: 13% First and coppice rotations, semi-mechanized plantations on flat land



APPENDIX B: Wood Production Performances Review of 7 Plantation Profiles

Profile No 1

Type of plantation:	Labor-intensive on hill
Location:	Nanning Prefecture, Wu Ming County
Land tenure:	Collective land
Investor / Plantation's 'owner':	Nanning-based private enterprise
Type of agreement:	30-year land rental; No clause for revising land rental price; Land rent is RMB 15/mu/year paid yearly
Plantation's main features:	1,000 mu planted in 1998. Harvest planned in 2005 Eucalypt clones planted 1.5 x 4 m (1,667 trees/ha) Low input of fertilizers, consequently growth has been slow. Assessed M.A.I (standing volume): 0.9 m ³ /mu equivalent to 13.5 m ³ /ha
Access to plantation:	No investment in road construction during the first rotation. Construction cost for a harvest road is estimated to RMB 55,000 for 1,000 mu.
Investment in silviculture:	Low: Plantation operational costs compounded at 7% DR amount to RMB 479.7 (USD875.9/ha)
Harvest costs:	RMB 50/m ³
Extraction and loading costs:	RMB 20/m ³
Transport on truck to Nanning:	RMB 0.7/ton/km for a transport distance of 30 km
Fees (as reported):	RMB 30/m ³
Costs performances (DR 7%):	Stumpage cost estimated to RMB 130.9/m ³ , equiv. to USD 15.9/m ³ . Estimated compounded costs at mill gate are RMB 283.4/m ³ , equiv. to USD 34.5m ³
Sale price at mill gate <u>estimated</u> to:	RMB 185/ton for diameter between 3 and 6 cm RMB 340/ton for diameter between 6.1 and 12 RMB 380/m ³ for diameter between 12.1 and 18 cm
IRR:	9.4%

The above cost calculation is based on operational costs as reported by the local representative of the enterprise which invested in the plantation. Sale prices are average prices at mill gate in Nanning area

Profile No 2

Type of plantation:	Labor-intensive on hill
Location:	Baise Prefecture, Pingguo County
Land tenure:	Collective land
Investor / Plantation's 'owner':	Village committee on its own land
Type of agreement:	RMB 20/mu/year is paid yearly to the County Forestry Bureau for technical back up
Plantation's main features:	<p>The village has a total of 6,000 mu of forest plantations (predominantly pine trees) and no more waste land available. 2,000 mu of eucalypt clones were planted between 2002 and 2004 to replace old pine plantations.</p> <p>Eucalypt was planted 1.5 x 4 m (1,667 trees/ha)</p> <p>Assessed M.A.I (standing volume): 0.9 m³/mu equivalent to 13.5 m³/ha</p>
Access to plantation:	Roads are already in place. The village is involved in plantation forestry since the early sixties.
Investment in silviculture:	High: Plantation operational costs compounded at 7% DR amount to RMB 745.3 (USD 1,360.8/ha)
Harvest costs:	RMB 50/m ³ , include harvest design (RMB 10/m ³) and felling plus crosscutting (RMB 40/m ³)
Extraction and loading costs:	RMB 45/m ³
Transport:	Potential buyer/future destination of the wood not yet known. Wood will be sold at road side.
Fees (as reported):	Contribution to two funds: 10% of the wood sale
Costs performances (DR7%):	<p>Stumpage cost estimated to 184/m³, equiv. to USD 22.4/m³.</p> <p>Estimated compounded cost at road side is RMB 298.8 /m³ equiv. to 36.4 USD /m³.</p>
Sale price at road side <u>estimated</u> to:	<p>RMB 150/ton for diameter between 3 and 6 cm</p> <p>RMB 300/ton for diameter between 6.1 and 12</p> <p>RMB 340/m³ for diameter between 12.1 and 18 cm</p>
IRR:	3.1%.

The above cost calculation is based on operational costs as reported by the village committee which owns the plantation. Sale prices were estimated on the basis of the information gathered in similar locations. The above calculation based on an assumed 7% Discount Rate shown that the operation will generate a deficit estimated to RMB 87.7 per mu equiv. to USD 160 per ha.

Profile No 3

Type of plantation:	Labor-intensive on hill
Location:	Laibing Prefecture, Xinbin District
Land tenure:	Collective land
Investor / Plantation's 'owner':	A local businessman
Type of agreement:	20-year land rental; RMB10/mu/year paid in advance for the entire duration of the contract
Plantation's main features:	The businessman started investing in eucalypt plantation in 1998. He currently manages a total area of 4,300 mu. Between 1998 and 2002 he bought the shares held by a village committee in a 70/30 share agreement with a County Forest Farm (70% of the shares held by the village committee). In 2004 he established his first eucalypt plantation (300 mu) on a rented land. Trees were planted 1.5 x 4 m (1,667 trees/ha). Expected commercial wood volume at harvest (at 6 year) is 5.5 m ³ /mu equiv to a M.A.I (recovered wood volume) of 0.92 m ³ /mu (equivalent to 13.75 m ³ /ha)
Access to plantation:	Existing roads will require upgrading at time of harvest
Investment in silviculture:	High: Plantation operational compounded costs at 7% DR amount to RMB 758.5 (USD 1,384.9/ha)
Harvest, extraction and loading:	RMB 35/m ³
Transport:	Potential buyer/future destination of the wood is not yet know. Wood will be sold at road side.
Fees (as reported):	10% of the wood sale and a 6% tax on labor costs.
Costs performances (DR7%):	Stumpage cost estimated to RMB 154.2/m ³ , equiv. to USD 18.8/m ³ Estimated compounded cost at road side is RMB 233.9/m ³ equiv. to USD 28.5/m ³ .
Sale price at road side <u>estimated</u> to:	RMB 150/ton for diameter between 3 and 6 cm RMB 300/ton for diameter between 6.1 and 12 RMB 340/m ³ for diameter between 12.1 and 18 cm
IRR:	9.1%.

The above cost calculation is based on operational costs as reported by the individual who has invested in the plantation. Sale prices were estimated on the basis of the information gathered in similar locations.

Profile No 4

Type of plantation:	Labor-intensive on hill
Location:	Nanning Prefecture, Shan Li County
Land tenure:	Collective land
Investor:	The Forest Technology Extension Station (FTES) under the County Forestry Bureau
Type of agreement:	30-year share agreement. Village committee holds 20% of the share / standing wood volume at end of the rotation. All costs until harvest provided for by the Forest Technology Extension Station which holds 80% of the share.
Plantation's main features:	500 mu planted in June 2004. Eucalypt clones 2 x 3 m apart (1,667 trees/ha). A case of a plantation established with much care and high-cost inputs. Unfortunately planting was followed by 4 months of exceptional drought (August to November 2004). First year-growth has been slow. M.A.I (recovered wood) at age 6 is expected to be 5.5 m ³ /mu. This is less than what it should have been under normal climatic conditions.
Access to plantation:	An access road was created with limited investment (extension of an existing road)
Investment in silviculture:	High: Plantation operational costs compounded at 7% DR amount to RMB 867 (USD 1,583.1/ha)
Harvest, extraction and loading:	RMB 50/m ³
Transport:	Potential buyer/future destination of the wood not yet known Wood likely to be sold at road side
Fees (as reported):	10% of the wood sale
Costs performances (DR 7%)	<p>Stumpage cost estimated to RMB 161.8/m³, equiv. to USD19.7/m³. Estimated compounded cost at road side is RMB 253.5 equiv. to USD 30.9. When dividing the above costs by 0.8, the estimated stumpage cost of the 80% FTES's wood share is increased to RMB 202.3/m³ (USD 24.6/m³) and compounded costs are increased to 297.2/m³ equiv. to USD 36.2/m³.</p> <p>Mature standing eucalypts trees were reported to have a local market price ranging between RMB 250 and 290/m³, depending on site accessibility. Based on this information it is estimated that the net return to the community provided by the sale of their 20% wood share should be no less than RMB 46/mu/year (USD84/ha/year) which is a value well above the</p>

local current market price for renting land of equal value (RMB 10 to 15/mu/year).

Sale price at road side estimated to: RMB 150/ton for diameter between 3 and 6 cm
RMB 300/ton for diameter between 6.1 and 12
RMB 340/m3 for diameter between 12.1 and 18 cm

IRR: 4.0 % (Calculated on the 80% share of FTES).

The above cost calculation is based on operational costs as reported by FTES staff. Sale prices were estimated on the basis of the information gathered in similar locations. The above calculation based on an assumed 7% Discount Rate shown that the operation will generate a deficit for FTES estimated to RMB 90.7 per mu equiv. to USD 165.6 per ha.

Profile No 5

Type of plantation:	Labor-intensive on hill
Location:	Qinzhou Prefecture, Pu Bei County
Land tenure:	Collective land
Investor:	A pulp Company
Type of agreement:	30-year share agreement. Village committee holds 30% of the share / standing wood volume at end of rotation. All costs until harvest provided for by the pulp company which holds 70% of the share.
Plantation's main features:	545 mu planted in August 2000. Eucalypt clones 1 x 1.25 m apart (2,000 trees/ha). A good quality and productive plantation. Expected volume of recovered wood at the end of the rotation is 8 m ³ /mu. This is equivalent to a M.A.I (standing volume) of 1.78/mu (26.7 m ³ /ha) at age 6.
Access to plantation:	An access road existed. Limited upgrading will be required at harvest time.
Investment in silviculture:	Average: Plantation operational compounded costs at 7% DR amount to RMB 699.2 (USD 1,276.7/ha)
Harvest, extraction and loading:	Estimated to RMB 50/m ³
Transport on truck to Qinzhou:	RMB 0.4/ton/km for a transport distance of 163 km
Fees (as reported):	Not applicable to plantation enterprises integrated to pulp industries
Costs performances (DR 7%)	<p>Stumpage cost estimated to RMB 87.3/m³, equiv. to 10.6 USD /m³. Compounded costs at mill gate estimated to 227.6/m³ equiv. to USD 27.7/m³</p> <p>When dividing the above costs by 0.7, the estimated stumpage cost of the 70% Company wood share is increased to RMB 124.7/m³ (USD 15.2/m³) and the compounded cost at mill gate is increased to RMB 268/m³ (USD 32.6/m³)</p> <p>Estimated market value of the standing trees at end of a 6 year rotation is RMB193.3/m³ (USD 23.5/m³).</p> <p>Estimated community's net revenue provided by the sale of their 30% wood share at market price is RMB 77.4/mu/year (USD 141.3/ha/year), a price which is well above the local current market price for renting land of equal value (RMB 25 to 30/mu/year).</p>
Sale price at mill gate (as reported):	RMB 200/ton for diameter between 3 and 6 cm RMB 370/ton for diameter between 6.1 and 18

IRR: 14.4 % (Calculated on the 70% share of the pulp Company).

The above cost calculation is based on operational costs as reported by members of the community who own the land and local residents who were contracted to establish the plantation.

Profile 6

Type of plantation:	Labor-intensive on hill
Location:	Yulin Prefecture, Bo Bai County
Land tenure:	Collective land
Investor:	A pulp Company
Type of agreement:	30-year share agreement. Village committee holds 25% of the share / standing wood volume at end of rotation. All costs until harvest provided for by the pulp company which holds 75% of the share.
Plantation's main features:	1,000 mu planted in August 2000. Eucalypt clones 1 x 1.25 m apart (2,000 trees/ha). An average quality Expected volume of recovered wood at the end of the rotation is 4.8 m ³ /mu. This is equivalent to a M.A.I (standing volume) of 1.07/mu (16 m ³ /ha) at age 6.
Access to plantation:	A good quality township access road existed. No upgrading will be required at harvest time.
Investment in silviculture:	Average: Plantation operational compounded costs at 7% DR amount to RMB 614.3 (USD 1,121.7/ha)
Harvest, extraction and loading:	Estimated to RMB 35/m ³
Transport on truck to Qinzhou:	RMB 0.35/ton/km for a transport distance of 200 km
Fees (as reported):	Not applicable to plantation enterprises integrated to pulp industries
Costs performances (DR 7%)	<p>Stumpage cost estimated to RMB 128/m³, equiv. to 15.6 USD /m³. Compounded costs at mill gate estimated to 255.4/m³ equiv. to USD 31.1/m³</p> <p>When dividing the above costs by 0.75 the estimated stumpage cost of the 75% Company wood share is increased to RMB 170.7/m³ (USD 20.8/m³) and the compounded cost at mill gate is increased to RMB 301.5/m³ (USD 36.7/m³)</p> <p>Estimated market value of the standing trees at end of a 6 year rotation is RMB 203.4/m³ (USD 24.8/m³).</p> <p>Estimated community's net revenue provided by the sale of their 25% wood share at market price is RMB 40.7/mu/year (USD 74.3/ha/year), a price which is well above the local current market price for renting land of equal value (RMB 15 to 20/mu/year).</p>
Sale price at mill gate (as reported):	RMB 200/ton for diameter between 3 and 6 cm RMB 370/ton for diameter between 6.1 and 18

IRR: 8.1 % (Calculated on the 75% share of the pulp Company).

The above cost calculation is based on operational costs as reported by members of the community who own the land and local residents who were contracted to establish the plantation.

Profile No 7

To compose this profile we have combined what we know about the pulpwood plantations in Hepu county (Land rent, silvicultural characteristics, expected M.A.I.) with cost data obtained in Zhanjiang Prefecture for same site conditions.

Type of plantation:	Semi-mechanized on Flat land
Location:	Behai Prefecture, Hepu County
Land tenure:	
Investor:	A pulp Company
Type of agreement:	30-year land rental; Land rent is RMB 45/mu/year
Plantation's main features:	Eucalypt clones 2 x 4 m apart (1,250 trees/ha). The expected volume of recovered wood at the end of the 7-year rotation is 8.5 m ³ /mu. This is equivalent to a M.A.I (standing volume) of 1.6/mu (24.3 m ³ /ha) during the first rotation.
Access to plantation:	An access road was created at the cost of RMB 80 per mu ..
Investment in silviculture:	Average: Plantation operational compounded costs at 7% DR amount to RMB 497.9 (USD 909.1/ha)
Harvest, extraction and loading:	Estimated to RMB 55/m ³
Transport on truck to the mill:	RMB 0.4/ton/km for a transport distance of 50 km
Fees (as reported):	Not applicable to plantation enterprises integrated to pulp industries
Costs performances (DR 7%)	Stumpage cost estimated to RMB 122.5/m ³ , equiv. to USD 14.9/m ³ . Compounded costs at mill gate estimated to 214.4/m ³ equiv. to USD 26.1/m ³
Sale price at mill gate (as reported):	RMB 200/ton for diameter between 3 and 6 cm RMB 370/ton for diameter between 6.1 and 18
IRR:	18 %

APPENDIX C: Guangxi Integrated Forestry Development and Conservation Project

Questionnaire for Tree Plantation Enterprises and Individual Tree Growers in Guangxi Province

Enterprise Name:
Contact person :; e-mail
Telephone : /; Fax

Enterprise profile / Main characteristics

Where is your Company located? Prefecture: C1- 1 County: C1- 2

When has your Company been established? : ... C1- 3 (year)

Please tick (...) the model that best applies to your Enterprise (several marks are possible for a given Enterprise) C1- 4

- ☐ (1) State-owned (Central Government)
- ☐ (2) State-owned (Provincial Government)
- ☐ (3) State-owned (Prefecture or County)
- ☐ (4) Domestic share Companies (including State - Private sector joint-venture)
- ☐ (5) Purely private - Chinese investment only
- ☐ (6) Purely private - Foreign investment only
- ☐ (7) Purely private - Joint-venture between Chinese and Foreign investors
- ☐ (8) Contractor for a large Industrial Company
- ☐ (9) Collectively-owned jiti
- ☐ (10) Individual (Geren)
- ☐ (11) Other

Please tick (...) the type of plantation that you grow and give a breakdown of the area (in mu) that you have already established C1- 5

- | | Area already established C1- 6
(in mu) |
|--|---|
| <input type="checkbox"/> (1) Fast-growing, high-yielding plantations for industrial raw material | |
| <input type="checkbox"/> (2) Longer-rotation plantations | |
| <input type="checkbox"/> (3) A combination of the above two types | |
| <input type="checkbox"/> (4) Plantations for environmental services | |

Does your Enterprise belong to a downstream industry? (Yes/No); If so, please specify which category of industry: C1- 7 ... 0 = NO / 1 = YES

Does your Enterprise have contractual links with a downstream industry? (Yes/No); If so, please specify which category of industry: C1- 8

What were the land use rights of the land before afforestation for the land that you have afforested during the last 5 years: Please give a breakdown of the area (in mu)

		(Area in mu)				
		2000	2001	2002	2003	2004
<input type="checkbox"/>	State-owned land (County, Township	C1- 9.	C1-10	C1-11.	C1-12	C1-13
<input type="checkbox"/>	State-farm land	C1-14.	C1-15	C1-16.	C1-17	C1-18
<input type="checkbox"/>	State-forest farm land	C1-19.	C1-20	C1-21.	C1-22	C1-23
<input type="checkbox"/>	Collectively- owned land (jiti)	C1-24.	C1-25	C1-26.	C1-27	C1-28
<input type="checkbox"/>	Individual land	C1-29.	C1-30	C1-31.	C1-32	C1-33
<input type="checkbox"/>	Other	C1-34.	C1-35	C1-36.	C1-37	C1-38
<input type="checkbox"/>						

How many active employees does your Company have? Permanent: C1-39...

How many workers involved in your plantations are employed through contractors? ... C1-40..... or are temporary workers: ... C1-41.....

Access to new plantation land

C2-1 How many mu of your 'own land' will you have available- between 2005 and 2010 - for expanding your forest plantation area (re-planting of existing plantation is excluded).

C2-2 For those enterprises / individuals who have no land on their own for expanding their plantation area: With whom and how do you negotiate access to new land?

- ☐ (1) Through agreement with Government agencies only (Province, Prefecture, County,)
- ☐ (2) Through contract with the land user with Government agencies facilitation
- ☐ (3) Through direct negotiation with State Forest Farms or State Agricultural Farms
- ☐ (4) Through direct negotiation with village associations / village leaders
- ☐ (5) Through contract with farmer groups or individual farmers
- ☐ (6) Through contract with non-village residents / individual traders / contractors / others

Please describe the previous land use or the type of pre-existing vegetation on the various potential plantation sites that you have negotiated recently or that are under negotiation.

Area (in mu)		
Site type 1.....	C2-3..... C2-4.....
Site type 2.....	C2-5..... C2-6.....
Site type 3.....	C2-7..... C2-8.....
Site type 4.....	C2-9..... C2-10.....

Please rank (in order of decreasing importance: 1 = most important criteria) the following criteria that are being used to negotiate land lease costs: Distance to potential processing mills or timber markets; Slope; Soil texture and depth; Soil water-retention capacity; Soil nutrient content; Altitude; Other.

Please list criteria in priority order here below

1. C2-11.....
2. C2-12.....
3. C2-13.....
4. C2-14.....

5. **C2-15**
6. **C2-16**
7. **C2-17**
8. **C2-18**

What is the minimum area of land (in mu) that you are willing to lease? **C2-19**

Land lease contracts are being signed for how many years?

Most common case: **C2-20** Years

Shortest contract period acceptable for a plantation enterprise / tree grower **C2-21** Years

Longest contract period that you have ever signed: **C2-22** Years

Mode of payment **C2-23**

Year per year payment: (Yes/No)

Payment in several steps including paying several years in advance at the time the contract is signed: (Yes/No)

If yes, how many years? **C2-24**

Do long-term contracts include a clause for revising land lease costs after **C2-25** Years ?

(Yes/No) Please indicate to what extent land lease costs have increased in recent years in the area where you are establishing your plantations:

	1999 <u>RMB/mu</u>	2002 <u>RMB/mu</u>	2004 <u>RMB/mu</u>
Land lease costs (Lower end of the range)	C2-26	C2-28	C2-30
Land lease costs (Higher end of the range)	C2-27	C2-29	C2-31

Risks

C3-1 What is your perception of the potential risks for your own plantation? :

.....

.....

.....

.....

C3-2 What is your perception of the potential risks for future competitiveness or sustainability of the plantation forestry business in Guangxi Province? :

.....

.....

.....

Costs Structure

Please indicate the most typical breakdown for operation costs (in RMB per mu) related to tree growing in your conditions

Silviculture costs for fast-growing plantations aiming at producing small diameter logs

Species, seed origin or clone: C41-

1.....

Logging at age : ... C41-2... years

Tree spacing: C41-3.....x..... meters

	<u>Year 1</u> RMB per mu	<u>Year 2</u> RMB per mu	<u>Year 3</u> RMB per mu	<u>Years 4 to 6</u> RMB per mu
Survey & Design	C41-4.....			
Land clearing	C41-5.....			
Burning	C41-6.....			
Seedling cost	C41-7.....			
Seedling transport	C41-8.....			
Ploughing (by machine)	C41-9.....			
Digging holes (by machine)	C41-10.....			
Digging holes (by hand)	C41-11.....			
Putting fertilizer into planting holes (by hand)	C41-12.....			
Mix fertilizer and soil and refilling holes	C41-13.....			
Planting	C41-14.....			
Open strips by hand	C41-15.....	C41-33.....	C41-51.....	C41-69.....
Replanting	C41-16.....	C41-34.....	C41-52.....	C41-70.....
Carrying fertilizer to planting site	C41-17.....	C41-35.....	C41-53.....	C41-71.....
Fertilizer costs	C41-18.....	C41-36.....	C41-54.....	C41-72.....
Fertilizer cost	C41-19.....	C41-37.....	C41-55.....	C41-73.....
Weeding / Tending	C41-20.....	C41-38.....	C41-56.....	C41-74.....
Labor costs for fertilizer distribution after planting	C41-21.....	C41-39.....	C41-57.....	C41-75.....
Guarding	C41-22.....	C41-40.....	C41-58.....	C41-76.....
Pest control (cost of chemicals for pest control)	C41-23.....	C41-41.....	C41-59.....	C41-77.....
Pest control (labor costs)	C41-24.....	C41-42.....	C41-60.....	C41-78.....
Forest road	C41-25.....	C41-43.....	C41-61.....	C41-79.....
Tool costs	C41-26.....	C41-44.....	C41-62.....	C41-80.....
Temporary construction costs	C41-27.....	C41-45.....	C41-63.....	C41-81.....
Management / Overheads	C41-28.....	C41-46.....	C41-64.....	C41-82.....
Extension / training costs	C41-29.....	C41-47.....	C41-65.....	C41-83.....
Supervision	C41-30.....	C41-48.....	C41-66.....	C41-84.....
Other costs before harvest	C41-31.....	C41-49.....	C41-67.....	C41-85.....
Contingency	C41-32.....	C41-50.....	C41-68.....	C41-86.....

Logging costs

	RMB per m3
Harvest design	C41-87.....
Felling tree	C41-88.....
Cutting into pieces at standard length	C41-89.....
Debarking	C41-90.....
Transport to road side	C41-91.....
Loading on truck	C41-91b.....
Road upgrading / repair	C41-92.....
Other costs	C41-93.....
Management / Overheads	C41-94.....

Silviculture costs for plantations aiming at producing medium to large diameter logs

Species, seed origin or clone: ... C42-1.....

Initial Tree spacing: C42-2x..... meters

First thinning at age : C42-3.....years Number of trees per mu left after first thinning: C42-4...

Second thinning at age : C42-5.....years Number of trees per mu left after second thinning: C42-6...

Final cut at age : C42-7.....years

	<u>Year 1</u>	<u>Year 2</u>	<u>Year 3</u>	<u>RMB / mu</u> <u>Year 4</u>	<u>Year 5 to end rotation</u>
Survey & Design	C42-8.....				
Land clearing	C42-9.....				
Burning	C42-10...				
Seedling cost	C42-11...				
Seedling transport	C42-12...				
Ploughing (by machine)	C42-13...				
Digging holes (by machine)	C42-14...				
Digging holes (by hand)	C41-15...				
Fertilizer into planting holes (by hand)	C41-16...				
Mix fertilizer and soil and refilling holes	C41-17...				
Planting	C41-18...				
Open strips by hand	C42-19...	C42-37...	C42-62	C42-80	C42-98
Replanting	C42-20...	C42-38...	C42-63...	C42-81...	C42-99
Carrying fertilizer to planting site	C42-21.....	C42-39...	C42-64...	C42-82...	C42-100
Fertilizer costs	C42-22...	C42-40...	C42-65...	C42-83...	C42-101
Fertilizer cost	C42-23...	C42-41...	C42-66...	C42-84...	C42-102

Weeding / Tending	C42-24...	C42-42...	C42-67...	C42-85...	C42-103
Labor fertilizer distribution after planting	C42-25...	C42-43	C42-68...	C42-86...	C42-104
Guarding	C42-26...	C42-44...	C42-69...	C42-87...	C42-105
Pest control (cost of chemicals)	C42-27...	C42-45...	C42-70...	C42-88...	C42-106
Pest control (labor costs)	C42-28...	C42-46...	C42-71...	C42-89...	C42-107
Forest road	C42-29...	C42-47...	C42-72...	C42-90...	C42-108
Tool costs	C42-30...	C42-48...	C42-73...	C42-91...	C42-109
Temporary construction costs	C42-31...	C42-49...	C42-74...	C42-92...	C42-110
Management / Overheads	C42-32...	C42-50...	C42-75...	C42-93...	C42-111
Extension / training costs	C42-33...	C42-51...	C42-76...	C42-94...	C42-112
Supervision	C42-34...	C42-52...	C42-77...	C42-95...	C42-113
Other costs before harvest	C42-35...	C42-53...	C42-78...	C42-96...	C42-114
Contingency	C42-36...	C42-54...	C42-79...	C42-97...	C42-115

<u>Thinning & Pruning costs</u>	<u>First thinning</u> RMB per m3	<u>Second thinning</u> RMB per m3
Marking trees	C42-116.....	C42-125.....
Pruning marked trees	C42-117.....	C42-126.....
Thinning marked trees	C42-118.....	C42-127.....
Cut felled trees at standard length	C42-119.....	C42-128.....
Debark	C42-120.....	C42-129.....
Transport to road side	C42-121.....	C42-130.....
Loading on truck	C42-122.....	C42-131.....
Other costs	C42-123.....	C42-132.....
Overheads / Administration	C42-124.....	C42-133.....

Costs of final cut

RMB per m3

Harvest design	C42-134.....
Felling tree	C42-135.....
Cutting into pieces at standard length	C42-136.....
Debarking	C42-137.....
Transport to road side	C42-138.....
Loading on truck	C42-138b.....
Road upgrading / repair	C42-139.....
Other costs	C42-140.....
Management / Overheads	C42-141.....

Transport Costs

Can large trucks (20 tonnes of load and above) access your plantation site? C42-142 (Yes/No)

If the above answer is NO, what is the maximum load capacity of trucks that can access your plantation site? **C42-143**.....

Taxes and Fees

Please list the Taxes and Fees related to the sale of wood

	<u>Type of tax or fee</u>	<u>Levy by (Agency's name)</u>	<u>Base of calculation m3, tonne or others</u>
1.	C5-1	C5-2	C5-3
2.	C5-4	C5-5	C5-6
3.	C5-7	C5-8	C5-9
4.	C5-10	C5-11	C5-12
5.	C5-13	C5-14	C5-15
6.	C5-16	C5-17	C5-18

Markets & Marketing

Is your Enterprise subject to a logging quota **C6-1** ? / If yes,

How is your yearly harvest quota calculated ? **C6-2**.....

Which agency calculates it? **C6-3**.....

At what stage do you sell your wood? **C6-4**

- ☐ Standing trees
- ☐ At stand side in plantation
- ☐ In Plantation Enterprise wood yard
- ☐ At mill gate

Sale of standing trees: Is sale standing volume used for calculating sale price of wood? **C6-5** (Yes/No)
or is the sale price based on the area to be harvested **C6-6** (Yes/No)?

When have you started using standing volume of wood to calculate sale price? **C6-7**:

How is the standing volume calculated? **C6-8**.....

Which agency calculates it?

C6-9.....

What most recent prices are you aware of for sale of standing trees? **C6-10** *RMB/m3* in **C6-11**
month/year

Sale of logs cut to a standard size: Are you grading the logs according to diameter classes? **C6-12**
(Yes/No)

C6-13 Is the standard log length imposed by transport constraints **(1)**, specified by the buyer **(2)** or due to other causes **(3)**?

Referring to the table (here below) please specify the pricing system which applies to your particular case. Please indicate the diameter class limits and the sale price for each class:

Please specify unit: m3 or tonne RMB per	RMB per	RMB per	RMB per
	Stand side	Wood yard	Mill gate
Fire wood	C6-14	C6-20	C6-26
Diameter below3 - 6... cm	C6-15	C6-21	C6-27
Diameter betweenbelow 8 cm	C6-16	C6-22	C6-28
Diameter between8... and ...12... cm	C6-17	C6-23	C6-29
Diameter between14... and ...18... cm	C6-18	C6-24	C6-30
Diameter above20... cm	C6-19	C6-25	C6-31

Please describe the pricing system that applies in your particular case if none of the above is relevant:

C6-32.....

Please indicate the volume or tonnage of wood logs that your Enterprise has sold to each of the following categories of end users and traders:

	<u>In 1999</u> Please specify m ³ or tonnes	<u>in 2004</u> Please specify m ³ or tonnes
Individual trader (chengbaoren)	C6-33	C6-51
Contractor	C6-34	C6-52
Transport / shipping Enterprise	C6-35	C6-53
Closest wood chips plant in Guangxi	C6-36	C6-54
Wood chips plant in neighboring Provinces	C6-37	C6-55
MDF & Fiber Board mills in Guangxi	C6-38	C6-56
MDF & Fiber Board mills in Guangdong	C6-39	C6-57
MDF & Fiber Board mills in other Provinces	C6-40	C6-58
Pulp & Paper mills in Guangxi	C6-41	C6-59
Pulp & Paper mills in Guangdong	C6-42	C6-60
Pulp & Paper mills in other Provinces	C6-43	C6-61
Sawmills and Veneer factories in Guangxi	C6-44	C6-62
Sawmills and Veneer factories in neighboring Provinces	C6-45	C6-63
Other wood processing mills	C6-46	C6-64

Chinese Export Companies	C6-47.....	C6-65.....
Overseas (Direct trade with foreign Companies)	C6-48.....	C6-66.....
Our own wood processing facilities	C6-49.....	C6-67.....
Others	C6-50.....	C6-68.....

Of the above-mentioned end-user which category has been your most regular costumers / buyers during the last 5 years? C6-69.....

Could you recommend measures that could be taken to raise efficiency and/or to reduce delivered wood costs in order to make your plantations wood more cost-competitive with regional and overseas suppliers?

C6-70.....

APPENDIX D: Lists of Wood-based Enterprises in Guangxi Province by Industry, 2003-2004

Table D-1: MDF, HDF, and Wet-Process Fiberboard Producers in Guangxi Province, 2003

Table D-2: Plywood Producers in Guangxi Province, 2003

Table D-3: Particleboard Producers in Guangxi Province, 2003

Table D-4: Blockboard Producers in Guangxi Province, 2003

Table D-5: Partial List of Pulp and Paper Companies in Guangxi Province, 2004

Table D-6: Partial List of Wood Chip Mills in Guangxi, by Location and Capacity, 2004

Table D-1: MDF, HDF, and Wet-Process Fiberboard Producers in Guangxi Province, 2003

Ref No.	Prefecture/ City	County	Company Name	Panel Type	Annual Capacity (m3/yr)	
					Installed	Under Construction
151	Baise	Baise	Fenglin International (Baise) Co. Ltd.	MDF		100,000
89	Beihai	Hepu	Qinlian Plantation Fiberboard Mill (MDF)	MDF	20,000	
90	Beihai	Hepu	Qinlian Plantation Fiberboard Mill (Hard Fiberboard)	Wet-process	10,000	
91	Beihai	Hepu	Beihai Guanhua Wood Panel Co. Ltd.	MDF		100,000
23	Chongzuo	Pingxiang	Pingxiang Daqingshan Tropical Forest MDF Mill	MDF		100,000
26	Chongzuo	Fusui	Fusui Nangfeng Wood Co. Ltd.	MDF		100,000
87	Guigang	Guigang	Guigang Hengtong MDF Mill	MDF	15,000	
144	Guilin	Yongfu	Guilin Tianhe Wood Co. Ltd.	MDF	30,000	
136	Guilin	Guilin	Guilin Wood Industry Co.	MDF	10,000	
45	Hezhou	Zhaoping	Zhaoping Hongjia Wood Co. Ltd.	MDF	30,000	
133	Laibin	Xiangzhou	Xianzhou Wood Panel Mill	MDF	10,000	
93	Liuzhou	Liuzhou	Liuzhou Sanyi Wood Panel Co. Ltd.	MDF	25,000	
119	Liuzhou	Luzhai	Luzhai Fiberboard Mill	Wet-process	5,000	
94	Liuzhou	Liuzhou	Liuzhou Wood Mill (Changtang) MDF	MDF		80,000
2	Nanning	Nanning	Fenglin International (Nanning) Co. Ltd.	MDF	150,000	
1	Nanning	Nanning	Guangxi Gaofeng Panel Board Co. Ltd.	MDF	100,000	
3	Nanning	Nanning	Nanning Wood Mill	MDF	25,000	
5	Nanning	Nanning	Nanning Gaoren Recycled MDF Co. Ltd.	MDF (recycled)	10,000	
6	Nanning	Nanning	Yongning Songhui Packaging Mill	MDF (recycled)	10,000	
37	Wuzhou	Qenxi	Guangxi Sunway Forest Industry Group Co. Ltd. (Cenxi MDF)	MDF	150,000	
33	Wuzhou	Wuzhou	Guangxi Sunway Forest Industry Group Co. Ltd. (MDF)	MDF	100,000	
34	Wuzhou	Wuzhou	Guangxi Sunway Forest Industry Group Co. Ltd. (HDF)	HDF		300,000
56	Yulin	Luchuan	Guangxi Gaofeng Guanhua Wood Panel Co. Ltd.	MDF	80,000	
54	Yulin	Xingye	Yulin Changqing Wood Panel Co. Ltd.	MDF	30,000	
57	Yulin	Bobai	Guangxi Sunway Bobai Wood Panel Co. Ltd.	MDF		200,000
86	Yulin	Rongxian	Guangxi Gaofeng Rongzhou Wood Panel Co. Ltd.	MDF		150,000
				Total	810,000	1,130,000

Data Source: Guangxi Forestry Bureau (2003).

Table D-2: Plywood Producers in Guangxi Province, 2003

Ref. No.	Prefecture/ City	County	Company Name	Panel Type	Installed Capacity (m3/yr)
42	Hezhou	Hezhou	Hezhou Plywood Mill	Plywood (furniture grade)	30,000
67	Yulin	Rongxian	Rongxian Huanda Forest Products Processing	Plywood (furniture grade)	10,000
32	Chongzuo	Tiandeng	Tiandeng Plywood Mill	Plywood (furniture grade)	5,000
95	Liuzhou	Liuzhou	Liuzhou Wood Mill (plywood)	Plywood (furniture grade)	5,000
4	Nanning	Nanning	Yongning Hengtong Wood Co. Ltd.	Plywood (furniture grade)	5,000
78	Yulin	Rongxian	Rongxian Yilufa Furniture Factory	Plywood (furniture grade)	4,000
137	Guilin	Guilin	Guilin Kaise Wood Industry Co. Ltd. (Plywood)	Plywood (furniture grade)	3,000
46	Hezhou	Zhaoping	Zhaoping Wood Craft and Product Mill	Plywood (furniture grade)	3,000
47	Hezhou	Zhaoping	Zhaoping Hongda Plywood Mill	Plywood (furniture grade)	3,000
48	Hezhou	Zhaoping	Zhaoping Kanghua Plywood Mill	Plywood (furniture grade)	3,000
120	Liuzhou	Luzhai	Jitai Plywood Mill	Plywood (furniture grade)	3,000
61	Yulin	Rongxian	Rongxian Wanfa Furniture Co. Ltd.	Plywood (furniture grade)	3,000
62	Yulin	Rongxian	Rongxian Fuda Furniture Factory	Plywood (furniture grade)	3,000
63	Yulin	Rongxian	Rongxian Haofa Furniture Factory	Plywood (furniture grade)	3,000
64	Yulin	Rongxian	Rongxian Xinhua Furniture Factory	Plywood (furniture grade)	3,000
66	Yulin	Rongxian	Rongxian Chengji Furniture Factory	Plywood (furniture grade)	3,000
70	Yulin	Rongxian	Rongxian Yangmei Plywood Mill	Plywood (furniture grade)	3,000
75	Yulin	Rongxian	Rongxian Hengye Furniture Factory	Plywood (furniture grade)	3,000
76	Yulin	Rongxian	Rongxian Hongda Furniture Factory	Plywood (furniture grade)	3,000
77	Yulin	Rongxian	Rongxian Minxingda Plywood Mill	Plywood (furniture grade)	3,000
79	Yulin	Rongxian	Rongxian Liufeng Plywood Mill	Plywood (furniture grade)	3,000
80	Yulin	Rongxian	Rongxian Hongguang Furniture Factory	Plywood (furniture grade)	3,000
81	Yulin	Rongxian	Rongxian Huajia Wanban (Curved Panel) Mill	Plywood (furniture grade)	3,000
83	Yulin	Rongxian	Rongxian Yongfa Plywood Mill	Plywood (furniture grade)	3,000
84	Yulin	Rongxian	Rongxian Rongxing Plywood Mill	Plywood (furniture grade)	3,000
85	Yulin	Rongxian	Rongxian Wood Co. Furniture Factory	Plywood (furniture grade)	3,000

Ref. No.	Prefecture/ City	County	Company Name	Panel Type	Installed Capacity (m3/yr)
58	Yulin	Rongxian	Rongxian Linpong Plywood Mill	Plywood (furniture grade)	2,000
59	Yulin	Rongxian	Rongxian Rongxi Shangrong Plywood Mill	Plywood (furniture grade)	2,000
60	Yulin	Rongxian	Rongxian Fuchang Furniture Factory	Plywood (furniture grade)	2,000
65	Yulin	Rongxian	Rongxian Lijun Furniture Factory	Plywood (furniture grade)	2,000
68	Yulin	Rongxian	Rongxian Dali Plywood Mill	Plywood (furniture grade)	2,000
69	Yulin	Rongxian	Rongxian Jincheng Furniture Factory	Plywood (furniture grade)	2,000
71	Yulin	Rongxian	Rongxian Jintai Furniture Factory	Plywood (furniture grade)	2,000
72	Yulin	Rongxian	Rongxian Weishi Plywood Furniture Factory	Plywood (furniture grade)	2,000
73	Yulin	Rongxian	Rongxian Luojiang Ruihua Plywood Mill	Plywood (furniture grade)	2,000
74	Yulin	Rongxian	Rongxian Dongfang Furniture Factory	Plywood (furniture grade)	2,000
82	Yulin	Rongxian	Rongxian Lingtingxiang Furniture Factory	Plywood (furniture grade)	2,000
				Subtotal	141,000
96	Liuzhou	Liuzhou	Liuzhou Railway Guilong Bamboo Panel Co.	Plywood (concrete-forming)	20,000
138	Guilin	Guilin	Guilin Kaise Wood Industry Co.	Plywood (concrete-forming)	10,000
31	Chongzuo	Daxin	Daxin Moulding Panel Mill	Plywood (concrete-forming)	8,000
43	Hezhou	Hezhou	Hezhou Wood Panel Mill	Plywood (concrete-forming)	8,000
150	Guilin	Gongcheng	Gongcheng Wood Panel Mill	Plywood (concrete-forming)	6,000
11	Nanning	Nanning	Nanning Gaoshen Plywood Co. Ltd.	Plywood (concrete-forming)	6,000
12	Nanning	Nanning	Nanning Jishen Wood Co. Ltd.	Plywood (concrete-forming)	6,000
13	Nanning	Nanning	Nanning Qipo Plantation Hengtong Wood Co. Ltd.	Plywood (concrete-forming)	6,000
24	Chongzuo	Pingxiang	Pingxiang Zhonglin Plywood Mill	Plywood (concrete-forming)	5,000
30	Chongzuo	Ningming	Ningming Yangsong Plywood Co. Ltd.	Plywood (concrete-forming)	5,000
139	Guilin	Guilin	Guilin Huashen Wood Panel Mill	Plywood (concrete-forming)	5,000
147	Guilin	Yongfu	Guilin Tianhe Wood Co. Ltd (Construction Panel)	Plywood (concrete-forming)	5,000
148	Guilin	Longsheng	Longsheng Fulong Plywood Co. Ltd.	Plywood (concrete-forming)	5,000
149	Guilin	Lingchuan	Guilin Lingchuan Linfeng Construction Panel Mill	Plywood (concrete-forming)	5,000
154	Hechi	Yizhou	Yizhou Desheng Wood Industry Co. Ltd.	Plywood (concrete-forming)	5,000

Ref. No.	Prefecture/City	County	Company Name	Panel Type	Installed Capacity (m3/yr)
50	Hezhou	Zhaoping	Zhaoping Fenghua Panel Co. Ltd.	Plywood (concrete-forming)	5,000
51	Hezhou	Zhaoping	Zhaoping Guijiang Panel Co. Ltd.	Plywood (concrete-forming)	5,000
99	Liuzhou	Liuzhou	Liuzhou Hi-Tech Zone Ruize Wood Industry	Plywood (concrete-forming)	5,000
100	Liuzhou	Liuzhou	Liuzhou Gumei Plywood Mill	Plywood (concrete-forming)	5,000
101	Liuzhou	Liuzhou	Liuzhou Bichao Wood Industry Processing Mill	Plywood (concrete-forming)	5,000
102	Liuzhou	Liuzhou	Liuzhou Wanglin Plywood Mill	Plywood (concrete-forming)	5,000
128	Liuzhou	Rong'an	Rongan Xishan Plantation Bamboo Fiberboard	Plywood (concrete-forming)	5,000
38	Wuzhou	Tengxian	Tengxian Taiping Plywood Mill	Plywood (concrete-forming)	5,000
39	Wuzhou	Tengxian	Tengxian Taiping Moulding Panel Mill	Plywood (concrete-forming)	5,000
29	Chongzuo	Ningming	Daiyangshan Plantation Wood Mill	Plywood (concrete-forming)	4,000
49	Hezhou	Zhaoping	Zhaoping Songlin Moulding Panel Co. Ltd.	Plywood (concrete-forming)	4,000
52	Hezhou	Zhaoping	Zhaoping Yinjiang Wood and Bamboo Products	Plywood (concrete-forming)	4,000
121	Liuzhou	Luzhai	Huangmian Forest Farm Wood Panel Mill	Plywood (concrete-forming)	4,000
10	Nanning	Nanning	Nanning Dingrong Plywood Co. Ltd.	Plywood (concrete-forming)	4,000
36	Wuzhou	Wuzhou	Wuzhou Danglin Wood Products Mill	Plywood (concrete-forming)	4,000
				Subtotal	174,000
				Total	315,000

Data Source: Guangxi Forestry Bureau (2003)

Table D-3: Particleboard Producers in Guangxi Province, 2003

Ref No.	Prefecture/City	County	Company Name	Panel Type (Type of Fiber)	Installed Capacity (m3/yr)
35	Wuzhou	Wuzhou	Guangxi Sunway Forest Industry Group Co. Ltd.	Particleboard (wood)	50,000
122	Liuzhou	Rongshui	Rongshui OSB Mill	Particleboard (wood)	30,000
41	Hezhou	Hezhou	Hezhou Particleboard Mill	Particleboard (wood)	18,000
55	Yulin	Xingye	Yulin Particleboard Mill	Particleboard (wood)	18,000
134	Laibin	Xiangzhou	Xianzhou Xianliuzhong Paperboard Co. Ltd.	Particleboard (wood)	15,000
97	Liuzhou	Liuzhou	Liuzhou Sanmengjiang Forest Farm OSB Mill	Particleboard (wood)	15,000
27	Chongzuo	Ningming	Guangxi Ningxin Wood Co. Ltd.	Particleboard (wood)	10,000
				Subtotal	156,000
88	Guigang	Guigang	Guigang Ganhua Panel Industry Co. Ltd.	Particleboard (bagasse)	30,000
132	Laibin	Laibin	Laibin Qianjiang Sugar Mill Group Co. Ltd.	Particleboard (bagasse)	25,000
25	Chongzuo	Chongzuo	Chongzuo Zhuojiang Paper Co. Ltd.	Particleboard (bagasse)	20,000
28	Chongzuo	Ningming	Ningming Sugar Mill Bagasse Board Factory	Particleboard (bagasse)	15,000
135	Laibin	Xincheng	Qicheng Fiberboard Mill	Particleboard (bagasse)	15,000
98	Liuzhou	Liuzhou	Liuzhou Liuxing Sugar Mill Board Factory	Particleboard (bagasse)	15,000
7	Nanning	Nanning	Yongning (Lingli) Bagasse Panel Board Co. Ltd.	Particleboard (bagasse)	15,000
8	Nanning	Nanning	Yongning Liangqing Sunshine (Yongguang) Bagasse Particleboard Co. Ltd.	Particleboard (bagasse)	15,000
18	Nanning	Hengxian	Hengxian Xiexu Sugar Mill Fiberboard Factory	Particleboard (bagasse)	15,000
21	Nanning	Binyang	Binyang Daqiao Yongkai Sugar Daqiao Branch	Particleboard (bagasse)	15,000
19	Nanning	Hengxian	Hengxian Liangqi Sugar Mill Fiberboard Factory	Particleboard (bagasse)	12,000
22	Nanning	Binyang	Binyang Daqiao Sugar Mill Bagasse Board Factory	Particleboard (bagasse)	12,000
9	Nanning	Nanning	Wuming Overseas Chinese Farm OSB Mill	Particleboard (bagasse)	10,000
				Subtotal	214,000
				Total	370,000

Table D-4: Blockboard Producers in Guangxi Province, 2003

No.	Prefecture/ City	County	Company Name	Panel Type	Installed Capacity (m3/yr)
152	Baise	Tianlin	Tianlin Huasha Wood Industry Co. Ltd.	Blockboard	3,000
153	Baise	Hechi	Hechi Wenming Decoration Material Factory	Blockboard	2,000
92	Beihai	Beihai	Beihai Jieshun Wood Industry Co. Ltd.	Blockboard	3,000
140	Guilin	Guilin	Guilin Diecai Fengfang Wood and Bamboo Processing	Blockboard	3,000
141	Guilin	Guilin	Guilin Diecai Huyue Plywood Processing Mill	Blockboard	3,000
142	Guilin	Guilin	Guilin Yanshang Liangfeng Sanshen Board Mill	Blockboard	3,000
143	Guilin	Guilin	Guilin Jiahua Plywood Mill	Blockboard	3,000
145	Guilin	Yongfu	Yongfu Yonghong Plywood Product Factory	Blockboard	3,000
146	Guilin	Yongfu	Yongfu Baishoudong Wood Craft Mill	Blockboard	3,000
155	Hechi	Donglan	Donglan Wood Panel Mill	Blockboard	3,000
156	Hechi	Tian'e	Tian'e Minority Bamboo and Wood Product Co. Ltd.	Blockboard	2,000
44	Hezhou	Hezhou	Hezhou Babu Shenyuan Blockboard	Blockboard	3,000
53	Hezhou	Zhaoping	Zhaoping Rongxin Panel Co. Ltd.	Blockboard	3,000
110	Liuzhou	Liuzhou	Liuzhou Nanrong Furniture Manufacturing Corp. Ltd.	Blockboard	6,000
107	Liuzhou	Liuzhou	Liuzhou Beihe Wood Chip Panel Mill	Blockboard	5,000
113	Liuzhou	Liuzhou	Liuzhou Rongfa Plywood Mill	Blockboard	5,000
125	Liuzhou	Rongshui	Rongshui Fengsha Wood Industry Co. Ltd.	Blockboard	2,000
103	Liuzhou	Liuzhou	Liuzhou Suburb Jiaqing Wood Industry	Blockboard	3,000
104	Liuzhou	Liuzhou	Liuzhou Siling Mine Cement Equipment Factory	Blockboard	3,000
105	Liuzhou	Liuzhou	Liuzhou Wood Mill (Blockboard)	Blockboard	3,000
106	Liuzhou	Liuzhou	Liuzhou Changqing Wood Industry	Blockboard	3,000
108	Liuzhou	Liuzhou	Liuzhou Xinqiangren Wood Panel Mill	Blockboard	3,000
109	Liuzhou	Liuzhou	Liuzhou Yongshan Plywood Processing Mill	Blockboard	3,000
111	Liuzhou	Liuzhou	Liuzhou Yongjia Wood Product Mill	Blockboard	3,000
112	Liuzhou	Liuzhou	Liuzhou Furong Wood Processing Mill	Blockboard	3,000
114	Liuzhou	Liuzhou	Liuzhou Fusheng Wood Panel Mill	Blockboard	3,000
115	Liuzhou	Liuzhou	Liuzhou Fulian Plywood Mill	Blockboard	3,000

No.	Prefecture/ City	County	Company Name	Panel Type	Installed Capacity (m3/yr)
116	Liuzhou	Liuzhou	Liuzhou Shengwang Wood Panel Mill	Blockboard	3,000
117	Liuzhou	Liuzhou	Liuzhou Guizhang Wood Panel Processing Mill	Blockboard	3,000
118	Liuzhou	Liuzhou	Liuzhou Jinxiang Plywood Mill	Blockboard	3,000
123	Liuzhou	Rongshui	Rongshui Kanghong Blockboard	Blockboard	3,000
124	Liuzhou	Rongshui	Rongshui Linxian Wood Panel Mill	Blockboard	3,000
126	Liuzhou	Rongshui	Rongshui Danjiang Wood Products	Blockboard	3,000
127	Liuzhou	Rongshui	Rongshui Jifu Wood Industry Co. Ltd.	Blockboard	3,000
129	Liuzhou	Rong'an	Rongan Welfare Factory	Blockboard	3,000
130	Liuzhou	Rong'an	Rongan Chengdong Xinwang Wood and Bamboo Processing Mill	Blockboard	3,000
131	Liuzhou	Rong'an	Rongan Changan Plywood Mill	Blockboard	3,000
14	Nanning	Nanning	Nanning Ruixin Wood Products Co. Ltd.	Blockboard	3,000
15	Nanning	Nanning	Nanning Meisan Wood Products Mill	Blockboard	3,000
16	Nanning	Nanning	Nanning Lufeng Integrated Development Co.	Blockboard	3,000
17	Nanning	Nanning	Nanning Qisheng Wood Crafts Factory	Blockboard	3,000
20	Nanning	Hengxian	Hengxian Guanglin Wood Processing Mill	Blockboard	2,000
40	Wuzhou	Changwu	Changwu Shantou Guidong Wood Industry Blockboard	Blockboard	3,000
				Total	132,000

Data Source: Guangxi Forestry Bureau, 2003

Table D-5: Partial List of Pulp and Paper Companies in Guangxi Province, 2004

No.	Company Name	Type of Enterprise	Location		Start Date	Major Grades	Installed Capacity (Adyr)		No. of Employees
			County	Prefecture			Paper & Board	Pulp	
1	Guangxi Heda Pulp & Paper Co. (Houda)	SOE	Hezhou	Hezhou	1996	BSKP, BHKP			1001-3000
2	Guangxi Liujian Paper-making Mill	SOE	Liuzhou	Liuzhou	1975	Printing and writing paper			1001-3000
3	Guangxi Nanning Phoenix Paper	SOE	Nanning	Nanning	1996	BSKP			501-1000
4	Guangxi Forestry Lipu Paper	Collectively Owned	Lipu	Liuzhou	1970	Linerboard			501-1000
5	Guangxi National Forestry Co. Ltd.	Collectively Owned	Luzhai	Liuzhou	1995	Linerboard			501-1000
6	Zhaoping Paper	SOE	Zhaoping	Hezhou	1968	Linerboard and packaging paper			501-1000
7	Guangxi Bao Jie Paper Industry Investment Share Co. Ltd.	Publically Owned	Guigang	Guigang	2001	Tissue			501-1000
8	Tianyang First Paper Mill	SOE	Tianyang		1958	Printing and writing paper			301-500
9	Liuzhou Paper	SOE	Liuzhou	Liuzhou	1958	Tissue			301-500
10	Hengxian Liancheng Paper	Collectively Owned	Hengxian	Nanning	1985	Printing and writing paper			101-300
11	Nanning Maoqiao Paper	SOE	Nanning	Nanning	1969	Specialty paper			101-300
12	Guangxi Forestry Construction Co. Ltd.	SOE	Liuzhou	Liuzhou	1993	Linerboard			101-300
13	Nanning Packaging Paper	Collectively Owned	Nanning	Nanning	1964	Linerboard			101-300
14	Wuzhou Zhongbo Packaging Co. Ltd.	Collectively Owned	Wuzhou	Wuzhou	1964	Linerboard			101-300
15	Yulin Packaging Paper	Collectively Owned	Yulin	Yulin	1993	Linerboard			101-300
16	Beiliu Xinyu Paper	Collectively Owned	Beiliu		1997	Linerboard			101-300
17	Guangxi Sanjiang Paper	Collectively Owned	Sanjiang		2000	Linerboard and other paper& board			101-300
18	Nanning Xinyang Paper	SOE	Nanning	Nanning	1958	Linerboard and Tissue			101-300
19	Nanning Yinxiang Paper	JV	Nanning	Nanning	1994	Medium			101-300
20	Haizhou Huabao Paper Molding	Collectively Owned	Huning		2000	Paper related products			101-300
21	Tianyang Huanrui	Privately Owned	Tianyang		2000	Paper related products			101-300
22	Binyang Hengan Tissue Co. Ltd.	Privately Owned	Binyang		1995	Tissue			101-300
23	Liuzhou Gutingshan Paper	Collectively Owned	Luzhai	Liuzhou	1995	Boxboard			51-100
24	Guilin Packaging	Collectively Owned	Guilin	Guilin	1966	Linerboard			51-100
25	Jinye Gongmao Co. Ltd.	SOE	Wuming		2001	Linerboard			51-100

No.	Company Name	Type of Enterprise	Location		Start Date	Major Grades	Installed Capacity (Adyr)		No. of Employees
			County	Prefecture			Paper & Board	Pulp	
26	Xingan Commercial Packaging	SOE	Xingan		1992	Linerboard			51-100
27	Guangxi Railway Service Co. Ltd.	Collectively Owned	Liuzhou	Liuzhou	1999	Paper related products			51-100
28	Shilong Sugar Co. Ltd.	Collectively Owned	Xiangzhou		1998	Paper related products			51-100
29	Yulin Dongming Paper	Collectively Owned	Yulin	Yulin	1993	Printing and writing paper			51-100
30	Liuzhou Liuchen Paper	Collectively Owned	Liuchen	Liuzhou	1988	Tissue			51-100
31	Liujian Coated Paper	Collectively Owned	Liuzhou	Liuzhou	1958	Coated paper			31-50
32	Xingan Gaoshang Paper	Privately Owned	Xingan		2001	Converted paper products			31-50
33	Tiandong Zhicai Canju	Collectively Owned	Tiandong		1998	Paper related products			31-50
34	Beiliu Liuqian Paper	Collectively Owned	Beiliu		1990	Specialty paper			31-50
35	Quanzhou Wansheng Paper	Privately Owned	Quangzhou		1977	Industrial paper			1-30
36	Quanzhou Beimen Paper	Collectively Owned	Quanzhou		1995	Linerboard and other board			1-30
37	Mashan Shuangfei Paper	Collectively Owned	Mashan		1998	Paper related products			1-30
38	Yongfu Jiafu Paper Co. Ltd.	JV	Yongfu	Guilin	1992	Paper tube			1-30
39	Bobai Forestry and Paper Co. Ltd.	Collectively Owned	Bobai	Yulin	1996	Printing and writing paper			1-30
40	Yulin Wangyao Paper	Privately Owned	Yulin	Yulin	1996	Printing and writing paper			1-30
41	Nanning Sugar Limited		Nanning	Nanning	1997	Printing and writing paper and Tissue			1-30
42	Guilin Duxiu Paper	Publically Owned	Guilin	Guilin	1998	Tissue			1-30
43	Guangxi Delibao Paper	Publically Owned	Wuming		1993	Tissue			1-30
44	Liuzhou Xinye Pregnant Materials Co. Ltd.	Privately Owned	Luzhai	Liuzhou	1999	Tissue and Packaging Paper			1-30
45	Guangxi Laibin Paper		Laibin	Laibin	1994	Bleached Bagasse Pulp and Tissue			N/A
46	Guangxi Beihai Sheen Paper	Privately Owned	Beihai	Beihai	1997	Linerboard			N/A
47	Jinxiu Pulp	SOE	Jinxiu		1991	Mechanical pulp and Boxboard			N/A
48	Guangxi Guitang Lihua		Guigang	Guigang		Printing and writing paper			N/A
49	Guangxi Nanpu Paper		Huning			Printing and writing paper			N/A
50	Guangxi Forestry Paper	SOE	Luzhai	Liuzhou	1971	Printing and writing paper			N/A
51	Tianyang Paper	SOE	Tianyang			Printing and writing paper			N/A
52	Yizhou Jiangtou Paper	Privately Owned	Yizhou		1989	Printing and writing paper			N/A
53	Guangxi Huajin Paper Group	Privately Owned	Nanning	Nanning		Printing and writing paper			N/A

Table D-6: Partial List of Wood Chip Mills in Guangxi, by Location and Capacity, 2004

Ref No.	Company Name	Prefecture	Region	Year Est'd	2004 Capacity (BDMT/yr)	2004 Production (BDMT)
1	Tian Yang County Yuan Hang Wood Industry Development Co. Ltd.	Baishe	South East	2004	2,000	2,100
35	Hepu County Lumber Co.	Beihai	South East	1954	8,000	6,000
36	Beihai Prefecture Tieshangang Wood Chip Mill	Beihai	South East	1996	3,000	6,000
14	Guigang Prefecture Chang Sheng Wood Industry Co. Ltd.	Guigang	South East	2004	6,000	6,000
15	Guigang Prefecture Gangnan District Haixiong Wood Chip Co. Ltd.	Guigang	South East	2004	4,000	4,000
2	Guiping City Jingtian Forest Farm Wood Chip Mill	Guigang	South East	2004	3,000	900
29	Hezhou Prefecture Shenxing Wood Industry Co. Ltd.	Hezhou	South East	2003	20,000	16,000
30	Hezhou Prefecture Shenli Da Lumber Mill	Hezhou	South East	2003	15,000	8,550
6	Wuzhou Prefecture Xiangmao Wood Processing Co. Ltd.	Wuzhou	South East	2004	10,000	7,000
7	Wuzhou Prefecture Guangfa Wood Processing Co. Ltd.	Wuzhou	South East	2003	9,000	9,000
8	Liuzhou Guting Rongsheng Wood Processing Mill	Wuzhou	South East	2000	2,160	2,160
34	Luchuan County Liang Tian Wood Chip Mill	Yulin	South East	2002	30,000	7,000
33	Bobai County Wendizhen Penghui District Wood Chip Mill	Yulin	South East	2003	30,000	6,000
13	Bobai Forest Farm Wood Chip Mill	Yulin	South East	1998	20,000	5,300
4	Guangxi State Owned Liu Wan Forest Farm Papermaking Mill (Wood Chip Mill)	Yulin	South East	1999	10,000	5,770
3	Guangxi State Owned Forest Farm Wood Chip Mill	Chongzuo	South	n.a.	50,000	11,081
5	Guangxi State Owned Pai Yang Shan Forest Farm Wood Chip Mill	Chongzuo	South	1996	10,000	7,630
11	Lehua Wood Industry Co. Ltd.	Chongzuo	South	1998	6,000	1,200
12	Ningming County Nanan Xiang Xingyuan Wood Chip Mill	Chongzuo	South	2003	5,000	1,200
10	Fushi County Fengchuang Shan Wood Chip Mill	Chongzuo	South	2001	4,000	4,000
27	Fangcheng District Lumber Co. Wood Chip Mill	Fangchanggang	South	2001	14,000	n.a.
28	Shangsi Huada Forest Wood Industry Co. Ltd.	Fangchanggang	South	1999	10,000	10,000
26	**** County Pine Resin Mill Labor Service Wood Processing	Fangchanggang	South	1997	7,000	7,000
20	Nanning Prefecture Guixing Lumber Co. Ltd.	Nanning	South	1996	20,000	20,000
24	Guangxi Tong Ning San Kai Wood Industry Co. Ltd.	Nanning	South	2001	10,000	10,000
23	Nanning Prefecture Guangfeng Wood Product Mill	Nanning	South	1998	10,000	3,500
25	Yongning Yangguang Panel Board Co. Ltd.	Nanning	South	2000	10,000	n.a.

Ref No.	Company Name	Prefecture	Region	Year Est'd	2004 Capacity (BDMT/yr)	2004 Production (BDMT)
21	Hengxianzhen Longshan Forest Farm Hongda Wood Chip Mill	Nanning	South	2000	4,500	4,500
22	Hengxian Shi Tang Forest Farm Wood Chip Mill	Nanning	South	2003	3,000	2,000
19	Pubei County Wood Chip Mill	Qinzhou	South	1996	60,000	51,333
18	Guangxi Lingshan County Jiangnan Wood Chip Mill	Qinzhou	South	2000	60,000	34,000
31	Yizhou City Longtang Wood Processing Mill	Hechi	North West	2003	3,600	600
32	Yizhou City Shenghong Wood Chip Mill	Hechi	North West	2004	2,000	2,500
17	*** County Lumber Co. Forest Industry Service Office Wood Processing Co.	Laibin	North	1995	1,500	600
9	Liuzhou Suburban Shatang Cheng Wood Processing Mill	Liuzhou	North	1997	6,000	6,000

APPENDIX E: Estimated 2004 Wood Demand by Industry for Each of Guangxi's 14 Prefectures

Table E-1: Estimated Wood Demand by Industry for Beihai Prefecture, 2004

Table E-2: Estimated Wood Demand by Industry for Guigang Prefecture, 2004

Table E-3: Estimated Wood Demand by Industry for Hezhou Prefecture, 2004

Table E-4: Estimated Wood Demand by Industry for Wuzhou Prefecture, 2004

Table E-5: Estimated Wood Demand by Industry for Yulin Prefecture, 2004

Table E-6: Estimated Wood Demand by Industry for Chongzuo Prefecture, 2004

Table E-7: Estimated Wood Demand by Industry for Fangchenggang Prefecture, 2004

Table E-8: Estimated Wood Demand by Industry for Nanning Prefecture, 2004

Table E-9: Estimated Wood Demand by Industry for Qinzhou Prefecture, 2004

Table E-10: Estimated Wood Demand by Industry for Guilin Prefecture, 2004

Table E-11: Estimated Wood Demand by Industry for Laibin Prefecture, 2004

Table E-12: Estimated Wood Demand by Industry for Liuzhou Prefecture, 2004

Table E-13: Estimated Wood Demand by Industry for Baise Prefecture, 2004

Table E-14: Estimated Wood Demand by Industry for Hechi Prefecture, 2004

Table E-1: Estimated Wood Demand by Industry for Beihai Prefecture, 2004

Wood Industry	Number of Mills	Annual Capacity	Roundwood Conversion Factor (m3 RWE per unit of product)	Estimated Roundwood Demand (m3 RWE/yr)	Estimated Fiber Demand by Wood Type									
					Residual Greenwood		Commercial Logs < 8cm		Commercial Logs ≥ 8cm		Commercial Wood Chips (RWE)		Mill Residues (RWE)	
					%	m3/yr	%	m3/yr	%	m3/yr	%	m3/yr	%	m3/yr
Sawnwood	200	100,000 m3/yr	1.50	150,000	0	0	0	0	100	150,000	0	0	0	0
MDF and HDF	2	120,000 m3/yr	1.33	159,600	50	79,800	18	28,728	7	11,172	10	15,960	15	23,940
Plywood -- thin panels	0	0 m3/yr	1.53	0	0	0	15	0	85	0	0	0	0	0
Plywood -- concrete forming	0	0 m3/yr	1.53	0	0	0	15	0	85	0	0	0	0	0
Particleboard (wood-based)	0	0 m3/yr	1.42	0	40	0	0	0	5	0	5	0	50	0
Blockboard	1	3,000 m3/yr	1.42	4,260	25	1,065	0	0	5	213	0	0	70	2,982
Wet process fiberboard	1	10,000 m3/yr	1.42	14,200	50	7,100	0	0	0	0	0	0	50	7,100
Veneer	30	30,000 m3/yr	1.55	46,500	0	0	15	6,975	85	0	0	0	0	0
Bleached hardwood kraft pulp	0	0 Adt/yr	4.15	0	8	0	55	0	17	0	15	0	5	0
Bleached softwood kraft pulp	0	0 Adt/yr	4.70	0	8	0	55	0	17	0	15	0	5	0
Unbleached kraft pulp	0	0 Adt/yr	4.70	0	8	0	55	0	17	0	15	0	5	0
Chemical thermo-mechanical pulp	0	0 Adt/yr	2.50	0	8	0	55	0	17	0	15	0	5	0
Thermo-mechanical pulp	0	0 Adt/yr	2.50	0	8	0	55	0	17	0	15	0	5	0
Wood chips	10	50,000 BDMT/yr	1.84	92,000	55	50,600	30	27,600	0	0	0	0	15	0
Total	244			466,560		138,565		63,303		161,385		15,960		34,022

Note: MDF capacity figure includes one mill which was under construction in 2003: Beihai Guanhua Wood Panel Co. Ltd. (100,000 m3/yr).

Table E-2: Estimated Wood Demand by Industry for Guigang Prefecture, 2004

Wood Industry	Number of Mills	Annual Capacity	Roundwood Conversion Factor (m3 RWE per unit of product)	Estimated Roundwood Demand (m3 RWE/yr)	Estimated Fiber Demand by Wood Type									
					Residual Greenwood		Commercial Logs < 8cm		Commercial Logs ≥ 8cm		Commercial Wood Chips (RWE)		Mill Residues (RWE)	
					%	m3/yr	%	m3/yr	%	m3/yr	%	m3/yr	%	m3/yr
Sawnwood	396	30,000 m3/yr	1.50	45,000	0	0	0	0	100	45,000	0	0	0	0
MDF and HDF	1	15,000 m3/yr	1.33	19,950	50	9,975	18	3,591	7	1,397	10	1,995	15	2,993
Plywood -- thin panels	0	0 m3/yr	1.53	0	0	0	15	0	85	0	0	0	0	0
Plywood -- concrete forming	0	0 m3/yr	1.53	0	0	0	15	0	85	0	0	0	0	0
Particleboard (wood-based)	0	0 m3/yr	1.42	0	40	0	0	0	5	0	5	0	50	0
Blockboard	0	0 m3/yr	1.42	0	25	0	0	0	5	0	0	0	70	0
Wet process fiberboard	0	0 m3/yr	1.42	0	50	0	0	0	0	0	0	0	50	0
Veneer	n.a.	n.a. m3/yr	1.55	n.a.	0	0	15	n.a.	85	0	0	n.a.	0	n.a.
Bleached hardwood kraft pulp	0	0 Adt/yr	4.15	0	8	0	55	0	17	0	15	0	5	0
Bleached softwood kraft pulp	0	0 Adt/yr	4.70	0	8	0	55	0	17	0	15	0	5	0
Unbleached kraft pulp	0	0 Adt/yr	4.70	0	8	0	55	0	17	0	15	0	5	0
Chemical thermo-mechanical pulp	0	0 Adt/yr	2.50	0	8	0	55	0	17	0	15	0	5	0
Thermo-mechanical pulp	0	0 Adt/yr	2.50	0	8	0	55	0	17	0	15	0	5	0
Wood chips	3	170,000 BDMT/yr	1.84	312,800	55	172,040	30	93,840	0	0	0	0	15	0
Total	400			377,750		182,015		97,431		46,397		1,995		2,993

Table E-3: Estimated Wood Demand by Industry for Hezhou Prefecture, 2004

Wood Industry	Number of Mills	Annual Capacity	Roundwood Conversion Factor (m3 RWE per unit of product)	Estimated Roundwood Demand (m3 RWE/yr)	Estimated Fiber Demand by Wood Type									
					Residual Greenwood		Commercial Logs < 8cm		Commercial Logs ≥ 8cm		Commercial Wood Chips (RWE)		Mill Residues (RWE)	
					%	m3/yr	%	m3/yr	%	m3/yr	%	m3/yr	%	m3/yr
Sawnwood	188	300,000 m3/yr	1.50	450,000	0	0	0	0	100	450,000	0	0	0	0
MDF and HDF	1	30,000 m3/yr	1.33	39,900	50	19,950	18	7,182	7	2,793	10	3,990	15	5,985
Plywood -- thin panels	4	39,000 m3/yr	1.53	59,670	0	0	15	8,951	85	50,720	0	0	0	0
Plywood -- concrete forming	5	26,000 m3/yr	1.53	39,780	0	0	15	5,967	85	33,813	0	0	0	0
Particleboard (wood-based)	1	18,000 m3/yr	1.42	25,560	40	10,224	0	0	5	1,278	5	1,278	50	12,780
Blockboard	2	6,000 m3/yr	1.42	8,520	25	2,130	0	0	5	426	0	0	70	5,964
Wet process fiberboard	0	0 m3/yr	1.42	0	50	0	0	0	0	0	0	0	50	0
Veneer	43	40,000 m3/yr	1.55	62,000	0	0	15	9,300	85	0	0	0	0	0
Bleached hardwood kraft pulp	1	35,000 Adt/yr	4.15	145,250	8	11,620	55	79,888	17	24,693	15	21,788	5	7,263
Bleached softwood kraft pulp	1	35,000 Adt/yr	4.70	164,500	8	13,160	55	90,475	17	27,965	15	24,675	5	8,225
Unbleached kraft pulp	0	0 Adt/yr	4.70	0	8	0	55	0	17	0	15	0	5	0
Chemical thermo-mechanical pulp	0	0 Adt/yr	2.50	0	8	0	55	0	17	0	15	0	5	0
Thermo-mechanical pulp	0	20,000 Adt/yr	2.50	50,000	8	4,000	55	27,500	17	8,500	15	7,500	5	2,500
Wood chips	32	60,000 BDMT/yr	1.84	110,400	55	60,720	30	33,120	0	0	0	0	15	0
Total	278			1,155,580		121,804		262,382		600,187		59,231		42,717

Note: Figures for BSKP and BHKP assume that Guangxi Heda Pulp & Paper Co. produces 50% of each grade.

Table E-4: Estimated Wood Demand by Industry for Wuzhou Prefecture, 2004

Wood Industry	Number of Mills	Annual Capacity	Roundwood Conversion Factor (m3 RWE per unit of product)	Estimated Roundwood Demand (m3 RWE/yr)	Estimated Fiber Demand by Wood Type									
					Residual Greenwood		Commercial Logs < 8cm		Commercial Logs ≥ 8cm		Commercial Wood Chips (RWE)		Mill Residues (RWE)	
					%	m3/yr	%	m3/yr	%	m3/yr	%	m3/yr	%	m3/yr
Sawnwood	97	50,000 m3/yr	1.50	75,000	0	0	0	0	100	75,000	0	0	0	0
MDF and HDF	3	550,000 m3/yr	1.33	731,500	50	365,750	18	131,670	7	51,205	10	73,150	15	109,725
Plywood -- thin panels	0	0 m3/yr	1.53	0	0	0	15	0	85	0	0	0	0	0
Plywood -- concrete forming	3	14,000 m3/yr	1.53	21,420	0	0	15	3,213	85	18,207	0	0	0	0
Particleboard (wood-based)	1	50,000 m3/yr	1.42	71,000	40	28,400	0	0	5	3,550	5	3,550	50	35,500
Blockboard	1	3,000 m3/yr	1.42	4,260	25	1,065	0	0	5	213	0	0	70	2,982
Wet process fiberboard	0	0 m3/yr	1.42	0	50	0	0	0	0	0	0	0	50	0
Veneer	32	12,000 m3/yr	1.55	18,600	0	0	15	2,790	85	0	0	0	0	0
Bleached hardwood kraft pulp	0	0 Adt/yr	4.15	0	8	0	55	0	17	0	15	0	5	0
Bleached softwood kraft pulp	0	0 Adt/yr	4.70	0	8	0	55	0	17	0	15	0	5	0
Unbleached kraft pulp	0	0 Adt/yr	4.70	0	8	0	55	0	17	0	15	0	5	0
Chemical thermo-mechanical pulp	0	0 Adt/yr	2.50	0	8	0	55	0	17	0	15	0	5	0
Thermo-mechanical pulp	0	0 Adt/yr	2.50	0	8	0	55	0	17	0	15	0	5	0
Wood chips	8	60,000 BDMT/yr	1.84	110,400	55	60,720	30	33,120	0	0	0	0	15	0
Total	145			1,032,180		455,935		170,793		148,175		76,700		148,207

Note: MDF and HDF capacity figure includes Guangxi Sunway Forest Industry Group Co. Ltd.'s HDF mill (300,000 m3/yr), which was under construction in 2003.

Table E-5: Estimated Wood Demand by Industry for Yulin Prefecture, 2004

Wood Industry	Number of Mills	Annual Capacity	Roundwood Conversion Factor (m3 RWE per unit of product)	Estimated Roundwood Demand (m3 RWE/yr)	Estimated Fiber Demand by Wood Type									
					Residual Greenwood		Commercial Logs < 8cm		Commercial Logs ≥ 8cm		Commercial Wood Chips (RWE)		Mill Residues (RWE)	
					%	m3/yr	%	m3/yr	%	m3/yr	%	m3/yr	%	m3/yr
Sawnwood	522	290,000 m3/yr	1.50	435,000	0	0	0	0	100	435,000	0	0	0	0
MDF and HDF	4	460,000 m3/yr	1.33	611,800	50	305,900	18	110,124	7	42,826	10	61,180	15	91,770
Plywood -- thin panels	28	81,000 m3/yr	1.53	123,930	0	0	15	18,590	85	105,341	0	0	0	0
Plywood -- concrete forming	0	0 m3/yr	1.53	0	0	0	15	0	85	0	0	0	0	0
Particleboard (wood-based)	1	18,000 m3/yr	1.42	25,560	40	10,224	0	0	5	1,278	5	1,278	50	12,780
Blockboard	0	0 m3/yr	1.42	0	25	0	0	0	5	0	0	0	70	0
Wet process fiberboard	0	0 m3/yr	1.42	0	50	0	0	0	0	0	0	0	50	0
Veneer	34	40,000 m3/yr	1.55	62,000	0	0	15	9,300	85	0	0	0	0	0
Bleached hardwood kraft pulp	0	0 Adt/yr	4.15	0	8	0	55	0	17	0	15	0	5	0
Bleached softwood kraft pulp	0	0 Adt/yr	4.70	0	8	0	55	0	17	0	15	0	5	0
Unbleached kraft pulp	1	20,000 Adt/yr	4.70	94,000	8	7,520	55	51,700	17	15,980	15	14,100	5	4,700
Chemical thermo-mechanical pulp	0	0 Adt/yr	2.50	0	8	0	55	0	17	0	15	0	5	0
Thermo-mechanical pulp	0	0 Adt/yr	2.50	0	8	0	55	0	17	0	15	0	5	0
Wood chips	25	110,000 BDMT/yr	1.84	202,400	55	111,320	30	60,720	0	0	0	0	15	0
Total	615			1,554,690		434,964		250,434		600,425		76,558		109,250

Note: MDF and HDF capacity figure includes two mills which was under construction in 2003: 1) Guangxi Sunway Bobai Wood Panel Co. Ltd (200,000 m3/yr) and 2) Guangxi Gaofeng Rongzhou Wood Panel Co. Ltd. (150,000 m3/yr).

Table E-6: Estimated Wood Demand by Industry for Chongzuo Prefecture, 2004

Wood Industry	Number of Mills	Annual Capacity	Roundwood Conversion Factor (m3 RWE per unit of product)	Estimated Roundwood Demand (m3 RWE/yr)	Estimated Fiber Demand by Wood Type									
					Residual Greenwood		Commercial Logs < 8cm		Commercial Logs ≥ 8cm		Commercial Wood Chips (RWE)		Mill Residues (RWE)	
					%	m3/yr	%	m3/yr	%	m3/yr	%	m3/yr	%	m3/yr
Sawnwood	7	24,000 m3/yr	1.50	36,000	0	0	0	0	100	36,000	0	0	0	0
MDF and HDF	2	200,000 m3/yr	1.33	266,000	50	133,000	18	47,880	7	18,620	10	26,600	15	39,900
Plywood -- thin panels	1	5,000 m3/yr	1.53	7,650	0	0	15	1,148	85	6,503	0	0	0	0
Plywood -- concrete forming	4	22,000 m3/yr	1.53	33,660	0	0	15	5,049	85	28,611	0	0	0	0
Particleboard (wood-based)	1	10,000 m3/yr	1.42	14,200	40	5,680	0	0	5	710	5	710	50	7,100
Blockboard	0	0 m3/yr	1.42	0	25	0	0	0	5	0	0	0	70	0
Wet process fiberboard	0	0 m3/yr	1.42	0	50	0	0	0	0	0	0	0	50	0
Veneer	0	0 m3/yr	1.55	0	0	0	15	0	85	0	0	0	0	0
Bleached hardwood kraft pulp	0	0 Adt/yr	4.15	0	8	0	55	0	17	0	15	0	5	0
Bleached softwood kraft pulp	0	0 Adt/yr	4.70	0	8	0	55	0	17	0	15	0	5	0
Unbleached kraft pulp	0	0 Adt/yr	4.70	0	8	0	55	0	17	0	15	0	5	0
Chemical thermo-mechanical pulp	0	0 Adt/yr	2.50	0	8	0	55	0	17	0	15	0	5	0
Thermo-mechanical pulp	0	0 Adt/yr	2.50	0	8	0	55	0	17	0	15	0	5	0
Wood chips	19	151,700 BDMT/yr	1.84	279,128	55	153,520	30	83,738	0	0	0	0	15	0
Total	34			636,638		292,200		137,815		90,444		27,310		47,000

Note: MDF and HDF capacity figure includes two mills which was under construction in 2003: 1) Pingxiang Daqingshan Tropical Forest MDF Mill (100,000 m3/yr) and 2) Fusui Nangfeng Wood Co. Ltd. (100,000 m3/yr).

Table E-7: Estimated Wood Demand by Industry for Fangchenggang Prefecture, 2004

Wood Industry	Number of Mills	Annual Capacity	Roundwood Conversion Factor (m3 RWE per unit of product)	Estimated Roundwood Demand (m3 RWE/yr)	Estimated Fiber Demand by Wood Type									
					Residual Greenwood		Commercial Logs < 8cm		Commercial Logs ≥ 8cm		Commercial Wood Chips (RWE)		Mill Residues (RWE)	
					%	m3/yr	%	m3/yr	%	m3/yr	%	m3/yr	%	m3/yr
Sawnwood	20	10,000 m3/yr	1.50	15,000	0	0	0	0	100	15,000	0	0	0	0
MDF and HDF	0	0 m3/yr	1.33	0	50	0	18	0	7	0	10	0	15	0
Plywood -- thin panels	0	0 m3/yr	1.53	0	0	0	15	0	85	0	0	0	0	0
Plywood -- concrete forming	0	0 m3/yr	1.53	0	0	0	15	0	85	0	0	0	0	0
Particleboard (wood-based)	0	0 m3/yr	1.42	0	40	0	0	0	5	0	5	0	50	0
Blockboard	0	0 m3/yr	1.42	0	25	0	0	0	5	0	0	0	70	0
Wet process fiberboard	0	0 m3/yr	1.42	0	50	0	0	0	0	0	0	0	50	0
Veneer	6	20,000 m3/yr	1.55	31,000	0	0	15	4,650	85	0	0	0	0	0
Bleached hardwood kraft pulp	0	0 Adt/yr	4.15	0	8	0	55	0	17	0	15	0	5	0
Bleached softwood kraft pulp	0	0 Adt/yr	4.70	0	8	0	55	0	17	0	15	0	5	0
Unbleached kraft pulp	0	0 Adt/yr	4.70	0	8	0	55	0	17	0	15	0	5	0
Chemical thermo-mechanical pulp	0	0 Adt/yr	2.50	0	8	0	55	0	17	0	15	0	5	0
Thermo-mechanical pulp	0	0 Adt/yr	2.50	0	8	0	55	0	17	0	15	0	5	0
Wood chips	4	100,000 BDMT/yr	1.84	184,000	55	101,200	30	55,200	0	0	0	0	15	0
Total	30			230,000		101,200		59,850		15,000		0		0

Table E-8: Estimated Wood Demand by Industry for Nanning Prefecture, 2004

Wood Industry	Number of Mills	Annual Capacity	Roundwood Conversion Factor (m3 RWE per unit of product)	Estimated Roundwood Demand (m3 RWE/yr)	Estimated Fiber Demand by Wood Type									
					Residual Greenwood		Commercial Logs < 8cm		Commercial Logs ≥ 8cm		Commercial Wood Chips (RWE)		Mill Residues (RWE)	
					%	m3/yr	%	m3/yr	%	m3/yr	%	m3/yr	%	m3/yr
Sawnwood	947	728,772 m3/yr	1.50	1,093,158	0	0	0	0	100	1,093,158	0	0	0	0
MDF and HDF	5	295,000 m3/yr	1.33	392,350	50	196,175	18	70,623	7	27,465	10	39,235	15	58,853
Plywood -- thin panels	1	5,000 m3/yr	1.53	7,650	0	0	15	1,148	85	6,503	0	0	0	0
Plywood -- concrete forming	4	22,000 m3/yr	1.53	33,660	0	0	15	5,049	85	28,611	0	0	0	0
Particleboard (wood-based)	0	0 m3/yr	1.42	0	40	0	0	0	5	0	5	0	50	0
Blockboard	5	14,000 m3/yr	1.42	19,880	25	4,970	0	0	5	994	0	0	70	13,916
Wet process fiberboard	0	0 m3/yr	1.42	0	50	0	0	0	0	0	0	0	50	0
Veneer	19	7,450 m3/yr	1.55	141,550	0	0	15	21,233	85	0	0	0	0	0
Bleached hardwood kraft pulp	0	0 Adt/yr	4.15	498,000	8	39,840	55	273,900	17	84,660	15	74,700	5	24,900
Bleached softwood kraft pulp	1	120,000 Adt/yr	4.70	564,000	8	45,120	55	310,200	17	95,880	15	84,600	5	28,200
Unbleached kraft pulp	0	0 Adt/yr	4.70	0	8	0	55	0	17	0	15	0	5	0
Chemical thermo-mechanical pulp	0	0 Adt/yr	2.50	0	8	0	55	0	17	0	15	0	5	0
Thermo-mechanical pulp	0	0 Adt/yr	2.50	0	8	0	55	0	17	0	15	0	5	0
Wood chips	56	285,125 BDMT/yr	1.84	524,630	55	288,547	30	157,389	0	0	0	0	15	0
Total	1,038			3,274,878		574,652		839,541		1,337,270		198,535		125,869

Note: MDF and HDF capacity figure includes two mills which produce recycled MDF: Nanning Gaoren (10,000 m3/yr) and Yongning Songhui Packaging Mill (10,000 m3/yr).

Table E-9: Estimated Wood Demand by Industry for Qinzhou Prefecture, 2004

Wood Industry	Number of Mills	Annual Capacity	Roundwood Conversion Factor (m3 RWE per unit of product)	Estimated Roundwood Demand (m3 RWE/yr)	Estimated Fiber Demand by Wood Type									
					Residual Greenwood		Commercial Logs < 8cm		Commercial Logs ≥ 8cm		Commercial Wood Chips (RWE)		Mill Residues (RWE)	
					%	m3/yr	%	m3/yr	%	m3/yr	%	m3/yr	%	m3/yr
Sawnwood	377	210,000 m3/yr	1.50	315,000	0	0	0	0	100	315,000	0	0	0	0
MDF and HDF	0	0 m3/yr	1.33	0	50	0	18	0	7	0	10	0	15	0
Plywood -- thin panels	0	0 m3/yr	1.53	0	0	0	15	0	85	0	0	0	0	0
Plywood -- concrete forming	0	0 m3/yr	1.53	0	0	0	15	0	85	0	0	0	0	0
Particleboard (wood-based)	0	0 m3/yr	1.42	0	40	0	0	0	5	0	5	0	50	0
Blockboard	0	0 m3/yr	1.42	0	25	0	0	0	5	0	0	0	70	0
Wet process fiberboard	0	0 m3/yr	1.42	0	50	0	0	0	0	0	0	0	50	0
Veneer	14	50,000 m3/yr	1.55	77,500	0	0	15	11,625	85	0	0	0	0	0
Bleached hardwood kraft pulp	0	0 Adt/yr	4.15	0	8	0	55	0	17	0	15	0	5	0
Bleached softwood kraft pulp	0	0 Adt/yr	4.70	0	8	0	55	0	17	0	15	0	5	0
Unbleached kraft pulp	0	0 Adt/yr	4.70	0	8	0	55	0	17	0	15	0	5	0
Chemical thermo-mechanical pulp	0	0 Adt/yr	2.50	0	8	0	55	0	17	0	15	0	5	0
Thermo-mechanical pulp	0	0 Adt/yr	2.50	0	8	0	55	0	17	0	15	0	5	0
Wood chips	11	67,400 BDMT/yr	1.84	124,016	55	68,209	30	37,205	0	0	0	0	15	0
Total	402			516,516		68,209		48,830		315,000		0		0

Table E-10: Estimated Wood Demand by Industry for Guilin Prefecture, 2004

Wood Industry	Number of Mills	Annual Capacity	Roundwood Conversion Factor (m3 RWE per unit of product)	Estimated Roundwood Demand (m3 RWE/yr)	Estimated Fiber Demand by Wood Type									
					Residual Greenwood		Commercial Logs < 8cm		Commercial Logs ≥ 8cm		Commercial Wood Chips (RWE)		Mill Residues (RWE)	
					%	m3/yr	%	m3/yr	%	m3/yr	%	m3/yr	%	m3/yr
Sawnwood	8	30,400 m3/yr	1.50	45,600	0	0	0	0	100	45,600	0	0	0	0
MDF and HDF	2	40,000 m3/yr	1.33	53,200	50	26,600	18	9,576	7	3,724	10	5,320	15	7,980
Plywood -- thin panels	1	3,000 m3/yr	1.53	4,590	0	0	15	689	85	3,902	0	0	0	0
Plywood -- concrete forming	6	38,000 m3/yr	1.53	58,140	0	0	15	8,721	85	49,419	0	0	0	0
Particleboard (wood-based)	0	0 m3/yr	1.42	0	40	0	0	0	5	0	5	0	50	0
Blockboard	6	18,000 m3/yr	1.42	25,560	25	6,390	0	0	5	1,278	0	0	70	17,892
Wet process fiberboard	0	0 m3/yr	1.42	0	50	0	0	0	0	0	0	0	50	0
Veneer	n.a.	n.a. m3/yr	1.55	n.a.	0	0	15	n.a.	85	0	0	n.a.	0	n.a.
Bleached hardwood kraft pulp	0	0 Adt/yr	4.15	0	8	0	55	0	17	0	15	0	5	0
Bleached softwood kraft pulp	0	0 Adt/yr	4.70	0	8	0	55	0	17	0	15	0	5	0
Unbleached kraft pulp	0	0 Adt/yr	4.70	0	8	0	55	0	17	0	15	0	5	0
Chemical thermo-mechanical pulp	0	0 Adt/yr	2.50	0	8	0	55	0	17	0	15	0	5	0
Thermo-mechanical pulp	0	0 Adt/yr	2.50	0	8	0	55	0	17	0	15	0	5	0
Wood chips	9	3,460 BDMT/yr	1.84	6,366	55	3,501	30	1,910	0	0	0	0	15	0
Total	32			193,456		36,491		20,895		103,923		5,320		25,872

Table E-11: Estimated Wood Demand by Industry for Laibin Prefecture, 2004

Wood Industry	Number of Mills	Annual Capacity	Roundwood Conversion Factor (m3 RWE per unit of product)	Estimated Roundwood Demand (m3 RWE/yr)	Estimated Fiber Demand by Wood Type									
					Residual Greenwood		Commercial Logs < 8cm		Commercial Logs ≥ 8cm		Commercial Wood Chips (RWE)		Mill Residues (RWE)	
					%	m3/yr	%	m3/yr	%	m3/yr	%	m3/yr	%	m3/yr
Sawnwood	30	152,022 m3/yr	1.50	228,033	0	0	0	0	100	228,033	0	0	0	0
MDF and HDF	1	10,000 m3/yr	1.33	13,300	50	6,650	18	2,394	7	931	10	1,330	15	1,995
Plywood -- thin panels	0	0 m3/yr	1.53	0	0	0	15	0	85	0	0	0	0	0
Plywood -- concrete forming	0	0 m3/yr	1.53	0	0	0	15	0	85	0	0	0	0	0
Particleboard (wood-based)	1	15,000 m3/yr	1.42	21,300	40	8,520	0	0	5	1,065	5	1,065	50	10,650
Blockboard	0	0 m3/yr	1.42	0	25	0	0	0	5	0	0	0	70	0
Wet process fiberboard	0	0 m3/yr	1.42	0	50	0	0	0	0	0	0	0	50	0
Veneer	0	0 m3/yr	1.55	0	0	0	15	0	85	0	0	0	0	0
Bleached hardwood kraft pulp	0	0 Adt/yr	4.15	0	8	0	55	0	17	0	15	0	5	0
Bleached softwood kraft pulp	0	0 Adt/yr	4.70	0	8	0	55	0	17	0	15	0	5	0
Unbleached kraft pulp	0	0 Adt/yr	4.70	0	8	0	55	0	17	0	15	0	5	0
Chemical thermo-mechanical pulp	0	0 Adt/yr	2.50	0	8	0	55	0	17	0	15	0	5	0
Thermo-mechanical pulp	0	0 Adt/yr	2.50	0	8	0	55	0	17	0	15	0	5	0
Wood chips	1	n.a.	1.84	n.a.	55	n.a.	30	n.a.	0	n.a.	0	n.a.	15	0
Total	32			262,633		15,170		2,394		230,029		2,395		12,645

Table E-12: Estimated Wood Demand by Industry for Liuzhou Prefecture, 2004

Wood Industry	Number of Mills	Annual Capacity	Roundwood Conversion Factor (m3 RWE per unit of product)	Estimated Roundwood Demand (m3 RWE/yr)	Estimated Fiber Demand by Wood Type									
					Residual Greenwood		Commercial Logs < 8cm		Commercial Logs ≥ 8cm		Commercial Wood Chips (RWE)		Mill Residues (RWE)	
					%	m3/yr	%	m3/yr	%	m3/yr	%	m3/yr	%	m3/yr
Sawnwood	187	500,000 m3/yr	1.50	750,000	0	0	0	0	100	750,000	0	0	0	0
MDF and HDF	2	105,000 m3/yr	1.33	139,650	50	69,825	18	25,137	7	9,776	10	13,965	15	20,948
Plywood -- thin panels	2	8,000 m3/yr	1.53	12,240	0	0	15	1,836	85	10,404	0	0	0	0
Plywood -- concrete forming	7	49,000 m3/yr	1.53	74,970	0	0	15	11,246	85	63,725	0	0	0	0
Particleboard (wood-based)	2	45,000 m3/yr	1.42	63,900	40	25,560	0	0	5	3,195	5	3,195	50	31,950
Blockboard	24	74,000 m3/yr	1.42	105,080	25	26,270	0	0	5	5,254	0	0	70	73,556
Wet process fiberboard	1	5,000 m3/yr	1.42	7,100	50	3,550	0	0	0	0	0	0	50	3,550
Veneer	11	20,000 m3/yr	1.55	31,000	0	0	15	4,650	85	0	0	0	0	0
Bleached hardwood kraft pulp	1	80,000 Adt/yr	4.15	332,000	8	26,560	55	182,600	17	56,440	15	49,800	5	16,600
Bleached softwood kraft pulp	0	0 Adt/yr	4.70	0	8	0	55	0	17	0	15	0	5	0
Unbleached kraft pulp	1	50,000 Adt/yr	4.70	235,000	8	18,800	55	129,250	17	39,950	15	35,250	5	11,750
Chemical thermo-mechanical pulp	0	0 Adt/yr	2.50	0	8	0	55	0	17	0	15	0	5	0
Thermo-mechanical pulp	1	20,000 Adt/yr	2.50	50,000	8	4,000	55	27,500	17	8,500	15	7,500	5	2,500
Wood chips	15	200,000 BDMT/yr	1.84	368,000	55	202,400	30	110,400	0	0	0	0	15	0
Total	254			2,168,940		376,965		492,619		947,243		109,710		160,854

Note: MDF and HDF capacity figure includes one mill which was under construction in 2003: Liuzhou Wood Mill (Changtang) MDF (80,000 m3/yr).

Table E-13: Estimated Wood Demand by Industry for Baise Prefecture, 2004

Wood Industry	Number of Mills	Annual Capacity	Roundwood Conversion Factor (m3 RWE per unit of product)	Estimated Roundwood Demand (m3 RWE/yr)	Estimated Fiber Demand by Wood Type									
					Residual Greenwood		Commercial Logs < 8cm		Commercial Logs ≥ 8cm		Commercial Wood Chips (RWE)		Mill Residues (RWE)	
					%	m3/yr	%	m3/yr	%	m3/yr	%	m3/yr	%	m3/yr
Sawnwood	517	150,000 m3/yr	1.50	225,000	0	0	0	0	100	225,000	0	0	0	0
MDF and HDF	1	100,000 m3/yr	1.33	133,000	50	66,500	18	23,940	7	9,310	10	13,300	15	19,950
Plywood -- thin panels	0	0 m3/yr	1.53	0	0	0	15	0	85	0	0	0	0	0
Plywood -- concrete forming	0	0 m3/yr	1.53	0	0	0	15	0	85	0	0	0	0	0
Particleboard (wood-based)	0	0 m3/yr	1.42	0	40	0	0	0	5	0	5	0	50	0
Blockboard	2	5,000 m3/yr	1.42	7,100	25	1,775	0	0	5	355	0	0	70	4,970
Veneer	14	20,000 m3/yr	1.55	31,000	50	15,500	0	0	0	0	0	0	50	15,500
Wet process fiberboard	0	0 m3/yr	1.42	0	0	0	15	0	85	0	0	0	0	0
Bleached hardwood kraft pulp	0	0 Adt/yr	4.15	0	8	0	55	0	17	0	15	0	5	0
Bleached softwood kraft pulp	0	0 Adt/yr	4.70	0	8	0	55	0	17	0	15	0	5	0
Unbleached kraft pulp	0	0 Adt/yr	4.70	0	8	0	55	0	17	0	15	0	5	0
Chemical thermo-mechanical pulp	0	0 Adt/yr	2.50	0	8	0	55	0	17	0	15	0	5	0
Thermo-mechanical pulp	0	0 Adt/yr	2.50	0	8	0	55	0	17	0	15	0	5	0
Wood chips	9	15,000 BDMT/yr	1.84	27,600	55	15,180	30	8,280	0	0	0	0	15	0
Total	543			423,700		98,955		32,220		234,665		13,300		40,420

Note: MDF capacity figure includes one mill which was under construction in 2003: Fenglin International (Baise) Co. Ltd.'s mill (100,000 m3/yr).

Table E-14: Estimated Wood Demand by Industry for Hechi Prefecture, 2004

Wood Industry	Number of Mills	Annual Capacity	Roundwood Conversion Factor (m3 RWE per unit of product)	Estimated Roundwood Demand (m3 RWE/yr)	Estimated Fiber Demand by Wood Type									
					Residual Greenwood		Commercial Logs < 8cm		Commercial Logs ≥ 8cm		Commercial Wood Chips (RWE)		Mill Residues (RWE)	
					%	m3/yr	%	m3/yr	%	m3/yr	%	m3/yr	%	m3/yr
Sawnwood	408	600,000 m3/yr	1.50	900,000	0	0	0	0	100	900,000	0	0	0	0
MDF and HDF	0	0 m3/yr	1.33	0	50	0	18	0	7	0	10	0	15	0
Plywood -- thin panels	0	0 m3/yr	1.53	0	0	0	15	0	85	0	0	0	0	0
Plywood -- concrete forming	1	5,000 m3/yr	1.53	7,650	0	0	15	1,148	85	6,503	0	0	0	0
Particleboard (wood-based)	0	0 m3/yr	1.42	0	40	0	0	0	5	0	5	0	50	0
Blockboard	2	5,000 m3/yr	1.42	7,100	25	1,775	0	0	5	355	0	0	70	4,970
Wet process fiberboard	0	0 m3/yr	1.42	0	50	0	0	0	0	0	0	0	50	0
Veneer	5	3,000 m3/yr	1.55	4,650	0	0	15	698	85	0	0	0	0	0
Bleached hardwood kraft pulp	0	0 Adt/yr	4.15	0	8	0	55	0	17	0	15	0	5	0
Bleached softwood kraft pulp	0	0 Adt/yr	4.70	0	8	0	55	0	17	0	15	0	5	0
Unbleached kraft pulp	0	0 Adt/yr	4.70	0	8	0	55	0	17	0	15	0	5	0
Chemical thermo-mechanical pulp	0	0 Adt/yr	2.50	0	8	0	55	0	17	0	15	0	5	0
Thermo-mechanical pulp	0	0 Adt/yr	2.50	0	8	0	55	0	17	0	15	0	5	0
Wood chips	12	42,000 BDMT/yr	1.84	77,280	55	42,504	30	23,184	0	0	0	0	15	0
Total	428			996,680		44,279		25,029		906,858		0		4,970



THE WORLD BANK

