

## **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is largely based on data provided by the Guangxi Provincial Forestry Bureau, either in published reports or in unpublished form.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 m<sup>3</sup>/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 m<sup>3</sup> of sawnwood in 2004, reflecting an increase of approximately 50 percent from 2001 when output is estimated to have been 1.2 million m<sup>3</sup>.

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 m<sup>3</sup>/yr in Guigang to a high of 5,067 m<sup>3</sup>/yr in Laibin. Overall, the average mill capacity in Guangxi is 1,557 m<sup>3</sup>/yr.

Table 3.1: Sawnwood Capacity by Prefecture in Guangxi, 2005

Prefecture	Region	No. Mills	Capacity (m <sup>3</sup> /yr)	Percent of Total	Mean Capacity (m <sup>3</sup> /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
<b>Total</b>		<b>3,904</b>	<b>3,175,194</b>	<b>100.0%</b>	<b>1,557</b>

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 (m<sup>3</sup>/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.<sup>1</sup>

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 m<sup>3</sup>/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 m<sup>3</sup>/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 m<sup>3</sup>/yr, or 13 percent of the

<sup>1</sup> The survey was limited to mills with a production capacity of 2,000 m<sup>3</sup>/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 m<sup>3</sup>/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 m<sup>3</sup>/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 m<sup>3</sup>/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 <sup>3</sup> /yr)		Total Capacity (m <sup>3</sup> /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
<b>Total</b>	<b>156</b>	<b>1,622,000</b>	<b>1,130,000</b>	<b>2,752,000</b>	<b>100.01</b>

Note: This table includes only mills with a capacity  $\geq$  2,000 m<sup>3</sup>/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 m<sup>3</sup>/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 m<sup>3</sup>/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 blockboard capacity, with 30 mills and a combined capacity of 96,000 m<sup>3</sup>/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 m<sup>3</sup>/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 m<sup>3</sup>/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 %
		<b>Sub-total</b>	<b>58</b>	<b>1,405,000</b>	
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 %
		<b>Sub-total</b>	<b>32</b>	<b>702,000</b>	
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 %
		<b>Sub-total</b>	<b>60</b>	<b>530,000</b>	
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 %
		<b>Sub-total</b>	<b>6</b>	<b>115,000</b>	
<b>Total</b>			<b>156</b>	<b>2,752,000</b>	

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.<sup>2</sup> 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.

<sup>2</sup> 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.
<b>Total</b>		<b>213</b>	<b>1,314,685</b>	<b>100.0%</b>	<b>6,172</b>

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 m<sup>3</sup>/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 m<sup>3</sup>/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 m<sup>3</sup>/yr, privately owned mills have a mean capacity of 7,500 m<sup>3</sup>/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 m<sup>3</sup>/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 <sup>3</sup> /yr)	% of Total Capacity
State-owned	46	1,672,000	61%
Domestic privately-owned	106	795,000	29%
Foreign-owned	4	285,000	10%
<b>Total</b>	<b>156</b>	<b>2,752,000</b>	<b>100%</b>

Data Source: Guangxi Provincial Forestry Bureau (2003)

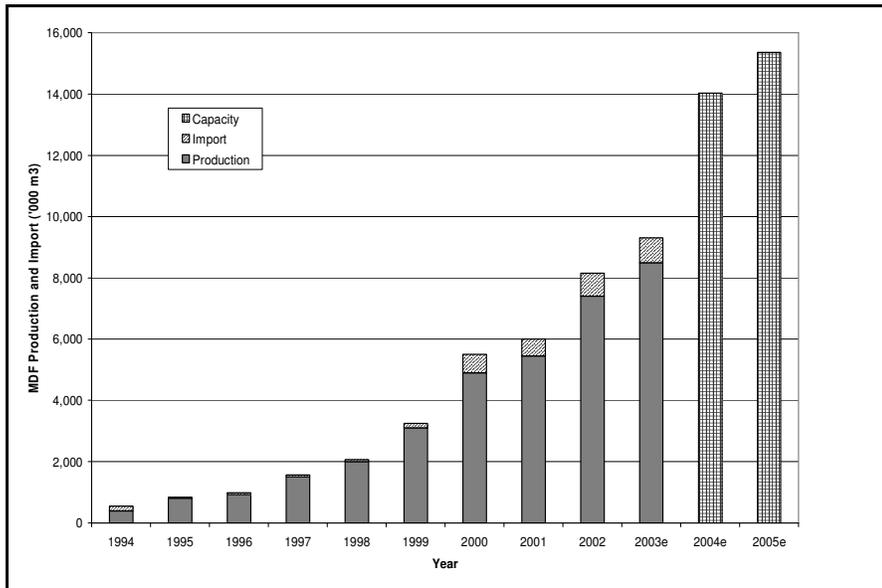
### 3.3 Medium and High Density Fiberboard

#### 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 m<sup>3</sup>/yr in 1994 to an estimated 15.3 million m<sup>3</sup>/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 m<sup>3</sup>/yr; in 2004, 50 new lines were added with a capacity of 4.5 million m<sup>3</sup>/yr; and in 2005, at least 13 new lines with a capacity of 1.3 million m<sup>3</sup>/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 m<sup>3</sup>/yr of installed capacity, China has now exceeded the aggregate capacity of Europe (estimated to be 14.3 million m<sup>3</sup>/yr in 2005) and has nearly tripled the capacity of North America (which stands at 5.4 million m<sup>3</sup>/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 m<sup>3</sup>/yr (see Table A-1). At that time, an additional 7 MDF mills with a combined capacity of 830,000 m<sup>3</sup>/yr were under construction, as was one HDF mill with a capacity of 300,000 m<sup>3</sup>/yr. By the end of 2004, Guangxi's total medium- and high-density fiberboard capacity is estimated to have reached 1.9 million m<sup>3</sup>/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 m<sup>3</sup>/yr or less; and 2) multi-line mills with capacities of 80,000 m<sup>3</sup>/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 m<sup>3</sup>/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 m<sup>3</sup>/yr or more. Five of these mills have capacities at or above 150,000 m<sup>3</sup>/yr, the largest of which is a 300,000 m<sup>3</sup>/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 m<sup>3</sup>/yr MDF/HDF line is being added to the existing 100,000 m<sup>3</sup>/yr MDF line. Most of the larger mills have multiple production lines of 30,000 to 50,000 m<sup>3</sup>/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.<sup>3</sup> 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 m<sup>3</sup>/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,

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<sup>3</sup> These include a 100,000 m<sup>3</sup>/yr MDF line and a 300,000 m<sup>3</sup>/yr HDF line at Sunway Group's Wuzhou mill sites; a 150,000 m<sup>3</sup>/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 m<sup>3</sup> 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.<sup>4</sup> 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.

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<sup>4</sup> Liuzhou Wood Mill, which operates a 50,000 m<sup>3</sup>/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

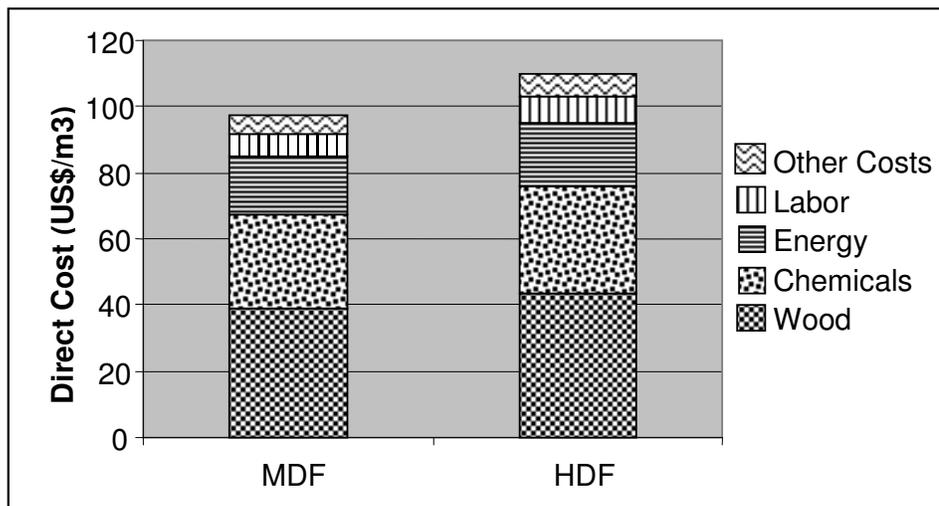
In spite of strong market demand, prices for MDF have declined slightly in recent years due to the significant new capacity that has come online. In March 2005, the average price for 12-15 mm thick panels was reported to be RMB 1,100-1,200 per m<sup>3</sup> (US\$ 134-146). This reflects a drop from 2003 when prices for thick panels averaged RMB 1,200-1,450 per m<sup>3</sup> (US\$ 146-177) and, and even more significantly, from 1997 when prices peaked at RMB 1,800 per m<sup>3</sup>.

Among the producers contacted during this study, direct production costs for MDF were reported to range between RMB 700-900 per m<sup>3</sup> (US\$ 85-110 per m<sup>3</sup>), excluding depreciation (which typically would add an additional RMB 200-250 per m<sup>3</sup>). For HDF, direct costs were reported to be in the range of RMB 800-1,000 per m<sup>3</sup> (US\$ 97-122 per m<sup>3</sup>), 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.<sup>5</sup> 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.

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<sup>5</sup> The Fenglin Group, for instance, reportedly purchased wood chips to supply 30 percent of the fiber consumed by its 160,000 m<sup>3</sup>/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 m<sup>3</sup>/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 m<sup>3</sup>/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 m<sup>3</sup>), 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 m<sup>3</sup>/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 m<sup>3</sup> 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.
<b>Total</b>	<b>100 %</b>	<b>1,940,000</b>				

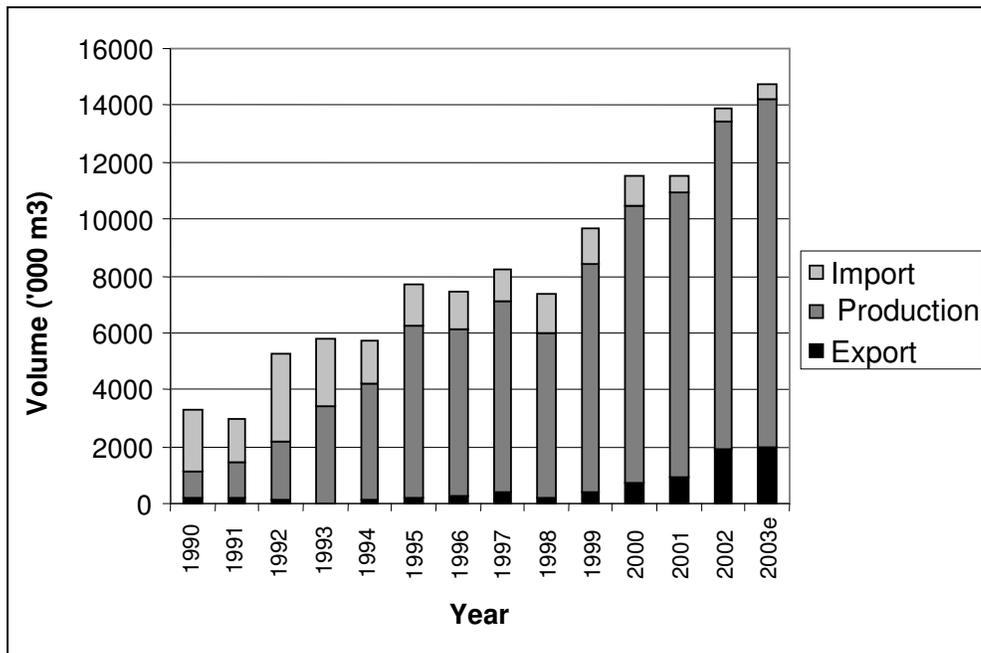
### 3.4 Plywood and Veneer

#### 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 m<sup>3</sup>, 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 m<sup>3</sup>/yr in the early-1990s to approximately 500,000 m<sup>3</sup>/yr at present. Indeed, China has emerged, in recent years, as a net plywood exporter with some 2.0 million m<sup>3</sup>/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 m<sup>3</sup>/yr in capacity, with a combined capacity of 141,000 m<sup>3</sup>/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 m<sup>3</sup>/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 m<sup>3</sup>/yr are located in Rongxian County in Yulin Prefecture alone. Four additional mills with a combined capacity of 39,000 m<sup>3</sup>/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 m<sup>3</sup>/yr. The median capacity of these mills is 5,000 m<sup>3</sup>/yr. Indeed, the province has only two mills with capacities of 10,000 m<sup>3</sup>/yr or more, and 22 of the 30 mills have installed capacities of 5,000 m<sup>3</sup>/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 m<sup>3</sup>/yr. Guilin Prefecture has 6 mills with an aggregate capacity of 36,000 m<sup>3</sup>/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 Rongxian<sup>6</sup>

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 m<sup>3</sup>. Prices for flat panels were generally reported to be RMB 1,600-1,800 per m<sup>3</sup>. One producer claimed to be getting RMB 2,300 per m<sup>3</sup> 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 m<sup>3</sup> 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 m<sup>3</sup>. 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 m<sup>3</sup>.

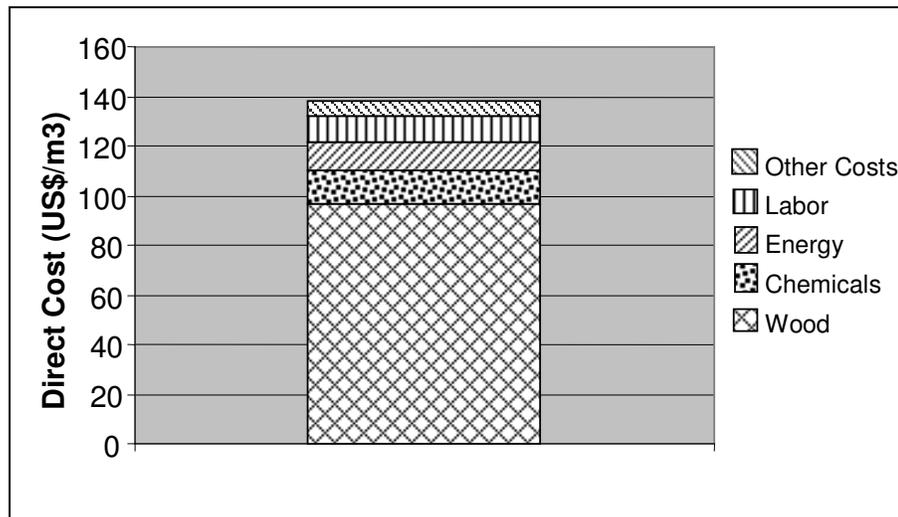
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<sup>6</sup> Interview with Mr. Zhou Peide, Hongfa Furniture Mill, Rongxian, March 28, 2005. Mr. Zhou noted, with a sense of irony, that "when furniture producers in Guangdong need irregular plywood, they immediately come to Rongxian. But when buyers 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 m<sup>3</sup> of eucalyptus is needed to produce 1 m<sup>3</sup> 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 m<sup>3</sup> 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 m<sup>3</sup> 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 m<sup>3</sup>. 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 m<sup>3</sup> of roundwood to produce 1.0 m<sup>3</sup> 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 m<sup>3</sup> 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 m<sup>3</sup> of Panels, According to 2003 Industry Structure

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

## 3.5 Particleboard

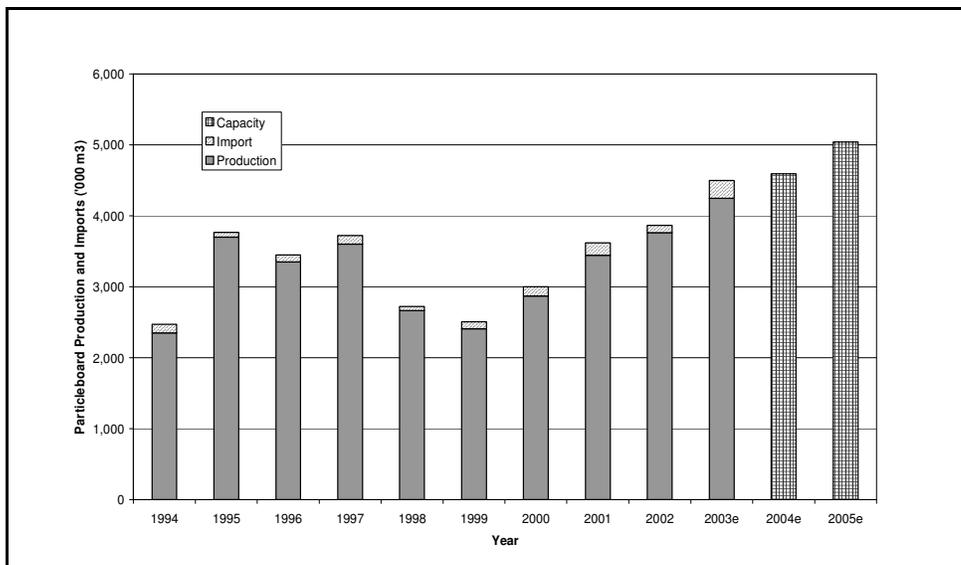
### 3.5.1 Recent Trends in China

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 m<sup>3</sup>/yr depending on the data and assumptions used.<sup>7</sup>

During the decade 1994-2003, China's annual particleboard production rose from approximately 2.4 million m<sup>3</sup> to 4.2 million m<sup>3</sup>. 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 m<sup>3</sup> 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)

<sup>7</sup> BIS Shrapnel (2002), for instance, projected in 2002 that China's particleboard capacity would reach 045 million m<sup>3</sup>/yr in 2005. This was based on an estimate that installed capacity in 2002 was 4.515 million m<sup>3</sup>/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 m<sup>3</sup>/yr and would reach 6.091 million m<sup>3</sup>/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 m<sup>3</sup>/yr. Of these, 13 producers make particleboard from bagasse, utilizing residues from harvested sugar cane. With an average production capacity of 16,400 m<sup>3</sup>/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 m<sup>3</sup>/yr. The capacities of these mills range in size from 10,000 to 50,000 m<sup>3</sup>/yr, with an average capacity of 21,600 m<sup>3</sup>/yr.<sup>8</sup> 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 m<sup>3</sup>/yr; and north region, which has three mills with a combined 60,000 m<sup>3</sup>/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.<sup>9</sup>

One exception is the 50,000 m<sup>3</sup>/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 m<sup>3</sup>/yr;
- One HDF mill with a capacity of 300,000 m<sup>3</sup>/yr;
- Three short-cycle laminating lines with a capacity of 6.0 million m<sup>2</sup>/yr;
- Two laminate flooring lines with annual output of 5.0 million m<sup>2</sup>/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.

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<sup>8</sup> 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 m<sup>3</sup>/yr. However, several other published sources put the Sunway Wuzhou mill's capacity as 50,000 m<sup>3</sup>/yr. In this report, we use the higher figure.

<sup>9</sup> 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 m<sup>3</sup>/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 m<sup>3</sup>/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.<sup>10</sup>

### **3.5.4 Prices and Cost Structures**

In March 2005, particleboard prices in Guangxi were reported to be RMB 900 per m<sup>3</sup> for 9 mm panels and RMB 750-800 per m<sup>3</sup> 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 m<sup>3</sup>, 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.<sup>11</sup> The purchase of chemicals accounted for

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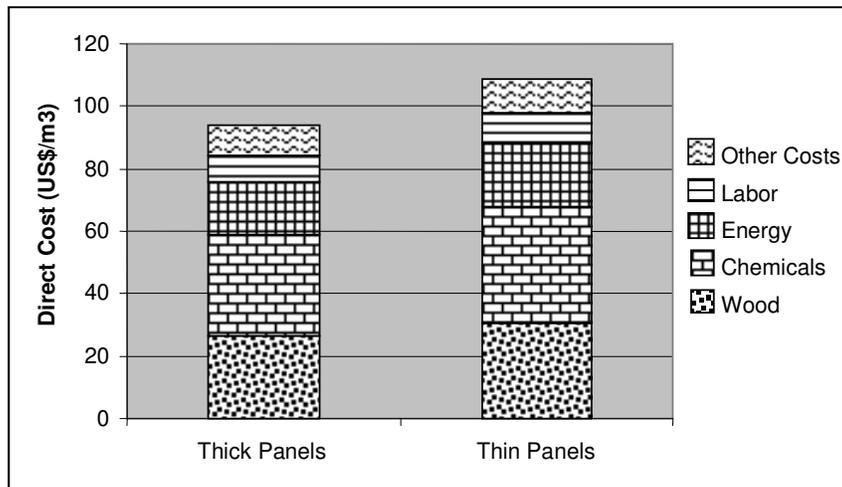
<sup>10</sup> At the same time, however, the mill manager at Sanmenjiang Forest Farm Particleboard Mill noted that at least one new particleboard mill is now being constructed in Vietnam; it is quite possible that further capacity increases in that country could limit demand for particleboard from Guangxi.

<sup>11</sup> 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 m<sup>3</sup>/yr apiece, and one with a designed capacity of 15,000 m<sup>3</sup>/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 m<sup>3</sup>/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 (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)	40 %	62,400	1.7 tonnes	106,080 tonnes	<b>1.2 tonnes/m3</b>	127,296 m3
Commercial logs (8-12 cm) for veneer	5%	7,800	1.5 m3			11,700 m3
Wood chips	5 %	7,800	0.77 BDMT	6,006 BDMT	<b>2.1 BDMT/m3</b>	12,612 m3
Dry mill residue	50 %	78,000	0.77 BDMT	60,060 BDMT	n.a.	n.a.
<b>Total</b>	<b>100 %</b>	<b>156,000</b>				

## 3.6 Wood-Based Pulp Production

### 3.6.1 Recent Trends in China<sup>12</sup>

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.<sup>13</sup>

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

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<sup>12</sup> 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.

<sup>13</sup> 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 m<sup>3</sup> of roundwood per 1.0 Adt of TMP;
- 4.15 m<sup>3</sup> of roundwood (eucalyptus) per 1.0 Adt of BHKP.
- 4.7 m<sup>3</sup> 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 m<sup>3</sup> of softwood and approximately 477,000 million m<sup>3</sup> 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 m <sup>3</sup> /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		
<b>Total</b>					<b>1,157,500</b>		<b>477,250</b>

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.<sup>14</sup> 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 m<sup>3</sup> 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.

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<sup>14</sup> 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 m<sup>3</sup> 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 m<sup>3</sup> for pine logs of 12-18 cm diameter; and RMB 380 per m<sup>3</sup> 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.

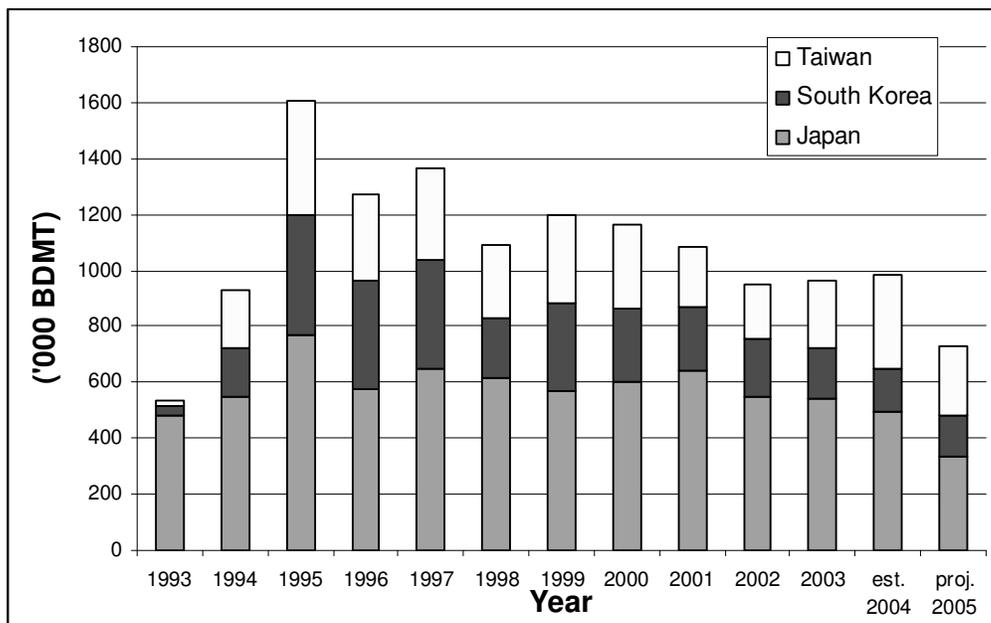
## 3.7 Wood Chips

### 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 m<sup>3</sup>/BDMT for Chinese hardwood and 2.04 m<sup>3</sup>/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 m<sup>3</sup> (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 m<sup>3</sup> (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.<sup>15</sup>

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.

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<sup>15</sup> 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
<b>Japan</b>												
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
<b>Taiwan</b>												
Eucalyptus	100	95	85	80	80	72	73	72	83	87	90	99
Mixed Hardwood				100	95	80-85		85	90	93	91	91
<b>Korea</b>												
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

	<b>Hardwood</b>	<b>Softwood</b>	<b>Total</b>
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