

China's development of a plantation-based wood pulp industry: government policies, financial incentives, and investment trends¹

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SUMMARY

The Chinese government is aggressively promoting development of a domestic wood pulp industry, integrated with a plantation-based fiber supply and downstream paper production. It is doing so by providing discounted loans from state banks, fiscal incentives, and capital subsidies for establishment of at least 5.8 million hectares of fast-growing pulpwood plantations. This article examines the development of bleached hardwood kraft pulp (BHKP) mills in South China, including the Asia Pulp & Paper (APP) Jinhai mill in Hainan Province and the proposed Fuxing pulp mill project in Guangdong Province. Both mills face fiber shortfalls over the medium term, and significant new investments in plantation development will be needed to provide a sustainable fiber supply at the mills' projected capacity levels. However, there are few sites in southern coastal China where fiber can be grown at internationally competitive costs. In most instances, the cost of Chinese plantation pulpwood will be considerably higher than in countries like Indonesia and Brazil, raising important questions about the economic competitiveness of Chinese pulp producers even within their home market.

Keywords: China; wood pulp, plantations, Asia Pulp & Paper, Fuxing

INTRODUCTION

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 domes-

tic producers modernize their operations and as international producers seek to capture a share of China's growing market (He and Barr, in this issue).

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. Much of the new paper and board capacity now coming online, however, relies on recovered paper obtained from both domestic sources and imports (Spencer 2004). Demand for wood-based pulp has also grown substantially in recent years, 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, in this issue). 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.²

To meet this growing demand, the Chinese govern-

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² 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, in this issue).

ment 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. To support these projects, the government has streamlined the sector's investment approval process and provided a variety of financial incentives and capital subsidies. These include several billion dollars worth of loan interest subsidies, discounted credit, and extended repayment periods for loans from state-owned banks.

In spite of the government's substantial support, the development of a competitive wood pulp industry in China faces a number of fundamental challenges. First, the cost of growing wood fiber in China is considerably higher than it is in countries like Indonesia and Brasil. As such, many analysts question whether Chinese wood pulp producers will be competitive even within their home market, particularly when they can often import market pulp at a lower cost than producing it themselves (cf Wright 2004; Kuusisto 2004). Second, there are signs that government subsidies are encouraging pulp producers in some parts of China to develop large-scale mills before fully securing a sustainable wood supply. The areas planted and the productivity levels achieved thus far are likely to fall well short of what will be needed to meet the projected demand for wood fiber, at least over the medium term and perhaps beyond (Cossalter 2004a; 2004b). Third, many of the risks and social impacts associated with fast-growing plantation development in China have not been fully evaluated.

In this article, we examine the policies and financial incentives that are now being used by the Chinese government to promote the development of a domestic wood pulp industry and integrated plantation resource base. We then assess the development of bleached hardwood kraft pulp (BHKP) mills in South China, where the largest investments in new pulp capacity and fast-growing plantations are now being made. The wood supply strategies of the Asia Pulp & Paper (APP) Hainan Jinhai mill project in Hainan Province and the proposed Fuxing pulp mill project in Guangdong Province are discussed in detail.

GOVERNMENT PROMOTION OF DOMESTIC WOOD PULP PRODUCTION³

As part of its broader effort to expand and modernize the country's pulp and paper sector, the Chinese government has actively promoted the development of a domestic wood-based pulp industry to achieve two complementary policy objectives. On the one hand, the government has sought to reduce China's growing reliance on various grades of imported wood pulp

(SFA 2002b). Policymakers recognize the substantial volumes of wood pulp that China will need to consume to produce the increasing volumes of paper and paperboard that are projected over the medium-term. To restrict the outflow of hard currency and to limit the industry's reliance on highly cyclical international markets, they have made the development of integrated wood pulp and paper production within China a cornerstone of the sector's industrial strategy.

On the other hand, the government has sought to close large numbers of heavily polluting nonwood pulp mills. Mechanical pulp mills using agricultural residues have been a major source of water pollution in many parts of China, and the government has reportedly closed over 4,000 small-scale nonwood pulp mills since 1999 (Jaakko Pöyry 2001). Within this context, Chinese policymakers view the expansion of chemical wood-based pulp production as a means of replacing the lost capacity with a cleaner and more efficient pulping process. By promoting the development of large-scale wood pulp mills, government planners also view this transition as being necessary to achieve the economies of scale needed to support an internationally competitive paper industry in China.

The government has used a variety of policy measures to promote the development of a domestic wood pulp industry. China's Tenth Five-Year Development Plan, covering the period 2001-2005, called for paper capacity to increase by 14 million air-dried tonnes per year (Adt/yr) by 2010 and prioritized the expansion of projects that integrated fast-growing pulpwood plantations, wood pulp production, and high-grade paper production (SFA 2002b). Specifically, it set a short-term target for domestic wood pulp capacity to triple in size from its 2000 level by reaching 2.2 million Adt/yr by 2005. 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.

As in other key sectors, the government has offered significant financial incentives and capital subsidies to support 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,

³ The government's policies to promote a wood-based pulp industry are described in some detail in an excellent report published in March 2004 by the American Forest and Paper Association (AF&PA) entitled „China's Fiber Resources and Forestry Industry Development.“ Much of the information presented in this and the following section has been adapted from this report.

have been an important source of financing for many producers (AF&PA 2004). For priority projects, these institutions have provided loans with interest rates up to 10 % lower than the standard loan interest rates set by the Central Bank. These loans often come with an extended repayment period, in some cases as long as 10-15 years.

Loan interest subsidies are another important form of incentive used by the government to achieve its policy targets in the pulp and paper sector.⁴ Indeed, the government has allocated loan interest subsidies totaling US\$ 2.13 billion (RMB 17.6 billion) to support the NDRC's 13 high-priority pulp-paper and plantation projects (AF&PA 2004). Under this scheme, borrowers investing in priority projects are allowed to forego interest payments on loans from state-owned banks for a period of 2-3 years.⁵ Typically, the Ministry of Finance will reimburse the banks involved with funds from the central budget or raised from treasury bonds. In some cases, these incentives not only allow borrowers to avoid interest payments but also to secure larger loans than they might otherwise obtain.⁶

In addition to promoting domestic investment in wood pulp production, the Chinese government has sought to encourage foreign investment as well (SFA 2002b). In March 2002, the NDRC included the following in the government's list of industry segments where foreign investment through joint ventures is encouraged:

- Wood base development for pulp and paper processing;
- Chemical pulp with annual capacity over 300,000 Adt/yr;
- Mechanical pulp (CTMP, BCTMP, APMP)⁷ with annual capacity over 100,000 Adt/yr;
- High-grade paper and paperboard (except newsprint).

Significantly, the NDRC also devolved to provincial governments substantial authority over the investment approval process for forestry and pulp-paper

projects (AF&PA 2004). Previously, the central government had played a lead role in approving new investments in the sector, and this frequently led to long delays before projects could begin. By devolving authority in this area, the NDRC has sought to reduce bureaucratic hurdles for investors and to facilitate fast-track approval for projects that integrate fast-growing plantations with pulp and paper production. According to a recent study by the American Forest and Paper Association, the State Council has also allowed 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), in the hopes that they can attract more foreign investment“ (AF&PA 2004).

CAPITAL SUBSIDIES FOR PLANTATION DEVELOPMENT

To ensure that China's pulp producers have adequate supplies of wood fiber, the government has also promoted the development of industrial tree plantations. With the adoption of China's Tenth Five Year Development Plan, the State Forest Administration (SFA) prioritized the establishment of a fast-growing, high-yielding (FGHY) plantation base by including this as one of six core initiatives in the National Forest Protection Program (SFA 2002b). 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.

According to the SFA's strategic plan for the forestry sector, the government has budgeted RMB 71.8 billion – or US\$ 8.6 billion – to finance the development of 13.3 million ha of FGHY plantations during the period 2001-2015 (SFA 2002a). Some 5.8 million ha, or approximately 45 % of the targeted area, is intended to be used for fast-growing plantations for pulpwood.

The fast-growing plantation program covers four priority geographic regions: China's south coastal region; the lower and middle reaches of the Yangtze River; the lower and middle reaches of the Yellow River; and Northeast China/Inner Mongolia. In aggregate terms, the largest area allocated for pulpwood plantation development is in Northeast China/Inner Mongolia, where 2.4 million ha of plantations are planned to produce pulpwood fiber (see Table 1). However, in the South Coastal and Yellow River regions, the areas planned for pulpwood are substantially larger relative to the total area allocated for FGHY plantations than they are in the other two regions.

The government has structured the FGHY program around 99 priority projects, which are eligible to receive subsidized financing to encourage fast-growing plantation development (SFA 2002a). Thirty-

⁴ During 1998-2002, for instance, the Chinese government provided loan interest subsidies totaling US\$ 1.67 billion for technological improvements and capacity expansions at 21 state-owned paper mills.

⁵ AF&PA (2004) notes that „the standard subsidy term is 2 years... [However] for enterprises found on the list of China's top 520 enterprises, the subsidy term is 3 years.“ In at least one case – Shandong Chenming Co., Ltd – the borrower received a loan interest subsidy for 5 years.

⁶ According to AF&PA (2004), „If a paper mill needs US\$ 10 million for technology renovations, the Ministry of Finance would provide a 2-year loan interest subsidy totaling 1.2 million to start the project. In fact, with this government subsidy, the company can usually receive a bank loan for up to 10 times the subsidy amount (US\$ 12 million).“

⁷ CTMP refers to chemi-thermomechanical pulp; BCTMP is bleached chemi-thermomechanical pulp; and APMP is alkaline peroxide mechanical pulp.

TABLE 1 *FGHY plantation area targets by region, 2001-2015*

Region	Provinces	Total FGHY (ha)	FGHY for pulpwood (ha)	Pulpwood as % of total
South coastal	Guangdong, Guangxi, Hainan, Fujian	1.9 m	1.4 m	74 %
Lower-middle Yangtze River	Zhejiang, Jiangxi, Hubei, Hunan	3.0 m	1.3 m	43 %
Lower-middle Yellow River	Hebei, Henan, Shandong	1.0 m	0.8 m	80 %
Northeast China/ Inner Mongolia	Inner Mongolia, Liaoning, Heilongjiang, Jilin	7.2 m	2.4 m	33 %

Source: State Forest Administration

nine of these projects involve the development of pulpwood plantations. Under the government's plan, development of these plantations will be subsidized through loan interest subsidies, discounted loans from state banks, and extended repayment periods. Specifically, financing for priority fast-growing plantation projects will come from four sources:

- State-owned banks will provide 70 % of the overall financing for the FGHY program – or approximately US\$ 6.1 billion – in the form of discounted loans to state forest farms, private sector plantation companies, and farmers' cooperatives. The China Development Bank and the Agricultural Bank of China, in particular, will provide loans with reduced interest rates and an extended 10-15 year repayment period.
- The Ministry of Finance will allocate 20 % of the FGHY program's total financing – or approximately US\$ 1.7 billion – through loan interest subsidies.
- Local governments are responsible for providing 3 % of the program's financing.
- Plantation companies receiving the discounted government finance are responsible for contributing 7 % of their project's financing from their own funds or from commercial sources (SFA 2002a; AF&PA 2004).

LIMITS ON CHINA'S COMPETITIVENESS

In spite of the heavy capital subsidies being allocated, China faces significant constraints which are likely to limit the competitiveness of a domestic wood pulp industry. In particular, many analysts caution that it is important to remain sober-minded about the government's capacity to develop a high-quality fast-growing plantation resource base on the scale planned under the FGHY program (URS Forestry 2003; Jaakko Pöyry 2001). Past experience has shown that large-scale plantation development initiatives in China have frequently been very effective at getting large areas of trees planted on an annual basis. However, it is not uncommon for a significant portion of these areas to have low levels of productivity due to infertile soils, inadequate site management, poor stocking and/or the use of inferior genetic materials (Jaakko Pöyry 2001). It remains to be seen whether the planting targets for the FGHY program over the next several years will be

met; moreover, there is little guarantee that the sites planted will achieve high levels of productivity on a sustained basis.

In many parts of the China, delivered wood costs are also substantially higher than those found in more efficient pulp-producing countries. As discussed in detail below, delivered wood costs in South China currently range between US\$ 20-25 per tonne for eucalyptus from state forest farms and US\$ 30-40 per tonne for eucalyptus grown on collectively owned land that is either managed by farmers' cooperatives or leased from local communities by plantation companies (Cossalter 2004a; 2004b). By contrast, 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 *Acatia 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.⁸ The relatively higher wood costs in 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).

Given this disparity in wood costs, many analysts question whether China-based pulp producers can, in fact, compete with low-cost producers in Indonesia and Brazil – in spite of the considerable distance required to ship pulp from those countries to China (Asprem *et al.* 2004; Wright 2004). Moreover, some analysts anticipate that the world will face a growing oversupply of market pulp over at least the medium-term, which would place further downward pressure on global pulp prices. Hawkins Wright, for instance, projects that global production capacity for market pulp will increase from 47.9 million Adt/yr in 2003 to 56.4 million Adt/yr in 2008 (Wright 2004). This ex-

⁸ 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.

pansion is expected to outpace growth in global demand for market pulp, which is projected to rise from 44.8 million Adt/yr to 51.0 million Adt/yr during the same period.

As China consumes nearly 50 % of the world's market pulp, global oversupply could mean that China-based pulp producers become increasingly reliant on either direct or indirect government subsidies to remain competitive within their home markets (Barr and Cossalter 2004). However, with China's entry into the World Trade Organization, the government will find it increasingly difficult to provide such subsidies and can no longer protect domestic producers with import tariffs as it has in the past (Roberts 2004).

PULP AND PLANTATION DEVELOPMENT IN SOUTH CHINA

The provinces of Guangdong, Hainan, and Guangxi, located along the country's southern coast, currently represent the most active region for the development of kraft pulp production in China. During the last three years, four of the world's largest pulp producers - including Indonesia-based Asia Pulp & Paper (APP) and RGM International and Finland-based Stora Enso and UPM-Kymmene - have announced that they are

either actively considering and/or initiating the development of large-scale hardwood pulp mills in the region (Figure 1). Reports of what these companies are considering, and the status of their plans, have varied widely and have changed over time. As Table 2 shows, however, these producers have either conducted feasibility studies or initiated development for five pulp mills with a combined capacity of 5.6 million Adt/year over the medium to long term.

Few analysts expect that all five of these mills will be developed or that the region's installed wood pulp production capacity will approach 5.6 million Adt/year in the near future. Indeed as of January 2005, only one of the projects under consideration - APP's Hainan Jinhai mill, which began test trials in November 2004 - had even initiated construction, much less started production. On the contrary, in late-2004 UPM-Kymmene announced that it had withdrawn from the planned Fuxing pulp mill project in western Guangdong Province (which will be discussed in greater detail below). While the project may ultimately go forward with another investor, the withdrawal of UPM-Kymmene will undoubtedly mean that the Fuxing mill is delayed significantly, if it is built at all. Stora Enso has also indicated that it is now in the process of restructuring the industrial concept for the

FIGURE 1 *Development of hardwood-mills in the region*



BHKP mill it had planned for Guangxi Province. APP has, likewise, indicated that it is planning to develop a bleached hot-grind mechanical pulp mill with a capacity of 300,000 Adt/yr as a first stage for its project in Guangxi's Qinzhou Prefecture.

Each of the planned mills has structured its wood supply strategies around the development of fast-growing eucalyptus plantations. The main species being used are *Eucalyptus urophylla*, *E. tereticornis*

TABLE 2 Wood-based pulp mills (capacity > 500,000 Adt/year) planned for South China, as of December 2004

Project name	Province	Planned/proposed capacity (Adt/yr)	Status (December 2004)
APP Hainan Jinhai	Hainan	2,400,000	Pulp line 1 with 1.1 million Adt/yr installed - test trials held in November 2004
APP Qinzhou	Guangxi	1,200,000	Approval pending for first phase of 300,000 Adt/yr
Stora Enso-Hepu	Guangxi	600,000	Approval pending - however, Stora Enso is considering a new industrial concept while studying feasibility of plantation resource base
Fuxing	Guangdong	700,000	Status uncertain - UPM Kymene withdrew from project in November 2004
RGM-Xinhui	Guangdong	700,000	Proposed - not yet approved
Total		5,600,000	

TABLE 3 Effective wood demand and approximate net plantation area needed according to potential pulp capacity levels

Pulp capacity (Adt/yr)	Wood demand (m ³ /yr)	Net plantation area needed		
		MAI = 12 m ³ /ha/yr	MAI = 15 m ³ /ha/yr	MAI = 18 m ³ /ha/yr
1,000,000	4,150,000	432,000	346,000	288,000
1,500,000	6,225,000	648,000	519,000	432,000
2,000,000	8,300,000	864,000	692,000	576,000
2,500,000	10,375,000	1,080,000	865,000	720,000
3,000,000	12,450,000	1,296,000	1,038,000	864,000
3,500,000	14,525,000	1,512,000	1,210,000	1,008,000
4,000,000	16,600,000	1,728,000	1,383,000	1,152,000
4,500,000	18,675,000	1,944,000	1,556,000	1,296,000
5,000,000	20,750,000	2,160,000	1,729,000	1,440,000
5,500,000	22,825,000	2,376,000	1,902,000	1,584,000
6,000,000	24,900,000	2,592,000	2,075,000	1,728,000

Note: Wood demand is based on the assumption that 4.15 m³ of roundwood (solid wood under bark) is needed to produce 1.0 Adt of pulp. Approximate net plantation area is based on the assumption that plantations are managed on a 5 year rotation; and 20 % of harvested volume is non-commercial.

In spite of the uncertainties involved, the ambitious plans and large-scale investments already being made in hardwood pulp production in South China raise a number of critical questions about the region's fiber resource base. Most significantly, perhaps, how much pulpwood fiber can the region's plantations supply on a sustainable basis? And how much land will be required to do so? If it is assumed that 4.15 cubic meters (m³) of pulpwood (solid wood under bark) are needed to produce 1.0 Adt of pulp, it can be estimated that some 4.15 million m³ of pulpwood will be needed annually to support every 1.0 million tonnes of pulp capacity that is brought online. Table 3 shows the projected wood demand of the region's pulp producers at various levels of installed capacity, and the approximate land area that would be needed to supply the volumes of wood if these were to be obtained from local plantations.

(12ABL Congo) and a number of eucalyptus hybrids including: *Eucalyptus grandis* x *E. urophylla*; *E. urophylla* x *E. grandis*; *E. urophylla* x *E. tereticornis*, which are well-suited for the growing conditions found in much of Hainan, Guangdong, and Guangxi. Large areas of eucalyptus have, in fact, been planted in the three provinces over the past decade, and clonal forestry has now become widely used. Based on provincial forest inventory figures, it is estimated that by the end of 2002, the three provinces had approximately 750,000 ha of standing eucalyptus plantations (Cossalter 2004a). However, at least a portion of these have been planted for environmental purposes and are not likely to be available for commercial use. In recent years, the region's plantations have expanded at approximately 65,000 ha annually. Growth rates and productivity levels in South China are highly variable,

with mean annual increments (MAI's) generally ranging between 10 and 20 m³/ha/yr depending on site conditions and plantation management practices (Cossalter 2004a).

to the mill at the prevailing market price.

A third model is structured as a production-sharing arrangement between the pulp company and the local community or land-owner. The pulp company

TABLE 4 APP's annual planting of pulpwood plantations in Guangdong, Guangxi, and Hainan Provinces, 1995-2003 (hectares)

Year	Guangdong		Guangxi	Year	Hainan
	Qingyuan	Shaoguan			
1995-1996	1,771	6,069	2,495	1996	0
1996-1997	7,380	7,012	7,623	1997	6,680
1997-1998	884	1,607	3,230	1998	0
1998-1999	996	894	1,516	1999	9,346
1999-2000	468	0	8,811	2000	30,733
2000-2001	0	0		2001	0
2001-2002	0	0	est. 16,000	2002	0
2002-2003	0	0		2003	16,768
Total	11,499	15,582	est. 39,675	Total	63,527

Source: APP, January 2003 and June 2004, for figures on Guangdong and Guangxi; Hainan Province Forestry Bureau, May 2004, for figures on Hainan.

Over the last few years, pulpwood plantations in South China have produced approximately 2.0 million m³/yr of small-diameter logs which have been exported in the form of wood chips, principally to Japan, South Korea, and Taiwan. Smaller volumes have been used by a handful of plywood and medium-density fiberboard (MDF) mills, as well as a few medium-scale pulp and paper mills located in southern China, and in one case, in Shandong Province.

At present, the sponsors of each of the planned pulp mills are competing with one another to secure an adequate land base for their respective plantation development initiatives. Due to the population density in South China, much of the suitable land is already held by local communities and individual farmers. Pulp companies are therefore seeking to gain access to plantation land by establishing partnerships with these groups, often with the assistance of provincial and municipal governments, and they are using a number of different models to do so (Cossalter 2004a; Lu Wenming *et al.* 2002). Under one such model, companies are leasing land from local communities – for periods that sometimes range up to 30 years – and then establishing and managing the plantations themselves. The company typically assumes full responsibility for financing the project and makes annual payments to the community, but manages the site directly.

A second model is structured around a joint financing arrangement between the pulp company and a private investor although again, the plantations are developed on land that is leased from communities. Under this model, the pulp company and the private investor generally share the cost of plantation development, and the latter assumes responsibility for managing the site, harvesting the wood, and delivering it to the mill site. Typically, the pulp company receives a predefined portion of the harvest, while the private investor retains the right to sell the remainder

assumes full responsibility for financing the plantation development on community land, and the community is responsible for managing the site. At the end of the rotation, the wood harvested is divided between the company and the community according to an agreed ratio. Often the company provides a guarantee that it will purchase the community's portion of the wood at a pre-determined price.

Under a fourth model, pulp companies are seeking to secure wood procurement contracts with the region's state-owned tree farms, which have fairly substantial existing plantation areas. The following sections examine the fiber supply strategies of two major pulp mill projects that have been planned for the region: APP's Hainan Jinhai pulp mill and the Fuxing pulp mill project. These projects are each included on the list of 13 high-priority pulp and paper projects prepared by the National Development and Reform Commission. Much of the information presented below was obtained during company visits and field studies in Hainan and Guangdong conducted during February, March, and September 2003 and May, June, and August 2004.

APP'S HAINAN JINHAI PULP MILL PROJECT

Hainan Jinhai Pulp & Paper Co. Ltd is a subsidiary company of APP China and the sole shareholder of the group's Hainan pulp mill. This new mill is located at Yang Pu on the west coast of Hainan Province approximately 110 km from Haikou, the provincial capital. The mill site covers an area of 400 ha within the recently created Yang Pu Free Trade and Economic Development Zone, and has its own port facilities. Construction of the mill was completed in October 2004 and test trials began in late-November.

According to company announcements, APP's Hainan Jinhai mill has initiated production with an in-

stalled capacity of 1.1 million Adt/yr for bleached hardwood kraft pulp. The company plans to expand capacity to 1.2 million Adt/yr by mid-2005 after debottlenecking. This is the first step of a larger project which will reportedly include the addition of a second pulp production line of the same capacity and of two paper lines of 1.6 million tonnes each. According to company plans, the Yang Pu project will have a total installed capacity of 2.4 million Adt/yr of BHKP and 3.6 million tonnes of paper once it is completed. The mill's fiber supply strategy has largely been structured around the development of eucalyptus plantations in the South China region. As Table 4 shows, APP has invested in fast-growing plantations in Guangdong, Guangxi and Hainan provinces since 1995. In making these investments, APP has sought to initiate a resource base in the neighborhood of sites that it had pre-selected for several potential pulp and fiber board industries. Several of those proposals have failed to obtain final agreement, and it now appears that the group will direct the wood from these sites to the Hainan mill, at least until other potential production facilities come online. By the end of 2003, APP had established approximately 130 000 ha of plantations, mostly composed of eucalyptus, in the three provinces.

APP's Guangdong plantations

In Guangdong Province, APP has planted an area of about 27 000 ha in Qingyuan and Shaoguan prefectures, located respectively at 120 km and 300 km northwest and north of Guangzhou. They were largely established during 1995-1998 as part of an overall plan to build a total plantation resource of 330 000 ha in Qingyuan and 400 000 ha in Shaoguan. The original purpose of these plantations was to supply two proposed pulp and medium density fiberboard mills. In both cases, the Bei Jiang River was expected to provide the water supply to the mills and to drain their effluents. In 1997, however, the provincial administration withdrew its initial agreement allowing APP to proceed with the construction of the two mills. The provincial administration's key concern was the high risk of water pollution of the Bei Jiang River, one of the main supplies of drinking water of the city of Guangzhou.

At this point, it is not altogether clear how APP will use the wood from the Guangdong plantation sites. The Qingyuan and Shaoguan plantations are far too remote to become an economic source of wood for the Hainan mill on a long-term basis. Road conditions north of Guangzhou are rather poor and access to the Guangzhou harbor is already extremely congested. However the possibility that the wood from these sites could be delivered to the Hainan mill, at least during the mill's start-up phase, should not be excluded.

APP's Guangxi plantations

Through the end of 2003, APP had planted approximately 40 000 ha in Guangxi Province. For South Chi-

na as a whole, Guangxi is where eucalyptus plantations are expanding most rapidly, with approximately 40 000 ha of new plantations being established annually in recent years. The provincial government's target is to establish approximately 670 000 ha of fast-growing, high-yielding plantations linked to processing industries, particularly to pulp mills. The most significant plantation development has occurred in the coastal region, where APP and Stora Enso are developing plantations in 38 counties. To support their proposed mill projects, the two companies have planned an aggregate plantation area of 950 000 ha. A number of other companies - including Oji Pulp & Paper, Jahan Forest Products (Sino Forest Group), Feng Lin, Gao Feng Group, and Guangxi Plantation Development Company - are also developing new plantations in the southern and south-central parts of the province.

The coastal region of Qinzhou, where most of the APP plantations in Guangxi are being established, is separated from the site of the Hainan mill by the Gulf of Tonkin. Topography in this region consists of gently undulating hills. In most cases, the new eucalyptus plantations have expanded on areas classified as 'wasteland' or have replaced sugar cane fields with low productivity. Soils are shallow and, as in western Guangdong, most sites have nutrient deficiencies. All of APP's plantations in this area have been established with eucalypt clones. According to APP officials, the company expects the MAI for these sites to be approximately 15 m³/ha/year. Until now, the entire expansion of APP's plantations has been on land where communities and individual farmers hold user rights, the so-called 'collectively-owned' land and 'farm land allocated to households'. In perhaps 90 % of all cases, APP has planted these lands on the basis of land lease contracts signed with the recognized users.

APP's Hainan plantations

In 1997, APP and the Hainan Forestry Bureau, created a joint venture through their respective subsidiaries, Hainan Jinhai Pulp & Paper Co. and the Hainan Province Forestry General Corporation. This joint venture, named Hainan Jinhua Forestry Corporation Ltd, was established with the objective of building a plantation base of 3.5 million *mu* - equivalent to 233 000 ha (15 *mu* = 1 ha) - for the Yang Pu mill. Within the joint venture, the specific task assigned to the Hainan Province Forestry General Corporation has been to make land available, while APP's Hainan Jinhai Co. has been responsible for financing and managing the plantation development. According to APP's projections, the partnership's future plantations are expected to cover approximately 180,000 ha of 'collectively-owned' land and 'farm land allocated to households', while the remaining 53,000 ha would be provided by the provincial network of state-owned agriculture

farms and state-owned forest farms.⁹

Between 1997 and 2003, the Hainan Jinhua Forestry Corporation planted a total area of 63,530 ha (Table 5). Over 80 % of this expansion has taken place on 'collectively-owned' land and 'farm land allocated to households' in 18 counties. Eucalyptus is the primary genus used, although areas that are not suitable for eucalyptus were planted with acacia, casuarina and pines. Planting peaked in 2000 with over 30,000 ha established during that year, before being suspended in 2001 and 2002 due to the APP group's financial difficulties.

TABLE 5 APP's annual plantation establishment in Hainan Province, 1997-2003 (hectares)

Plantation model	1997	1998	1999	2000	2001	2002	2003	Total
State owned farms	2,370	0	1,255	6,462	0	0	0	10,087
Collective land	4,310	0	8,091	24,271	0	0	16,768	53,440
Total	6,680	0	9,346	30,733	0	0	16,768	63,527

Source: Hainan Province Forestry Bureau, May 2004.

In developing its plantation resource base, APP is implementing several models through which farmer cooperatives and individual households grow wood fiber on their own land. Land leasing has become the most common practice throughout the province, as this is the partnership model that contains the least uncertainty and the lowest risks for the leaser. Contracts are signed for a minimum period of 12 years, but in some cases can last for 30 years.

To some extent, APP's efforts have been hindered by the fact that there has been little spontaneous engagement of local communities and individual farmers towards short-rotation plantations in Hainan. One reason for this is that until recently, there has been very limited local demand for small-diameter logs or wood chips. In addition, two companies under the authority of the provincial government share a monopoly on wood chip exports. Consequently, prices offered to Hainan producers are often 20-25 % lower than prices paid to producers in western Guangdong, where buyers purchase fiber in a competitive market.

In addition to leasing land from local communities, APP has also sought to secure wood from Hai-

nan's existing plantations of eucalyptus, acacia and casuarina, which produce approximately 600,000 m³ of wood on a yearly basis. These include areas planted through government-funded projects and, since 1993, plantations established by private forestry companies.¹⁰ Two local MDF mills use approximately one-third of this production, while the rest is processed into wood chips and shipped to Japan, South Korea and Taiwan. It is estimated that about one-half of the annual production potential of the Hainan plantations grown for fiber (i. e. 300 000 m³/yr) could be re-routed, through contractual agreements, to the Yang

Pu mill. This represents approximately 7.5 % of the total wood volume required by the mill during its first year of operation.

Fiber balance

APP will need a total area of approximately 360,000 ha of plantations to sustain its Hainan pulp mill at a capacity of 1.2 million Adt/yr (Cossalter 2004a; 2004b). This would provide some 72,000 ha that could be harvested annually, assuming that sites were managed on a five year rotation. This should be adequate for generating the 5.0 million m³ of wood needed to fully supply the mill at current growth rates.

We estimate that the 130,000 ha of APP plantations already in place in the three provinces would be able to deliver approximately 7.3 million m³ of pulpwood during the first five years of operation of the Hainan mill (i. e. 2005-2009). If, during this period, the total pulp output is 6.0 million Adt, the mill would require approximately 25 million m³ of wood. It is likely that at least 17 million m³ of this – or more than two-thirds of the total volume of fiber consumed by the mill – will have to be sourced from external suppliers. The Hainan mill's fiber shortfall will be considerably greater if APP chooses to raise capacity further by installing a second pulp production line or moves ahead with plans to build a second pulp mill in Guangxi province.

Part of this shortfall could, in principle, be met by South China's inter-provincial trade.¹¹ Until this year, the region's three provinces have exported the equivalent of 2.3 million m³ of wood annually in the form of wood chips. Only a very small share of this market is bound by long-term contracts, and it is possible that a significant portion of the fiber exported could be

⁹ According to data provided by APP, the company expects that: (i) 15 % (approximately 35,000 ha) of the entire Hainan plantation program will be located on volcanic red soils characterized by high clay content and relatively good fertility; (ii) 50 % (approximately 116,500 ha) on the granites soils of the foothills in the central region, which are of variable fertility; and (iii) the remaining 35 % (approximately 81,550 ha) on the sedimentary infertile sands.

¹⁰ The history of fast-growing plantation development in Hainan is relatively recent and all the areas planted until 1993 were through government-funded projects. After 1993 several industries started to invest in tree plantation. A joint venture between a private enterprise named Korean Wood Chips Company and the Hainan Province Forestry General Corporation (a subsidiary of the Provincial Forestry Bureau) was created to plant casuarina trees. The Wuzhishan Group started planting Caribbean pine for resin production. Also two MDF plants started building up their own eucalyptus resource base.

¹¹ See Cossalter 2004a and 2004b for a more detailed analysis of the potential effects that APP's fiber demand could have on South China's wood chip trade.

redirected to APP's Hainan mill or other pulp production facilities that may come online. However, APP's access to this wood will depend on its willingness to offer prices that are competitive with those offered by Japanese, Taiwanese, and South Korean importers. It is also conceivable that APP will seek to ship in wood from Yunnan Province, where it has forestry operations, and/or from other countries in the region where it has timber and plantation concessions, such as Indonesia or Cambodia.

THE PROPOSED FUXING PULP MILL PROJECT

The proposed Fuxing pulp mill project had, until very recently, been designed as a joint venture involving China's Ministry of Planning (which held 45 % of total shares), Finnish multinational UPM Kymmene (45 % of total shares) and Guangdong's provincial government (10 % of total shares). The proposed mill was to be located on the Leizhou Peninsula in the western portion of Guangdong Province, about 30 km south of

TABLE 6 Areas of eucalyptus and acacia plantation in the four prefectures of western Guangdong Province (hectares)

Prefecture	Age class					Total
	Young	Intermediate	Nearly mature	Mature	Overmature	
Zhanjiang	38,615	29,782	18,592	11,330	40,870	139,189
Maoming	4,467	7,121	8,829	7,602	1,871	29,890
Yangjiang	2,199	3,350	2,434	1,449	8,328	17,760
Jiangmen	9,079	6,009	3,792	4,322	5,405	28,607
Total	54,360	46,262	33,647	24,703	56,474	215,446

Source: Forestry Department of Guangdong Province, November 2004.

Land and wood costs

In the north-west part of Hainan, leasing land that is not suitable for agriculture costs approximately RMB 30-55 per *mu* on an annual basis (equivalent to approximately US\$ 55-100 per ha per year) depending on the location, topography and soil fertility. Land lease prices on the province's east coast are no less than RMB 70 per *mu* per year (US\$ 130 per ha per year) since soils are more fertile and there is more demand for agricultural land. In August 2004, APP officially announced its new land lease policy for Hainan. A yearly payment at 30 % above the current market price would replace the company's earlier practice by which the totality of the lease was paid up-front for the entire contract duration. In addition, a special premium of RMB 70 per *mu* (US\$ 130 per ha) will be paid each year during the first five years of lease for land that could be used for agriculture.

A simulation based on current practices indicates that costs for plantation establishment and maintenance are higher at most Hainan sites as compared to those found in western Guangdong (as discussed below). One reason for this is that tree growing in Hainan requires greater expenditures for fertilizer. This is especially true for the north-west part of the province, which is close to the mill. Provincial forest farms using their own land can produce pulpwood with stumpage costs of US\$ 10-15 per m³ and costs at mill gate ranging between US\$ 20-25 per tonne for a transport distance of 100-150 km. However, the land availability of these government farms is extremely limited. If land has to be leased at costs ranging between RMB 30-55 per *mu* per year (US\$ 55-100 per ha per year), stumpage costs come close to US\$ 20 per m³ and the range of production costs (compounded at 6 % interest rate) at mill gate is between US\$ 30-40 per tonne for a transport distance of 100-150 km.

the city of Zhanjiang. The project had been designed to produce bleached hardwood kraft pulp from plantation-grown wood, particularly eucalyptus. According to project plans, the mill would have an initial production capacity of 700,000 Adt/yr of BHKP, which corresponds to an annual wood demand of 2.9 million m³.

Initial plans were to launch the mill's production in 2006. However, the project encountered delays due to the government's lengthy approval process and efforts by the project sponsors to obtain guarantees that sufficient volumes of fiber would be available at an economically viable cost on a sustainable basis. In November 2004, UPM Kymmene announced that it had decided to withdraw from the project altogether. In its public statement concerning this decision, UPM implied that its withdrawal was based on concerns about the availability and cost of wood fiber in the region surrounding the proposed mill.¹²

As of January 2005, the future of the Fuxing pulp project remains unclear. It is possible that China's national government and/or the Guangdong provincial government will seek to proceed with the project if it can find an investor willing to replace UPM Kymmene. To have a realistic chance of doing so, however, the government will need to ensure that a sufficient resource base of fast-growing plantations would be available to the pulp mill if it were built. The following sections review the fiber supply strategy that had been formulated for the planned mill when UPM was

¹² In a statement posted on the company's website on November 17, 2004, UPM offered only the following explanation: „According to a letter of intent signed in 2003, the task of the joint venture company was to investigate and make preparations for wood supplies for a possible future pulp mill. The decision to withdraw was made after studies of the local conditions and the availability and cost of wood for a modern large-scale mill.“

still involved, and outline many of the issues that would need to be addressed for the project to go forward.

Fibre supply and plantation development plans

According to the project's original plans, the plantation base for the proposed Fuxing pulp mill would be located in the four most western prefectures of Guangdong, namely: Zhanjiang, Maoming, Yangjiang and Jiangmen. Approximately 220,000 ha of eucalyptus plantations currently exist in these four prefectures, although at least a portion of these have been developed for ecological purposes and will not be available for commercial use (Table 6).¹³

These plantations have a total annual production capacity of roughly 1.8-1.9 million m³. They currently supply approximately 350,000 m³ of wood fiber to two local MDF mills and a fiber board mill. Their annual output also consists of 500,000 bone dry tonnes (Bdt) of wood chips which are exported, and an additional 150,000-200,000 Bdt of chips sent to the Rizhao pulp mill in Shandong Province, north of Shanghai.¹⁴ A smaller portion of the production goes to local plywood mills. It is estimated that about one-half of the eucalyptus harvested from these existing plantations could, in principle, be redirected – through contractual agreements – to the Fuxing mill in Zhanjiang, if it were built. This assumes, however, that future wood prices would not be lower than those offered by Japanese and South Korean importers.

According to the initial project plan for the Fuxing pulp mill, substantial investments would be needed to develop new areas of eucalyptus plantations above and beyond those that currently exist in western Guangdong. The mill's fiber supply strategy was to be based upon the development of 200,000 ha of plantations under three different models: 'self managed', 'contracted', and 'membership' plantations.

'Self-managed' plantations – These plantations were to be established and managed by a company affiliated with Fuxing-UPM Kymmene, and would have formed the mill's core raw material area. The company plan-

ned to develop 50,000 ha of 'self-managed' plantations on land that would be leased within Zhanjiang and Maoming prefectures. The average distance to the proposed mill from these sites is 85 km. These plantations also were to have been used as a demonstration area for extension purposes, a base where outside tree growers could learn how to improve the cultural practices and plantation yields on their own land.

'Contracted' plantations – Fuxing-UPM Kymmene had planned to enter into long-term procurement contracts with the 'owners' of 60,000 ha of existing plantations. This was to include a number of existing forestry and agricultural farms located in several counties (municipalities) of the four prefectures of western Guangdong. Most of these farms are state-owned forest farms and are managed either by prefecture or county forestry or agriculture bureaus. According to the proposed plan, the current farm owners would continue to manage the plantations under contracts to the mill. These contracts were to include a protection clause that would set a minimum price for the purchase of pulpwood. The company also planned to stipulate that the Fuxing mill would purchase its wood at the local market price whenever the market price was higher than the agreed contractual price. The average distance of the 'contracted' plantations to the mill would be approximately 135 km.

'Membership' plantations – According to the initial project plan, Fuxing-UPM Kymmene intended to work with the four prefectures of western Guangdong, county governments and forest bureaus to develop 90,000 ha of pulpwood plantations through an outgrower program involving farmer and village land. Under this scheme, members of the outgrower program and the pulp company would sign a contract through which the latter would provide loans and technical assistance in exchange for a share of the future wood harvest. The contract would also give the pulp company a priority right to purchase any additional wood production, above the specified share, from the partner tree growers. It was expected that the 'membership' plantations would be located at an average distance of 130 km to the mill.

Most of the project's 'self-managed' and 'contracted' plantations were to be managed on a five-year rotation period and would use clones of *Eucalyptus urophylla* and E. 12ABL (a variety of *E. tereticornis* bred in the People's Republic of Congo) as planting material. The minimum stand size would be 100 mu (between 6.5 and 7.0 ha). On most sites, the mean annual increment of the existing eucalyptus plantations of western Guangdong ranges between 10 and 20 m³/ha/year, depending on site quality and management

¹³ There are a number of ecological and geographical features that have favored plantation development in western Guangdong. The region's humid tropical climate is well-suited to tree growth and particularly to some of the fastest growing eucalypts. The annual mean temperature is 23.5 °C. Absolute recorded maximum and minimum temperatures were respectively 38.8 °C and -3.0 °C. The annual mean precipitation is 1,800 mm. Topography in the coastal area where eucalyptus plantation are grown consists of plains and gently undulating tablelands easily accessible to vehicles and heavy machinery used for forest work. In addition, a dense network of well maintained national and secondary roads is already in place in the region. Zhanjiang is also connected to the central and eastern part of Guangdong province as well as to the neighboring province Guangxi by rail. Finally, the four prefectures cities have their own sea port.

¹⁴ 1.0 Bdt of wood chips is equivalent to approximately 2.1 m³ of debarked wood (sub).

practices. The sponsors of the Fuxing mill project expected that their future plantation base would have an average increment of 18.5 m³/ha/year to be able to deliver an average of 14 m³/ha/year of commercial wood.¹⁵

Fibre balance

According to the project's original plan developed in 2002, the sponsors of the proposed Fuxing pulp mill foresaw modest fiber shortfalls during the first few years of the mill's operation, which was initially scheduled for 2006. To gain insights into UPM's recent decision to withdraw from the project, we have reassessed those projections based on what we believe would have been the most optimistic scenario for the project had it gone forward (Cossalter 2004b). This reassessment is based on the assumptions that the mill would begin operating by 2008 and that the associated plantation development plan, as described above, would be fully implemented but delayed by one year.

According to these calculations, the mill could be expected to produce an aggregate of 1.015 million tonnes of pulp during its first two years of operation (i. e. 2008-2009). This would require approximately 4.2 million m³ of pulpwood (solid wood under bark). The mill would likely have been able to secure some 3.7 million m³ of wood from plantations associated with the project during that two-year period, while approximately 500,000 m³ would need to be obtained from outside sources.

Similarly, during the ensuing five years of operation (i. e. 2010-2014), the mill could be expected to produce some 3.46 million tonnes of pulp, requiring an aggregate of approximately 14.4 million m³ of pulpwood. During this period, plantations associated with the project would likely be able to generate 13.0 million m³, leaving a shortfall of some 1.4 million m³. Assuming that they produced a commercial MAI of 14 m³/ha/year on an industrial scale, it is reasonable to expect that after 2014 the 200,000 ha of fast-growing plantations that were to be developed would be able to supply the Fuxing mill's entire fiber demand – at an installed capacity of 700,000 Adt/yr – on a sustainable basis.

It is quite conceivable that the relatively modest fiber shortfalls that the Fuxing mill would face in its first few years of operation could be filled through external purchases from plantation companies within

China and/or through wood chip imports. Of perhaps far greater concern to the project sponsors is the fact that competition for land in western Guangdong would make it very difficult to develop a plantation resource base for a second pulp production line, if they chose to expand the mill. If, for instance, the project sponsors were to raise the mill's capacity to 1.4 million Adt/yr, they would need to develop a plantation base of approximately 400,000 ha. Moreover, as the following sections explain, plantation development in western Guangdong also faces greater risks and higher costs than are commonly recognized.

Significant risk factors

The main uncertainty regarding the development of the proposed fiber resource base lies in the extent to which farmers would agree to participate in the 'membership' plantation scheme. Western Guangdong has a rural population of 10.5 million people, of which 4.1 million reside in Zhanjiang prefecture. Per capita area of arable land and forestland are respectively 1.08 *mu* (720 m²) and 1 *mu* (670 m²) is approximately, and farmers rely heavily on their land for their daily subsistence and income. Consequently, a farmer's decision to plant eucalyptus on his/her limited land area would mainly depend on the comparative benefits associated with growing eucalyptus wood rather than fruit trees or sugar cane.

Recent years have seen the proliferation of wood chip plants in western Guangdong in response to strong demand and high prices offered on the export market. Local chip producers are buying eucalyptus wood at attractive prices – up to US\$ 36.5 per tonne at mill gate in September 2003 and up to US\$ 40 in August 2004 for wood without bark and with diameter ranging between 3 and 8 centimeters (cm). This has led to a sharp increase in private investment in eucalyptus plantations on community and farmer lands in recent years. Much of this investment has been made by local entrepreneurs developing plantations on so-called 'wastelands' leased from communities. Also, there have been cases of farmers converting their sugar cane fields into eucalyptus plantation.

Within this context, managers of local plantations and wood chip plants fear that the government could impose a limit on wood chips exports in order to force the re-routing of most of the current production to the Fuxing mill, if it were built. Their concern is that a limit on exports would result in lower prices for the wood chips used domestically, and this, in turn, would create disincentives for tree growers. Less favorable market conditions would lead many tree growers to re-evaluate the levels of risk and uncertainty they are willing to accept.

Eucalyptus plantations in western Guangdong also face significant risks and constraints associated with the region's biophysical conditions. A large proportion of the region's soils have granites or sedimenta-

¹⁵ The project sponsors reportedly expected that altogether, the plantations located in the prefectures Zhanjiang and Maoming should be able to supply approximately 80 % of the mill's needs on a sustainable basis at an installed capacity of 700,000 Adt/yr. Their average distance to the mill would be approximately 90 km. Plantations in Yangjiang and Jiangmen would be located further away, at distances up to 350 km.

ry infertile sands as parent material, and therefore, they often have low fertility and poor water-retaining capacity. It is estimated that 90 % of the area of existing plantations has nutrient deficiency problems. Over the last 15 years, the widespread adoption of fertilizers and micronutrient regimes, coupled with the generalization of clonal forestry, has resulted in plantation yields more or less doubling. At present, purchase of fertilizers may account for 35-40 % of the total plantation establishment and management costs. Further progress is expected when new clones which are more efficient in the use of scarce water and nutrient soil resources become available. However, we estimate that the overall poor soil characteristics will remain the most important constraint to further improvement of plantation growth in the region.

Typhoons represent another risk factor in western Guangdong which has been largely underestimated. Typically, they come from the east between July and September. Meteorological statistics show that between 1979 and 2001, there were 45 typhoons in the region: six had winds exceeding force 12 on the Beaufort scale; 29 had winds between force 8 to 11; 10 had winds below force 8. There is a risk of at least one typhoon above force 8 every year causing breakage among young trees and exposing wounded trees to disease infection. There is also a risk of an entire age-class being knocked down every 7-8 years by a force 11-12 typhoon. Eucalypts are particularly exposed between ages 2 and 3.

Another significant risk factor is the general lack of genetic diversity in the region's plantation base. Since the late-1980s, substantial investments have been made to develop tree breeding and clonal forestry in western Guangdong. This has involved the testing of a large number of eucalyptus species and provenances, the establishment of seed orchards, the synthesis of new breeds through controlled pollination and the testing of clones. In spite of this important research effort, the number of eucalyptus clones which are available for mass distribution is still extremely limited. Approximately 90 % of the plantations established in recent years are composed of three clones: U6, W5 and Leizhou N° 1.

The fact that the very dynamic eucalyptus plantation expansion in western Guangdong is not supported by a continuous flow of new clones selected and tested for their genetic superiority and resistance to pest and diseases is a matter of concern. In other words, the new clonal eucalyptus plantations of western Guangdong lack the minimum threshold of diversity that would place the risks of pest and disease attacks at a reasonable or acceptable level. Plantation managers are concerned by the recent outbreak and rapid propagation of a new disease - not yet clearly identified - on the clone U6 of *E. urophylla*. It is likely that such phenomena will become more common in the future with an expanding plantation resource made of monoclonal stands, if nothing is done to guarantee a sufficient yearly turnover of new clones.

Land and fibre costs¹⁶

A simulation based on current practices and operation costs indicates that the stumpage costs of plantations established under the 'self-managed' model would be on the order of US\$ 22 per m³ (+/- 10 %). The cost at mill gate of 'self-managed' wood would amount to US\$ 35 per tonne (+/- 10 %) for an average transport distance of 85 km between the plantation sites and the mill. The other parameters used for this simulation included:

- A land lease cost of RMB 80 per mu and per year (equivalent to US\$ 148 /ha /year) payable on a yearly basis;
- Production of 70 m³/ha of commercial wood at the end of the 5-year rotation;
- General overhead costs of the 'self-managed' plantation estimated to be 8 % of its direct production costs;
- A 6 % rate of interest for calculating the compounded production costs.

Most of these parameters were also used for simulating the costs of wood to be produced under the 'contracted' plantation model, the only exceptions being the cost of overhead (raised to 12 %) and the average transport distance (raised to 135 km). We have also assumed the absence of a land lease fee for the 'contracted' model, due to the fact that the farms involved in this type of arrangement - state-owned farms, in most cases - will generally use their own land. Stumpage costs in this case would be on the order of US\$ 10 per m³ (+/- 15 %). Average costs, not including the farm's profit, for wood delivered at the Zhanjiang mill gate would amount to approximately US\$ 24 per tonne (+/- 10 %).

The same simulation approach was used to estimate the wood production costs of the 'membership' model. These calculations found stumpage and compounded costs to be US\$ 12 per m³ (+/- 10 %) and US\$ 30 per tonne (+/- 10 %), respectively. The parameters used in this simulation included:

- A growth period of four years and the harvest of 64 m³/ha of commercial wood at the end of each rotation;
- An average transport distance of 130 km between the plantation sites and the mill;
- A 6 % rate of interest for calculating the compounded production costs;
- Overhead costs of tree growers amounting to 3.5 % of their direct production/operational costs.

CONCLUSION

The Government of China is actively promoting the development of a domestic wood pulp industry by providing significant capital subsidies and investment

¹⁶ The figures presented in this section are examined in greater detail in Cossalter 2004a and 2004b.

incentives to a handful of priority projects. Most immediately, the government is supporting 13 high priority pulp and paper projects – including three kraft pulp mills – by allocating several billion dollars in discounted loans from state-owned banks, loan interest subsidies from the Ministry of Finance, and an accelerated investment approval process. The government has also set a target to subsidize the development of up to 5.8 million ha of fast-growing pulpwood plantations in order to provide the new mills with a sustainable supply of fiber. It remains unclear what portion of this has been achieved thus far.

In this article, we have traced the wood supply strategies of two of the government's priority pulp mill projects: APP's Hainan Jinhai mill and the planned Fuxing mill project. Based on existing plantation establishment, we anticipate that both mills are likely to face fiber shortfalls over the medium term, and in APP's case, these shortfalls will be quite substantial. Significant new investments in plantation development will be needed to provide an adequate fiber supply at the mills' projected capacity levels. This will need to involve not only expansion of annual planting programs, but also measures to increase productivity levels and to mitigate risks at plantation sites. In particular, it will be essential to expand the genetic diversity in the region's plantation resource base to strengthen protection against pests and diseases.

The need to raise productivity and to expand plantation development is particularly urgent in the case of the APP Hainan Jinhai mill, which began BHKP production trials in November 2004. To the extent that existing plantation resources are insufficient to meet the currently installed capacity, the mill will be forced to ship in wood from other parts of China or from external sources – which could include, for instance, forested parts of the Mekong region or Indonesia (Barr 2004). Given APP's experience in Indonesia – and more recently, in China's Yunnan Province – it is conceivable that fiber shortfalls at the Hainan mill could place new pressures on natural forests in supplier countries (Greenpeace 2004; Lang 2002; Barr 2001).

Estimates of the delivered wood costs for the APP Hainan Jinhai mill and the proposed Fuxing mill suggest that the cost of wood produced by state-owned forest farms will often be in the range of US\$ 20-25 per tonne. By contrast, the cost of wood grown on land that has been leased by the companies or on collective land managed through outgrower schemes will often range between US\$ 30 and US\$ 40 per tonne, depending in part on the distance the wood needs to be transported. These costs are significantly higher than the delivered wood costs reported by producers in Indonesia and in Brasil. This, in turn, raises fundamental questions about the competitiveness of wood-based pulp production in China, particularly when substantially cheaper pulp is readily available on the global market.

The wood supply strategies of both mill projects examined in this study highlight the importance of providing secure benefits for local communities. In both cases, the pulp producers will depend heavily on collectively owned land to secure their respective plantation bases – whether these areas are leased by the companies or developed through outgrower schemes with rural households and/or farmer cooperatives (Cossalter 2004a). In either case, it will 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 wood they produce (Lu Wenming *et al.* 2002). Given the large volumes of wood that will potentially be consumed by the pulp mills currently planned for South China, the development of fast-growing plantations through company-community partnerships could hold considerable promise as a strategy for raising farmers' incomes. However, experiences from other countries suggests that plantation outgrower schemes can also pose significant risks (Nawir *et al.* 2003; Mayer and Vermeulen 2002). Further analysis will therefore be needed to assess the strengths and weaknesses of various models for such partnerships and to evaluate the likely socio-economic impacts of pulp and plantation projects on surrounding communities.

More generally, there is a critical need for improved government planning and regulation with respect to large-scale kraft pulp mill projects. In particular, it will be essential for government planning agencies at the national and provincial levels to ensure that a fully legal and sustainable supply of wood fiber is secured before new pulp processing capacity is installed (Barr 2004). This will require close coordination between the agencies responsible for industrial licensing – i. e. the National Development and Reform Commission (NDRC) and its provincial counterpart – and the State Forest Administration and provincial forestry bureaus. Given the very large scale of modern pulp mills, which now routinely have single production lines of 700,000 tonnes or more, there is also a need for pulp producers to develop accountable plans for meeting sustainability targets on key social and environmental issues (Spek 2004). Government agencies at the national and provincial levels should monitor the companies' implementation of these plans to ensure that key targets are being met.

Finally, there is a need for stronger financial due diligence practices, particularly on the part of China's state banks, to assess both the economic risks and the social-environmental impacts of pulp capacity expansion projects (Spek 2004). Given the large amounts of capital required, kraft pulp mills are generally associated with high levels of moral hazard, as APP's financial troubles in recent years have demonstrated. In particular, there is a need for investment institutions to involve forestry experts in evaluating pulp producers' fiber supply strategies before new processing capaci-

ty is financed (Barr 2004). China's state banks would likely benefit from participating in the Equator Principles initiative, sponsored by the World Bank Group's International Finance Corporation (IFC), and other international efforts to raise investment standards for socially and environmentally sensitive projects (Spek 2004).

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