Research paper

Analysis of Timber Supplier Selection and Domestic Timber Requirements of the Forest Products Industry in Taiwan

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【Summary】

In this study, we used the supply selection criteria theory to formulate a questionnaire survey to analyze issues of wood materials selection criteria and domestic wood demand within the Taiwanese domestic forestry industry. The investigation surveyed 232 companies, and the results showed that companies currently in the forest products industry are mainly small and medium-sized. Only 26.29% of respondents within the past 3 yr had used at least some raw wood materials from a domestic source, and the main reason for that was "there is an insufficient number of domestic sources", while the most important factor for companies in the supply of raw wood material choice was "stable source of supply of wood and wood products,". The proportion of respondents who had used domestic wood in the past 3 yr was 59.32%, and they expected to increase the use of domestic wood in the future. Among companies that had not used domestic wood in the past 3 yr, 66.67% said that they would not consider using domestic wood. The most practical way to increase the demand for domestic wood would be to upgrade domestic timber self-sufficiency, while maintaining a commitment to sustainable forest management. To increase the use of domestic timber production, the number of domestic timber suppliers should be increased and the domestic wood self-sufficiency rate should be upgraded, while maintaining a commitment to sustainable forest management.

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研究報告

國內林產工業經營者對木材供應選擇與對國產木材需求之研究

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摘　要

本研究以供應來源選擇準則理論，以問卷調查的方式，分析國內林產工業經營者對選擇木材料源時之準則與對國產木材需求與使用問題。盼藉由瞭解國內林產工業經營者對木材供應選擇，以找出未來提升國內木材供應之可行管道，依調查232份之不同受訪廠商的結果顯示：目前林產工業廠商主要以中小型為主的經營型態，僅有26.29％的受訪廠商近3年之木材原料來源有使用部分國內木材，不使用的主要原因「國內木材供應來源及數量不足」，而廠商選擇木材原料供應考慮因素即以「木材供應來源穩定」最為重要。而過去3年曾使用過國內木材的受訪廠商，有59.32％的比例，未來仍會增加使用比例，而過去3年未曾使用國內木材廠商仍將不會考慮使用(66.67％)，因此如何提高國內生產木材的使用，應提高國內木材供應來源及數量，即提升國內木材自給率，為可行的方式，這也符合森林經營的永續。

關鍵詞：國產木材、林產工業、供應來源選擇準則、木材自給率、永續森林經營。

INTRODUCTION

Timber is a basic raw material crucial to the life of a nation and necessary for the development of its industries. Government and industry alike attach great importance to the supply of and demand for timber. Many alternatives were proposed in response to questions of how to strike a balance between timber production and forest management. One such example is the Principles for the Sustainable Management of Forests from the 1992 Earth Summit in Rio de Janeiro, Brazil, which was declared to be a solution to address the issue of the destruction of forests. New forestry measures in the US in 1992 also stressed the prudent use of resources, in order to ensure the natural restorative ability of ecosystems. Various international groups have responded by suggesting increased restrictions on logging, and the surprising notion that any timber not having received international certification would no longer be permitted to flow freely internationally. Recently, as global forest resources continue to diminish, there has been a growing awareness of environmental issues such as the conservation of biodiversity, mitigation of and adaptation to climate change, the combating of illegal logging, forest certification, reductions of deforestation and forest degradation, and other well-publicized environmental issues. These have become increasingly important, and more and more people are beginning to pay attention to environmental issues. When consumers purchase or use products, they consider

the price, delivery time, quality, and other economic aspects (Dickson 1966, Weber et al. 1991, Zhang et al. 2003). Concern for the environmental and social dimensions of products purchased in the production process can have a negative impact (global warming, loss of biodiversity, illegal logging, deforestation, and forest degradation). Therefore, we can expect future purchases of products to exhibit significant changes, and forest product purchases will initiate the concept of sustainable procurement. That is, in the process of purchasing wood and paper products, in addition to maximizing the monetary value, one will also need to be concerned about the social and environmental impacts in the entire life cycle when purchasing products and services.

As a result, timber-producing countries have begun to pay more attention to protecting their own forest resources and limiting their timber exports. Due to increased environmental awareness, domestic forestry policies in Taiwan: have evolved from large-scale logging of earlier periods to a stage where restrictions are placed on logging, in an attempt to meet requirements for environmental protection and national land conservation. This has led to a gradual reduction in domestic timber production. According to forestry statistics in Taiwan, between 1971 and 1976, domestic timber production was more than 10^6 m^3 yr^{-1}, but this has since drastically declined. Since 1990, production was $< 10^5$ m^3, and in 2008, it was only 3 x 10^4 m^3 (Taiwan Forest Bureau 2009). Because domestic timber production has been declining annually while domestic demand for timber has been increasing, there has been a corresponding increase in a dependence on imported timber. The current domestic timber self-sufficiency rate is $< 1\%$.

In contrast, other countries are increasing their timber self-sufficiency. According to a study by Papadopoulos and Karagouni (2007) on timber supplies in Europe, most EU countries have reached a self-sufficiency rate of milled lumber of 93%, although a number of European countries, such as Hungary, Italy, Greece, Cyprus, Holland, Denmark, and Malta, have seen their rates drop to $< 20\%$. The reasons for this drop include (1) inadequate forest areas, (2) poor forest management over the past 200 yr, (3) forests being protected and managed as recreational areas, not for logging, and (4) a failure to invest in the timber-processing industry or delays in its development, which have led to reduced yields. Obviously, self-sufficiency in timber is related to sustainable forest management.

Because most companies in the forest products industry are unable to produce their own raw materials (timber), these supplies must be obtained from other sources. Through the processing or reselling of this lumber, greater value can be added and higher profits obtained. Therefore, as the procurement of raw materials is a necessary process during manufacturing, the evaluation and selection of material suppliers are crucial (Dahel 2003, Millington et al. 2006). Managing the supply chain involves uncertainties in demand, transactions, and the market when bargaining with suppliers (Hakansson and Wootz 1979). Zsidisin and Ellram (2003) summarized the sources of risk inherent in the purchase and supply of products: (1) an inability to control market demand, (2) delivery oversights, (3) an inability to provide competitive price advantages, (4) substandard technology, and (5) an inability to meet quality requirements. In studying market purchasing behavior, Monczka and Trent (1991) stated that companies should try their best to estimate the risk of procurement before a purchase. A company's procurement strategy must be evaluated according to a number of considerations: the

supplier and buyer relationship; development of global sources; development of long-term supplier relationships; long-term supply contracts; buyer-stipulated material sources; multidimensional trading technology; development of multiple supply sources; centralized procurement practices; and reductions in the proportion of consumables.

When choosing a supply source, manufacturers often base their decisions on past experience or their own subjective point of view. Such limited, fragmented decision-making processes often influence the quality of the decisions. A more-objective and scientific approach is to use screening and selection indicators to more comprehensively evaluate potential suppliers. Supplier selection criteria are applied to achieve an integrated, standardized, basic assessment of supply sources for manufacturers, reflecting an integrated assessment of criteria regarding various aspects of a complex system that forms as a result of interactions between manufacturers and the environment. Among various industries, criteria for manufacturers, product demands, the environment, and supplier selection vary. However, this process generally involves no more than the sum total of the various aspects of supplier quality, such as performance, equipment management, human resource development, quality control, cost control, technology development, customer satisfaction, delivery, and post-sales service agreements that may affect cooperation with the supplier. Dickson (1966) examined the criteria used by manufacturers to select suppliers. Results showed that supplier selection criteria varied in different situations. Among 23 criteria, quality, delivery, and performance history were more-important selection criteria. Wind and Robinson (1968) found that most manufacturers use different criteria to screen and select suppliers, and the rules they use include

a number of tangible and intangible benefit factors. Evans (1982) believed that the importance of supplier assessment criteria is related to categories of the products traded. Shipley (1985) asserted that when selecting suppliers, the price, quality, and delivery are necessary but insufficient criteria. Gregory (1986) suggested that evaluation criteria should be quality, effectiveness of manufacturing systems, performance history, procurement, and price. Caddick and Dale (1987) believed that assessment criteria are affected by products, services, and procurement factors. Cayer (1989) pointed out that supplier selection criteria often include staff relations, financial conditions, production capability, quality control, material control, and technical support; all of these are based on supplier-related factors rather than product-related factors. Weber et al. (1991) applied the 23 listed supplier selection criteria from Dickson's research as the basis to summarize 74 published studies; they showed that the 3 most frequently used selection criteria are supplier net price, delivery, and quality. Subsequently, Wilson (1994) and Lamber et al. (1997) chose the same items as the most important assessment criteria. Lehmann and O'Shaughnessy (1993) proposed the use of other indicators such as performance, economy, overall fitness, and legal compliance. Chao et al. (1993) believed that the quality of goods purchased was most important, followed by on-time delivery and accuracy in transporting the goods. Swift (1995) asked why manufacturers used particular criteria to choose their suppliers, and by analyzing various factors, supplier selection was summarized according to 5 factors: product-related properties, dependability, experience, price, and availability. Vonderembse and Tracey (1999) found that aspects of supplier selection, involvement, and performance had significant positive impacts on

both manufacturing and performance. Zhang et al. (2003) based a study on research by Weber et al. (1991) in selecting and summarizing 49 studies from the published literature in 1992~2003. The results showed that the top 3 criteria were the net price of the supplied material, product quality, and the punctuality of delivery. There are many other studies on the importance of assessment criteria for supplier selection (Choi and Hartley 1996, Petroni and Bragli 2000, Narasimhan et al. 2001, Quayle 2002).

Climate change is recognized by most countries as an unprecedented challenge, unlike anything we have ever faced. The world demand for wood products can be expected to significantly increase if developed countries are sincere about their commitment to reducing greenhouse gas emissions. All wood-substitutes (steel, cement, plastics, and aluminium) are major energy users and require much more energy than equivalent wood products (Koch 1992, Sutton 1993). Through reforestation efforts and improved forestry management, increased absorption and storage of carbon dioxide can be achieved. The development of forestry and improvements in carbon storage efficiency are 2 feasible approaches to carbon management. One after another, countries around the world have begun strengthening forest protection and reducing emissions due to deforestation and forest degradation, in conjunction with forest restoration and sustainable management (REDD-plus) under the full effect of the framework. Currently, 99% of the lumber in Taiwan comes from imports, which means that future sources of domestic timber are certain to be a problem. Over the years, our self-sufficiency in timber has been relatively low, mostly due to a reliance on imports, and any changes in international timber prices affect domestic prices. Therefore, with the expected reduction in import sources and

pressure from international environmental organizations, increasing self-sufficiency in timber is essential. On the other hand, increasing self-sufficiency in timber will also reduce carbon imports that accompany the importation of timber and reduce the carbon footprint from transporting timber. During a Council of Agriculture meeting held in June 2010, in which an "Agricultural Adaptation to Climate Change Policy Conference" was discussed, and under management strategies and concrete action plans developed as part of the vision of a "low-risk, low-carbon emission, new business opportunities", 7 key coping strategies were proposed. Key coping strategy number 3 of promoting low-carbon agriculture includes organizing production and marketing cooperatives, establishing regional production systems, improving processing techniques, and developing the forestry industry.

In this study based on manufacturers of the Taiwanese forest products industry, our intention was to determine the current status of the requirements and applications for domestic timber. We also examined the applicability of plantation timber to the Taiwanese forestry industry, to determine the feasibility of raising domestic self-sufficiency through the use of plantation timber. We sought to apply supplier selection criteria theory to operations of the domestic forest products industry. It is hoped that through a deeper understanding of the selection of timber suppliers by operators in the domestic forest products industry, a feasible solution for increasing the future domestic timber supply can be identified. It was our hope that this can lead to formulation of policies to meet actual demands, reduce differences between production and consumption, expand the applicability of domestically produced plantation timber, and improve domestic self-sufficiency in timber.

MATERIALS AND METHODS

Questionnaire design

This study used the above-mentioned elements and previous relevant research to formulate a topic-specific questionnaire. The survey was divided into 5 parts. In part 1, we identified the number of employees and type of company among those participating. In part 2, we identified sources of raw materials (timber or timber products) for production and marketing during the past 3 yr. In part 3, we identified the level of agreement/disagreement regarding questions related to the domestic timber supply, according to research results of Jen (1996), Jen et al. (1999), Lin et al. (1999), and other previous relevant research. As previous researchers made clear, traditional criteria for selecting suppliers can serve as the basis for assessing supplies, even today. Although the selection of sources of raw material varies among industries and time frames, differences are not significant. Because this study discusses the demands for timber, the above-mentioned elements were considered in this study. We employed the results from previous studies, and collected information from the literature regarding supplier selection criteria, to serve as the basis of this study. These issues were further divided into 7 items: 1. high domestic timber prices; 2. insufficient domestic timber supply sources; 3. domestic timber types and failure to meet required specifications; 4. poor domestic timber quality; 5. forest protection policies of banning the cutting of domestic forests; 6. the period in which limitations were imposed on cutting domestic forests; and 7. complicated procedures for domestic logging. In part 4, we identify the importance of various considerations in choosing timber suppliers. Based on different industry characteristics, 14 important items when selecting a raw timber supplier were listed: 1. the provision of low-cost timber or timber products; 2. source stability for timber or timber products; 3. favorable past business dealings; 4. the quality of supplier facilities; 5. the quality of timber or timber products; 6. on-time delivery; 7. the quality of the service provider; 8. being a big-name supplier; 9. provision of technical information by suppliers; 10. changes in exchange rates; 11. domestic forest conservation policies; 12. certification of timber or timber products; 13. legitimate cutting of timber; and 14. domestic production of timber or timber products. Items 1~10 were adapted from Dickson (1966), Weber et al. (1991), and Zhang et al. (2003), and items 11~14 were based on future trends of sustainable procurement and environmental policy. In parts 3 and 4, we adopted a 5-point Likert scale for each company of this survey to rank the level of agreement/disagreement and importance regarding the items they had already identified; with 1 representing strongly disagree (or extremely unimportant); and 5 representing strongly agree (or extremely important); and the ranking was thus divided into 5 grades. Part 5 deals with factors related to the question of whether or not a company would consider using domestically produced timber in the next 3 yr.

Sample and data collection

Data on companies in this survey came from registries of timber product import manufacturers and traders listed in the complete Taiwanese industry catalog produced by the National Federation of Industries in Taiwan (National Federation of Industries 2009). It included 1404 companies (but excluding those in the paper industry), all of which were targeted as samples for this survey. We mailed 2 sets of questionnaires. The first wave of surveys was sent to 1404 recipients on July

27, 2009. On August 17, 2009, those who had failed to answer the first questionnaire were sent a second one. The collection period of the questionnaires was July 27 to October 31, 2009. After removing invalid questionnaires, 232 were deemed to be valid, for a response rate of 16.52%. Following data collection, the presence of a non-response bias was estimated and, if necessary, corrected for, in order to increase the ability to generalize the results (Armstrong and Overton 1977). The non-response was evaluated using a method described by Armstrong and Overton (1977). The first respondents were compared to the last respondents by the number of employees and company type. Independent t-tests were used to compare differences in the means of the 2 subsamples. No significant differences in the results were detected between the 2 subsamples.

Analysis method

After the questionnaires were collected, valid questionnaires were number-coded, and the data were entered into a computer. SPSS software (Chicago, IL, USA), which includes descriptive statistics and Chi-squared analysis, was used for data processing and analysis. By identifying the origin of the timber, companies using domestically produced timber were distinguished from those not using it. An analysis of variance (ANOVA) was applied to compare the agreement level between the 2 categories (100% imported timber vs. some use of domestic timber) of companies regarding questions of domestic timber supply, the level of importance of each factor when selecting a timber supplier, and whether or not similarities existed regarding the factors considered in deciding to use domestic timber. For future statements, we used the U_{im} category for companies that used 100% imported timber (no domestic timber), and the

U_{dom} category was for companies using some percentage of domestic timber.

RESULTS AND DISCUSSION

Raw materials for the production or sale of timber or timber products in the past 3 yr

Of all the surveyed companies, those companies using 100% imported with no domestic timber (U_{im}) in the past 3 yr accounted for 73.71%, and the remaining (companies using domestic timber, U_{dom}) 26.29% had used some domestic timber. Of those U_{dom} companies which used domestic timber, half of them used < 20% domestic timber (Table 1). Because the quantity of timber produced in Taiwan is very low, the rate of using home-grown timber was not high. Even among the small number of manufacturers who used domestic timber, the proportion of domestic timber used was not high. This is a clear indication that increasing self-sufficiency in timber is crucial.

Type of manufacturer and number of employees of its Taiwanese location

Among the 232 valid questionnaires collected, those with 1~10 local employees accounted for 44.35%; and those with 11~50 accounted for 40.87%. These results were similar to findings by Lin et al. (1999). Respondents with fewer than 10 employees accounted for approximately half of the total, indicating that Taiwanese wood-based manufacturers and traders are mainly small companies. The company type (multiple choices were allowed), with the highest proportion was of factories, accounting for 78.88%, followed by importers at 29.31%. In efforts to control costs and increase profits in their operations, factories try to minimize the costs of their raw materials by going straight to timber

Table 1. Sources of raw materials for wood products produced and sold in the last 3 yr

Item	Percentage (%)
Source of raw materials	
U_{im}: 100% imports (no use of domestic timber)	73.71
U_{dom}: Some use of domestic wood (use of domestic timber)	26.29
The proportion of domestic wood use (U_{dom})	
< 10%	29.51
11~20%	21.31
21~30%	11.48
31~50%	13.11
51~99%	8.20
100%	16.39

importers, in order to shorten the supply chain (Jen 1996, Lin et al. 1999). That was obvious. The number of companies with fewer than 50 employees among all Taiwan industries accounted for more than 85%. At present, the forest products industry consists mainly of small- to medium-sized businesses (Table 2).

Raw material sources were divided into 2 categories: the U_{im} category of companies which used 100% imported and no domestic timber and the U_{dom} category which used some domestic timber. Most (54.1%) U_{dom} companies had fewer than 10 employees, and a higher proportion of U_{im} companies had 11~50 employees. The dominant company type for both U_{im} and U_{dom} was factories.

However, a slightly higher proportion of U_{dom} companies than U_{im} companies was factories, but a slightly higher proportion of U_{im} companies than U_{dom} companies was importers.

Level of agreement regarding questions of domestic timber supply

For all manufacturers, the biggest problem was item 2: "insufficient number of domestic source of wood" (4.16), or whenever the quantity of raw materials supplied by a source became insufficient, the willingness to continue using that source naturally diminished. Item 4, "poor quality of domestic timber" (2.81), had the lowest mean, indicating that the quality of domestic timber is

Table 2. Number of employees and company type in different categories in Taiwan (%)

Item/Category	U_{dom}	U_{im}	Total
Number of employees			
1~10	54.10	40.83	44.35
11~50	36.06	42.61	40.87
51~100	4.92	8.28	7.39
> 100	4.92	8.28	7.39
Company type (multiple response)			
Agent of a foreign company	6.56	7.02	6.90
Importer	21.31	32.16	29.31
Factory	81.97	77.78	78.88
Other	22.95	15.79	17.67

U_{im}, company that used 100% imported timber; U_{dom}, company that used some domestic timber.

not a problem. Within the category of different sources of timber, those companies that used domestic timber were separated from those that did not. The highest and the lowest agreement levels regarding questions of domestic timber supply were items 2 and 4, respectively, which turned out to be similar. The other options were in slightly different orders. Agreement levels for the question of domestic timber were items 2 > 7 > 5 > 6 > 1 > 3 > 4; the priorities of agreement levels for the question of domestic timber supply answered by those that did not use domestic timber were items 2 > 3 > 1 > 5 > 7 > 6 > 4. A variance analysis was used to compare the agreement levels between the 2 categories of company in terms of domestic timber supply. According to the variance analysis results, at a significance level of 5%, the 2 categories of company showed a significant difference in item 3: "types of domestic wood and specifications do not meet requirements". U_{im} companies were significant higher than U_{dom} companies. In addition to the quantity of domestic timber, the specification and type of domestic timber failed to meet demands. Therefore, the only solution for U_{im} companies was importation (Table 3).

Importance level in selecting suppliers of raw timber by manufacturers

The most important item of surveyed manufacturers when selecting a raw timber supplier was item 2 (4.44) ("stable source of supply of wood or wood products"), followed by items 5 ("good quality wood or wood

Table 3. Level of agreement regarding the domestic timber supply

Item	Category	Mean	SD	F-value
1. High price of domestic timber	U_{dom}	3.51	0.99	3.36
	U_{im}	3.79	1.04	
	Total	3.72	1.03	
2. Insufficient number of domestic sources of wood	U_{dom}	4.03	0.68	2.02
	U_{im}	4.20	0.82	
	Total	4.16	0.79	
3. Types of domestic wood and specifications do not meet requirements	U_{dom}	3.46	0.98	6.02*
	U_{im}	3.81	0.96	
	Total	3.72	0.98	
4. Poor quality of domestic timber	U_{dom}	2.70	0.74	1.18
	U_{im}	2.85	0.93	
	Total	2.81	0.88	
5. Domestic logging ban policy	U_{dom}	3.69	0.76	0.37
	U_{im}	3.77	0.97	
	Total	3.75	0.92	
6. Limiting the amount of domestic forest cutting each year	U_{dom}	3.67	0.93	0.15
	U_{im}	3.73	0.91	
	Total	3.71	0.92	
7. Complicated procedures for logging in national forests	U_{dom}	3.79	0.73	0.11
	U_{im}	3.74	0.95	
	Total	3.75	0.90	

U_{im}, company that used 100% imported timber; U_{dom}, company that used some domestic timber; SD, standard deviation. * Significant at the 5% level.

products") (4.39) and 6 ("delivery on time") (4.38); while items 8 ("being a big-name supplier") (2.88) and 14 ("domestic production of wood or wood products") (3.38), were relatively less important. In Jen et al.'s (1999) analysis of the current level of concern regarding operations among Taiwanese timber industry manufacturers, they were more concerned about supplier stability in the next 3 yr. In 1995, Lee and Xu (1996) conducted a questionnaire survey of domestic wood-based manufacturers. The data analysis from that study indicated that 1 of the most difficult problems encountered in the domestic operations of wood-based industries was "unstable sources of supply of raw materials". Jen (1996) showed similar results regarding the importance manufacturers attached to factors such as timber quality, delivery accuracy, and supplier stability, when analyzing the timber procurement decision-making factors of Taiwanese manufacturers. Evidently, material supply sources have always been a central concern of manufacturers.

Through the use of an ANOVA, this study compared the degree of importance regarding factors when selecting a raw material supplier between the 2 categories of manufacturers.

The results showed that for companies that used some domestic timber (U_{dom}), items 2 ("stable sources of supply of wood or wood products") (4.34), 13 ("legal timber from logging") (4.25), and 6 ("delivery on time") (4.15) were the most important when choosing a raw timber supplier, while items 8 ("being a big-name supplier") (2.93), 3 ("good previous business dealings") (3.67), and 1 ("provision of low-cost wood or wood products") (3.70) were least important. The results showed that for companies that did not use domestic timber (U_{im}), items 5 ("good quality wood or wood products") (4.50), 2 ("stable

sources of supply of wood or wood products") (4.48), and 6 ("delivery on time") (4.47) were most important when choosing a raw timber supplier, while items 8 ("being a big-name supplier") (2.87), 14 ("domestic production of wood or wood products") (3.20), and 9 ("suppliers provide technical information") (3.64) were least important.

According to the variance analysis results, between the 2 categories, 3("good previous business dealings"), 4("excellent equipment suppliers"), 5("good quality wood or wood products"), 6("delivery on time"), 7("good service provider"), and 14("domestic production of wood or wood products") showed significant levels of differences.

For items 3~7, the significance level from companies that did not use domestic timber (U_{im}) was higher than those that did (U_{dom}). For 14("domestic production of wood or wood products"), the significance level from those that did not use domestic timber (U_{im}) was lower than for those that did (U_{dom}). Therefore, good business dealings in the past, good quality, and on-time delivery affected those manufacturers that did not use domestically produced timber; while those manufacturers that did use domestically produced timber attached greater importance to whether the timber was domestically produced (Table 4).

Possible reasons as to whether you would or would not consider using domestically produced timber in the next 3 yr

Of all surveyed companies, 52.61% were not planning to even consider using domestically produced timber in the next 3 yr. This was much more than the 26.29% of companies which had used domestically produced wood products in the previous 3 yr. However, whether or not this proportion could be transferred to the real world is a question that will require follow-up investigations. Test

Table 4. Importance of various factors for factories when considering the selection of wood-supply firms

Item	Category	Mean	SD	F-value
1. Provision of low-cost wood or wood products	U_{dom}	3.70	1.02	0.84
	U_{im}	3.85	1.11	
	Total	3.81	1.09	
2. Stable source of supply of wood or wood products	U_{dom}	4.34	0.60	2.05
	U_{im}	4.48	0.64	
	Total	4.44	0.64	
3. Good previous business dealings	U_{dom}	3.67	0.68	16.17**
	U_{im}	4.10	0.72	
	Total	3.99	0.74	
4. Excellent equipment suppliers	U_{dom}	3.74	0.68	5.36*
	U_{im}	4.01	0.81	
	Total	3.94	0.78	
5. Good quality wood or wood products	U_{dom}	4.07	0.63	22.35**
	U_{im}	4.50	0.62	
	Total	4.39	0.65	
6. Delivery on time	U_{dom}	4.15	0.68	12.02**
	U_{im}	4.47	0.60	
	Total	4.38	0.63	
7. Good service provider	U_{dom}	3.98	0.70	5.02*
	U_{im}	4.23	0.74	
	Total	4.16	0.74	
8. Being a big-name supplier	U_{dom}	2.93	0.79	0.25
	U_{im}	2.87	0.97	
	Total	2.88	0.93	
9. Suppliers provide technical information	U_{dom}	3.84	0.80	1.73
	U_{im}	3.64	1.04	
	Total	3.69	0.98	
10. Exchange rate changes	U_{dom}	4.07	0.65	0.31
	U_{im}	4.13	0.79	
	Total	4.11	0.76	
11. Domestic and international forest conservation policies	U_{dom}	3.85	0.57	3.51
	U_{im}	4.05	0.73	
	Total	4.00	0.70	
12. Certified wood or wood products	U_{dom}	3.84	0.66	1.30
	U_{im}	3.68	1.00	
	Total	3.72	0.93	
13. Legal timber from logging	U_{dom}	4.25	0.67	0.01
	U_{im}	4.23	0.78	
	Total	4.24	0.75	
14. Domestic production of wood or wood products	U_{dom}	3.85	0.79	19.41**
	U_{im}	3.20	1.05	
	Total	3.38	1.02	

* Significant at the 5% level; ** significant at the 1% level. SD, standard deviation.

results using a Chi-squared analysis gave a Pearson Chi-squared value of 56.18. It significantly differed ($p < 0.01$), indicating that there was a significance difference between the 2 categories of companies. Of companies that had used domestically produced timber (U_{dom}) over the previous 3 yr, 59.32% would consider increasing their use, while 66.67% of companies that had not used domestically produced timber (U_{im}) over the previous 3 yr would not consider using it (Table 5).

Overall, the issue regarding item 3 ("insufficient number of domestic sources of wood") was widely recognized as important (69.74%), followed by item 5 ("types of domestic wood and specifications do not meet requirements") (51.75%); while item 7 ("poor quality of domestic timber") was not really a concern (14.47%). The possible reasons as to whether a manufacturer would or would not consider using domestically produced timber in the next 3 yr were divided into 3 categories. Test results using the Chi-squared analysis indicated that there were significance differences among the 3 categories for items 3 ("insufficient number of domestic sources of wood"), 6 ("complicated procedures for logging in national forests"), and 8 ("cost considerations") which had Pearson Chi-squared values at the < 0.01 significance level. Item 3 ("insufficient number of domestic sources of wood") was an important consideration for a company that would increase its proportion of domestic wood in the next 3 yr (increase its use) and one that would use less than the cur-

rent ratio of domestic timber (reduce its use), and the proportion was significantly higher than for companies that would not use domestic wood in the next 3 yr (no use). For item 6 ("complicated procedures for logging in national forests"), the proportion of domestic wood used by companies that would increase its proportion in the next 3 yr (increase its use) was significantly higher than those of the other types (reduce its use and no use). For item 8 ("cost considerations"), the proportion of domestic wood used by companies that would increase its proportion in the next 3 yr (increase its use) was significantly less than those of the other 2 types (reduce its use and no use) (Table 6).

CONCLUSIONS

This study used supply selection criteria to formulate a questionnaire survey for the purpose of analyzing issues within the domestic forest products industry. These issues are related to timber selection criteria and problems associated with domestic timber requirements and usage. It is hoped that by developing a deeper understanding of timber supply options, the means to increase the practicality of supply pipelines for domestic timber can be determined. In total, 232 forest industry manufacturers participated in this survey. Results showed that the forest products industry comprises mainly small- to medium-sized companies. Of these companies, 73.71% had used imports as the exclusive source of their

Table 5. Responses to whether a company would consider using domestic wood in the next 3 yr

Consider using domestic wood?	Percentage (%)		
	U_{dom}	U_{im}	Total
Yes, we will increase the proportion of domestic wood	59.32	26.90	35.22
Yes, but we will use less than the current ratio of domestic timber	28.81	6.43	12.17
No	11.86	66.67	52.61
Total	100	100	100

Table 6. Reasons for not using domestic materials

Item		Percentage (%)	X^2
1. High price of domestic timber	Yes, increase	43.04	0.835
	Yes, less	35.71	
	No	37.19	
	Total	39.04	
2. Domestic logging ban	Yes, increase	29.11	2.905
	Yes, less	46.43	
	No	36.36	
	Total	35.09	
3. Insufficient number of domestic sources of wood	Yes, increase	81.01	10.868**
	Yes, less	78.57	
	No	60.33	
	Total	69.74	
4. Limiting the cutting of forests per year	Yes, increase	27.85	1.163
	Yes, less	17.86	
	No	23.97	
	Total	24.56	
5. Types of domestic wood and specifications do not meet requirements	Yes, increase	54.43	3.299
	Yes, less	35.71	
	No	53.72	
	Total	51.75	
6. Complicated procedures for logging in national forests	Yes, increase	39.24	17.338**
	Yes, less	14.29	
	No	14.88	
	Total	23.25	
7. Poor quality of domestic timber	Yes, increase	12.66	1.322
	Yes, less	21.43	
	No	14.05	
	Total	14.47	
8. Cost considerations	Yes, increase	20.25	9.411**
	Yes, less	42.86	
	No	39.67	
	Total	33.33	

** Significant at the 1% level.
Yes, increase: Yes, we will increase the proportion of domestic wood in the next 3 yr; Yes, less: Yes, but we will use less than the current ratio of domestic timber; No: We will not use domestic wood in the next 3 yr.

raw timber supply for the last 3 yr, and only 26.29% of the respondents had sourced any raw timber through domestic timber suppliers. The domestic timber usage ratio was not high, and the biggest problem appeared to be "insufficient number of domestic sources of wood".

Among the various factors considered by the industry as selection options for raw timber suppliers, "stable source of supply

of wood or wood products" was the most important consideration, followed by "good quality wood or wood products". Among the respondents who had used domestically produced timber within the past 3 yr, 59.32% indicated a willingness to increase their use in the future; while 66.67% of those which had not used domestically produced timber within the past 3 years did not plan to use it in the future. Therefore, 1 way to convince those which had exclusively used imports in the past 3 yr (73.71% of all respondents) to consider domestically produced timber would be to increase the number of suppliers and the quantity of available domestic timber. In other words, the most practical way would be to upgrade domestic timber self-sufficiency, while maintaining a commitment to forest management sustainability.

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