Journal of Sustainability Science and Management
Volume 14 *Number* 5, October 2019: 115-127
ISSN: 1823-8556

EXPORT PERFORMANCE OF TROPICAL TIMBER PRODUCTS CERTIFIED BY THE MALAYSIAN TIMBER CERTIFICATION SCHEME

NORZANALIA SAADUN*[1,2], MOHD NOOR KHAMURUDIN[1], BADRUL AZHAR[1,3], HISHAMUDIN OMAR[2] AND MOHD HUSNI HARIZ[1]

[1]Faculty of Forestry, [2]Institute of Tropical Forestry and Forest Products, [3]Institute of Bioscience, Universiti Putra Malaysia, 43400 UPM Serdang, Selangor, Malaysia.

**Corresponding author: norzanalia@upm.edu.my*

Abstract: A study on the export performance of timber products certified under the Malaysian Timber Certification Scheme (MTCS) was conducted from 2003 to 2015. The objectives were to analyse the trend and growth of certified timber products (CTP) and to determine the factors that influenced their export using Generalised Linear Models (GLM). The annual growth of CTP export had a fluctuating trend. The compound annual growth rate (CAGR) within the study period was estimated at 31%. The average annual growth rate (AAGR) estimated using log-linear regression analysis was 22%. The primary markets for CTP export were European countries, accounting for nearly 83% of exports over the study period. The Netherlands seemed to be the main destination for almost half (40%) of the CTP. The major product was sawn timber (59%), followed by plywood (31%). GLM revealed that the export trend of CTPunder the MTCS increased with the number of Chain-of-Custody (CoC) certificate holders. More active involvement in the MTCS CoC certification scheme by industry players could promote the growth of Malaysia's sustainable timber trade.

Keywords: Certified timber, forest certification, chain-of-custody, trend, growth.

Introduction

The timber industry is an important socioeconomic sector in Malaysia. Timber and timber products contribute approximately RM21.86 billion to the nation's economy in 2016, constituting 2.78% of the country's total export (MPIC, 2017a), with 3000 manufacturers employing about 180,000 workers (Ratnasingam *et al.,* 2017). At present, Malaysia is one of the world's largest tropical timber and timber product exporter to more than 160 destinations. Japan, the United States, India, Australia and Singapore were among the major markets in 2016 (MPIC, 2017b). The products exported in 2016 were furniture worth RM7.84 billion, followed by plywood (RM4.37 billion) and sawn timber (RM3.39 billion) (MPIC, 2017b).

Considering the magnitude of the contribution of timber export towards the Malaysian economy, long-term growth and performance of the industry are under constant pressure as global markets become complex and demanding. With respect to timber and timber products, forest certification is being adopted as a market requirement worldwide, especially in environmentally-sensitive countries and has become an instrument of private and public procurement policies to prove the legality of timber origins (Rametsteiner *et al.*, 2005; Ratnasingam, *et al.*, 2008; Palus *et al.,* 2017). Furthermore, green building codes in Europe, the US and Asia-Pacific are having a significant impact on the supply and demand of certified timber products (CTP) (Fernholz & Kraxner, 2012). Hence, forest certification can be seen as critical to ensure continued market access of Malaysian timber products (CTP) in the global marketplace.

Forest certification programs were introduced in 1992 as a response to rapid deforestation worldwide, which led to import bans or boycotts of tropical wood products, particularly in Europe and USA (Rusli 1996). Forest Management Certification (FMC) and Chain-of-Custody certification (CoC) are the

two major components of all third-party forest certification programs (Suryani *et al.*, 2011).

In FMC, the forest management is assessed based on a pre-determined criteria, indicators and verifiers, which then provides assurance that the forests where the timber products originated from have been managed sustainably (Anderson & Hansen, 2003). The CoC, on the other hand, is a category that deals with the certification of wood and wood-based products throughout the supply chain. It begins from the time the raw material leaves the forest until the final product reaches the consumer (Upton & Bass, 1996). Thus, any company in this supply chain, including harvesters, processors, manufacturers, distributors, printers, retailers or anyone taking ownership of the wood and wood-based products before the consumer, needs to be certified. The CoC certification thus assures consumers that the wood and wood-based products originate from certified sustainable forests (Anderson *et al*., 2005).

Forest certification in Malaysia started in 2001, with the implementation of the Malaysian Timber Certification Scheme (MTCS) developed by the Malaysian Timber Certification Council (MTCC) (Shukri & Sam Shor 2015). However, due to the lack of international recognition, market access for MTCS-certified timber had been a challenge (Mohd Shahwahid, 2004). To resolve this issue, the MTCC worked to gain international recognition of its scheme. In 2009, the certification was endorsed by the Pan European Forest Council (PEFC) after a comprehensive and thorough sustainability assessment process (Lewis & Davis, 2015). The endorsement allows the MTCC to market MTCS certified products using the PEFC-label. Another third-party independent certification body in Malaysia is the Forest Stewardship Council (FSC). Most of the certified forests in Malaysia were endorsed by MTCS. As of 2017, 4.12 million hectares of forests in Malaysia were certified under MTCS, whereas the FSC's scheme covered about 678,855 ha of forests (FSC, 2017; PEFC, 2017).

Forest certification will continue to be an essential part of the Malaysian timber industry. Firms involved in timber and timber product trade are encouraged to voluntarily participate in the CoC certification program. Potential benefits for CoC-certified companies include international market access, price premiums, improved corporate environmental image, reputation, financial performance and production efficiency (Miles & Covin, 2000; Humphries *et al*., 2001; Ratnasingam *et al*., 2008). Although the cost associated with acquiring and maintaining certification is also known to be very expensive (Suryani *et al.*, 2011), especially for industries in developing countries (Perera and Vlosky, 2006), the number of global CoC certificate holders in both FSC and PEFC schemes has experienced a steady growth over the past few years (FAO, 2018).

This trend indicates that demand for CTP in the global market is very promising. The Malaysian government — through its National Timber Industry Policy (NATIP) (2009 – 2020) — has revised its annual export target of timber and timber products to RM25–30 billion in 2020 (MTC, 2017). It is, therefore, crucial for Malaysia to take advantage of the growing CTP trade while meeting the national policy timber products export target.

However, despite the growing influence of forest certification, research on CoC certification in Malaysia has received scant scholarly attention. Most studies have focused on the adoption of CoC by Malaysian furniture manufacturers (Ratnasingam *et al.*, (2008), the willingness of consumers to pay more for CTP (Mohamed & Ibrahim, 2007; Shukri *et al.,* 2013) or the certification cost for sawnwood manufacturers (Suryani *et al*., 2011). Thus far, little attention has been given on the trend, growth and performance of CTP export, especially under MTCS. As noted by Kaimakoudi *et al.*, (2013), foreign market environments are much more diverse and competitive, and for these reasons, information on trend and export performance is vital to business managers, marketing researcher and policymakers.

Moreover, country- or sectoral-level export performance can be influenced by many factors. Fugazza (2004) classified determinants of export performance into internal and external components. External factors include foreign market access conditions, such as trade barriers, competition factors and transportation cost, which include geography and physical infrastructure. Internal factors are related to supply-side conditions, which depend on supply capacity (e.g., access to raw materials) and production cost factor (e.g., labour and capital). Other supply factors that influence export performance include domestic transport infrastructure, macroeconomic environment (i.e., real exchange rate), foreign direct investment and governmental institution(UNCTAD, 2005).

Thus far, determinants of timber product export performance have been studied extensively (e.g., Buongiorno and Uusivouri (1991); Sun and Zhang (2003); Samad *et al.*, (2009)). However, only a few studies have focused on the impact of certification on export performance. Using firm-specific data, Adis (2010) investigated the impact of export marketing strategy and the moderating effects of environmental factors (i.e., certification) on export performance in the Malaysian furniture industry.He found that certification gave a positive contribution towards export performance if companies put emphasis on product adaptation, and distribution and design strategies. In a more recent study, Guan *et al*., (2019) had investigated the impact of FSC CoC certification on global export of wood products and found that the certification had positive effect on the net export of timber products, especially for sawnwood, particleboard, plywood, furniture and fibreboard. While the authors did consider the role of CoC certification on the export of global timber products, their study focused on FSC CoC certification and used the aggregated global timber trade, which might include uncertified and certified timber trade data from various forest certification schemes. To date, there is hardly any study that specifically investigates the factors influencing the export performance of CTP, particularly the supply-side factors.

Therefore, in an attempt to address the gap in the literature, this paper aims to examine the performance of CTP exports under MTCS. Specifically, the objective is to analyse the trend and growth of CTP exports from 2003 to 2015,and determine the factors that influenced their performance.

Materials and Methods

Export Trend and Growth Analysis

The data for the analysis was obtained from published MTCC annual reports and publicly accessible online data from the PEFC website. The period of the study was from 2003 to 2015 (12 years). The time series data comprised the export volume of CTP by region, country and product type. Yearly aggregated exports of CTP volume in m^3 were obtained from the MTCC annual reports for growth analysis. In addition, the number of forest management (FM) certificate holders, number of CoC certificate holders and area of forest certified under MTCS were also collected. The analysis of top markets and types of products for certified timber export were based on the highest cumulative volume over the 12 years. Analysed data were then sorted and presented in a graph. The annual growth rate (AGR) of CTP exports was calculated using Eq. 1:

$$AGR_t = \frac{Y_t - Y_{t-1}}{Y_{t-1}} \quad (1)$$

where AGR_t is the annual growth rate at year t; Y_t is the export volume of certified timber product at year t; and, Y_{t-1} is the export volume of certified timber product at year t-1.

To determine the mean annual growth rate of CTP export between 2003 and 2015, the compound annual growth rate (CAGR) was determined using Eq. 2:

$$CAGR\ (t_0, t_n) = \left(\frac{Y(t_n)}{Y(t_0)}\right)^{\frac{1}{(t_n - t_0)}} - 1 \quad (2)$$

where $CAGR(t_0, t_n)$ is the compound annual growth rate between year $t_0$and yeart_n;$Y(t_0)$ is the

export volume of certified timber product at year t_0; and, $Y(t_n)$ is the export volume of certified timber product at year t_n.

The CAGR estimation could give a broader picture of CTP export growth over the 12 years. Although the CAGR considered compounding, nevertheless it focused on the first and last export volume observations in the series and ignored the information in intermediate observations and any trend in growth rates that might develop over the period. A common approach to measuring average growth rates was using the linear regression approach as it considered all data points in the series. Several studies had employed linear regression to estimate the average growth rate of agriculture exports, such as rice in Vietnam (Thanh & Singh, 2006) and ginger in India (Karthick *et al.,* 2015). In this study, the log-linear regression was employed to estimate the average annual growth rate (AAGR) of CTP by using Eq. 3.

$$InYt = \alpha + \beta^t + \varepsilon^t \quad (3)$$

where lnY_t is the natural log of CTP export volume at year t; α and β are unknown parameters; and, ε_t is the error term with mean zero and common variance i.e.$\varepsilon_t \sim N(0,\sigma^2)$. The α and β parametersin Eq. 3 were estimated using the least squares method and the estimated model is as shown in Eq. 4:

$$InYt = \alpha + \beta^t \quad (4)$$

The estimated on the time variable becomes a measure of CTP AAGR. The percentage of AAGR was calculated using Eq. 5.

$$AAGR = \beta \times 100 \quad (5)$$

Factors Influence Export Performance of Certified Timbers Products

Supply-side factors which depend on supply side capacity were assumed to have a significant influence toward CTP export performance. Guan *et al.*, (2019), using the Heckscher-Ohlin-Vanek model, suggested that the level of CoC application had significant and positive impact on net global timber export. For this study, three supply-side condition factors were considered,namely the MTCS-certified forest area, number of MTCS CoC certificate holders and number of forest management (FM) certificate holders. The selection of supply factors were largely dependent on the availability of data from MTCC and literature.

Generalised Linear Models (GLM) were used to examine the relationship between supply factorvariables and CTP export volume.The data were fitted using a normal distribution with the identity link function. Correlation among pairs of predictor variables was examined with $|r|>0.7$, implying that model estimation and prediction could be distorted due to collinearity between the variables (Dorman *et al.,* 2013). In this study, the number of FM certificate holders was removed because it was highly correlated with CoC certificate holders (r= -0.824). All analysis was conducted using GenStat software version 12.0 (VSN International, Hemel Hempstead, UK).

Results and Discussion

Trend and Growth of Timber Products Exports under MTCS

The export volume of timber products with MTCS certification from 2003 to 2015 experienced a fluctuating upward trendas shown in Figure 1. A cumulative total of 1.182 billion m^3 of CTP had been exported within the period. CAGRwas estimated at 31% (Table 1). Using the log-linear regression analysis, AAGR of CTP export exhibited significant growth with an estimated rate of 22% annually (F=39.78, P=0.0000).

As shown in Figure 1, the export volume increased drastically from 5,720m^3 in 2003to 75,279 m^3 in 2006. During this period, it registered positive and remarkable growth with the highest growth rate recorded in 2004 (237%) and 2006 (152%) (Table 1).

The volume of CTP exported somewhat levelled off between 2007 and 2010. However, the growth analysis revealed that there were two negative growth rates registered during this

Figure 1: Export of timber product certified by the MTCS from 2003-2015

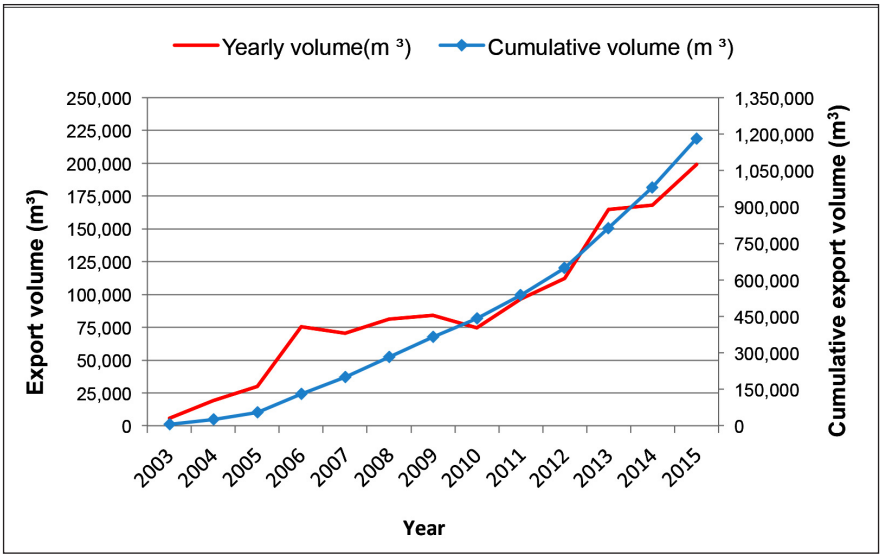

Table 1: Estimated annual growth, CAGR, and AAGR of Certified Timber Export

Year	Export Volume (m^3)	Annual Growth Rate
2003	5,720	-
2004	19,257	237%
2005	29,893	55%
2006	75,279	152%
2007	70,385	-7%
2008	81,338	16%
2009	84,118	3%
2010	74,778	-11%
2011	96,722	29%
2012	112,098	16%
2013	164,612	47%
2014	168,094	2%
2015	198,992	18%
CAGR		**31%**
	R^2	0.78
AAGR	Coefficient (β)	0.2236** (0.4782)
	% growth	**22%**

Note: Figure in parenthesis indicates standard error of the respective coefficient. **- Significant level at 0.01

period (2007-2010), with -7% in 2007 and -11% in 2010. A similar downward trend was also observed by Harun *et al.* (2014). The fall of CTP export from 2007 to 2010 could be attributed to a wide range of factors, but the global financial and economic crisis then had been cited as the main reason for the downturn of tropical timber and timber product trade globally, especially in the European and US markets.

In fact, the European Union (EU),which was once the world's largest importers of tropical timber and timber products before the crisis, experienced a dramatic drop of 22% in its timber import share between 2007 and 2011 (ETTF, 2013). Oliver (2015) pointed that during the global economic downturn, many European importers, wholesalers and agents had to changetheir procurement strategies to maintain a low level of inventory and favouring local timber suppliers to ensure just-in-time delivery. Because of this, many European buyers were stopping and cancelling overseas orders even beyond 2009, causing a massive shock to the industry in Malaysia, especially on small- and medium-scale enterprises (Maplesden, 2013). The economic crises had also adversely affected the construction sector, especially in the US, which subsequently reduced its demand for wood building material and furniture (Masiero *et al.*, 2015).

Nevertheless, the export volume of CTP rebounded and recorded a remarkable increase again from 2011 onwards, almost doubling from 96,722 m^3 in 2010 to 198,992 m^3 in 2015. Several reasons might explain the increasing trend during these periods. First was due to the economic recovery in 2011 and 2012, whereby demand for certified timber began to increase, especially from industrialized countries (Oliver, 2015). Second was related to the growing market for Malaysian CTP due to the PEFC endorsement of MTCS in May 2009 (Lewis & Davis, 2015). In 2013, the MTCC statedthatits strategy to promote the use of PEFC logo among all PEFC CoC certificate holders since 2012 seemed to facilitate market penetration and hence, helped to increase the export volume of CTP. Third was linked to the enactment and implementation of strict timber laws in many importing countries/regions. They included the Lacey Act 2008 in the US, the EU Timber Regulation 2013 within the framework of EU Forest Law Enforcement Governance and Trade (FLEGT) action plan 200, and theAustralian Illegal Logging Prohibition Act 2012 (Masiero *et al.*, 2015).

Besides these legal requirements, the gradual spread of sustainable and legal timber procurement policies adopted around the world, especially for the public sectors to buy timber products from a sustainable and legal source,had also given significant impact to the global tropical timber trade. As of July 2014, about 26 countries had established government procurement policies, either voluntary or according to mandatory guidelines, with 19 countries in the EU and at least seven outside the EU (Australia, China, Japan, Mexico, New Zealand, Norway and Switzerland) (Brack, 2014). As noted by Brack (2014), various indicators were used as proof of legality and/or sustainability, but most of the policies specifically required a third-party certification scheme (either FSC or PEFC). According to Martin and Ghazali (2015), both timber legality and new public sector timber procurement policies appeared to have helped some of the tropical timber producers to comply with the standards set by the importing countries and subsequently increased export of CTP among International Tropical Timber Organisation (ITTO) countries.

Trend of Timber Products Exports under MTCS by Destination

As shown in Figure 2, the main and traditional export destination for Malaysian CTP between 2002 and 2015 was the EU, with a cumulative total of about 97,8905m^3 or 83% share. The second largest destination was Oceania/Pacific, followed by East Asia, West Asia and, finally, Africa with cumulative totals of 67,396m^3, 46,241m^3, 35,253m^3 and 28,533m^3, respectively. Most regions except the EU and Oceania/Pacific (i.e., Australia) began importing CTP from

Malaysia from 2010 onwards, and the market became more diversified in 2012 (Figure 2).

This trend showed that the international eco-labelling marketing strategy (i.e., use of PEFC logo) engaged by MTCC since 2009 (Johannson, 2014) had born fruit by helping Malaysia to increase export share in existing markets and facilitated penetration into new markets like East Asia (China, Japan, Korea), West Asia (Bahrain, Jordan, Kuwait, Oman, Qatar and UAE), Africa (South Africa) and the Oceania/Pacific region. In addition, legal requirements and public procurement policies for timber might also explain the variety and increasing market for Malaysian certified timber as evidenced by new markets such as China. According to Oliver (2015), China had emerged as an important export destination for tropical timber products since 2009 due to growing demand and decreased supply of local raw materials.

As expected, the top five CTP importing countries were mostly from the EU (Figure 3). The Netherlands was the largest importer between 2003 and 2015, with a cumulative trade volume of 473,646 m^3 or 40.1% share. The United Kingdom was second largest market with a cumulative total of 257,018 m^3 (21.85%), followed by Belgium with 74,018 m^3 (6.3%), Germany with 68,884m^3 (5.85%), and France with 57,997 m^3 or about 4.9% of the export share. Exports to the Netherlands were mostly sawntimber, which was generally used to make window frames in the construction sector (Oliver, 2015). Although the Netherlands served as an essential market for Malaysian CTP, dependency on a single market, however, was a concern in the long run as exports would become dependent on the importing country's political and economic climate. Sudden changes in legal and trade policies (e.g. import tariff) would greatly impact the timber industry. Furthermore, construction markets in the Netherlands were more exposed to sharp decline (Oliver, 2015). Therefore, export strategies needed to be re-examined with more effort to promote the acceptance of Malaysian CTP in other green markets such as the USA. Malaysian efforts to negotiate on the FLEGT Voluntary Partnership Agreement (VPA) with the EU, which started way back in 2007, should continue as this could facilitate the trade of Malaysian timber in the EU countries. In realising this effort, cooperation with all stakeholders were needed as the VPA would not only cover Peninsular Malaysia, but also Sabah and Sarawak.

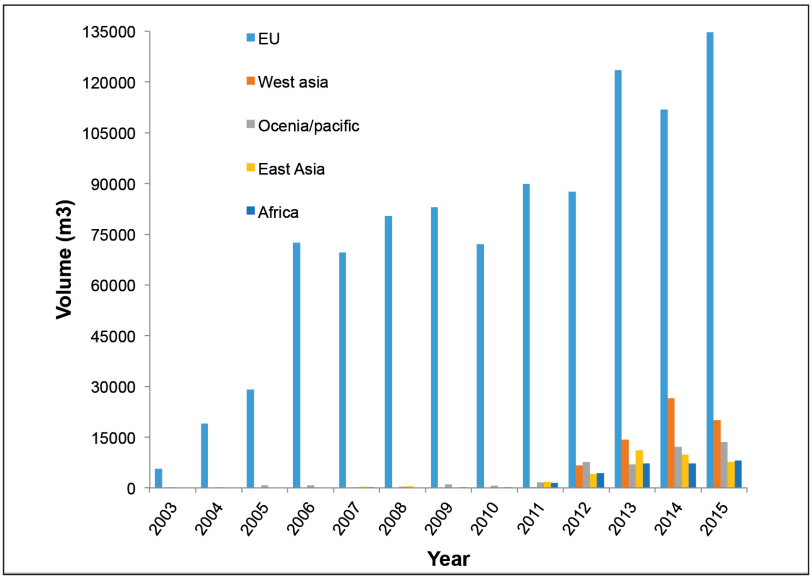

Figure 2: Export of timber products certified by the MTCS by region from 2003-2015

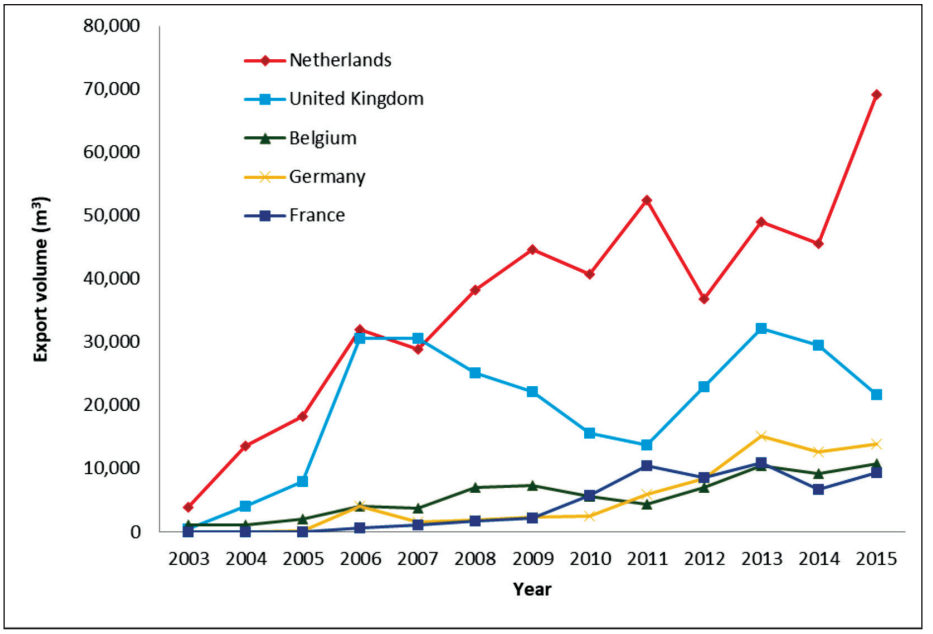

Figure 3: Export of timber products certified by the MTCS by country from 2003-2015

Trend of Timber Products Exports under MTCS by Products

Figure 4 shows the types of CTP export from 2003 to 2015. Most of them were sawntimber and plywood, which were low value products, with export shares of about 58.5% and 30.9%, respectively. This was followed by mouldings with an export share of about 9.5%. Other products, such as door jambs, woodchips, paper and laminated scantling contributed a small portion of the export only as demand for these products was not consistent.

Efforts were needed to promote the export of secondary and tertiary certified wood products through enhanced value-adding, such as furniture. Even though furniture was the biggest export earner among wood-based products in Malaysia (MPIC, 2017b), it was interesting to note that the export of MTCS-certified furniture only started in 2015. This might be due to the introduction of the new "PEFC controlled sources" claim in 2013, whereby rubberwood was allowed to be used as a source material in timber products that could carry the PEFC endorsement (MTCC, 2012). While there had been more interest among furniture manufacturers to obtain PEFC CoC certification under MTCS, the uptake had been rather slow (MTCC, 2014; Ratnasingam *et al*., 2018). As noted by Ratnasingam *et al*., (2008), furniture manufacturers in Malaysia were not ready to be CoC-certified due to several reasons, including lack of price premiums, limited market potential and high implementation cost.

While the Malaysian furniture manufacturerswere not keen to obtain CoC certification, the prospects for CTP, especially garden furniture, were expected to be good. According to CBI (2017) report, certified garden furniture was expected to gain preference, especially in the European market. In the advent of the Internet age, online marketing channels in developed countries allowed household consumers and importers, such as "Do-It-Yourself" (DIY) retailers and wholesalers, to order directly from producers in developing countries (CBI 2017). This purchasing trend implied that more business opportunities would be available for Malaysian furniture companies that engaged in CoC certification and green e-commerce.

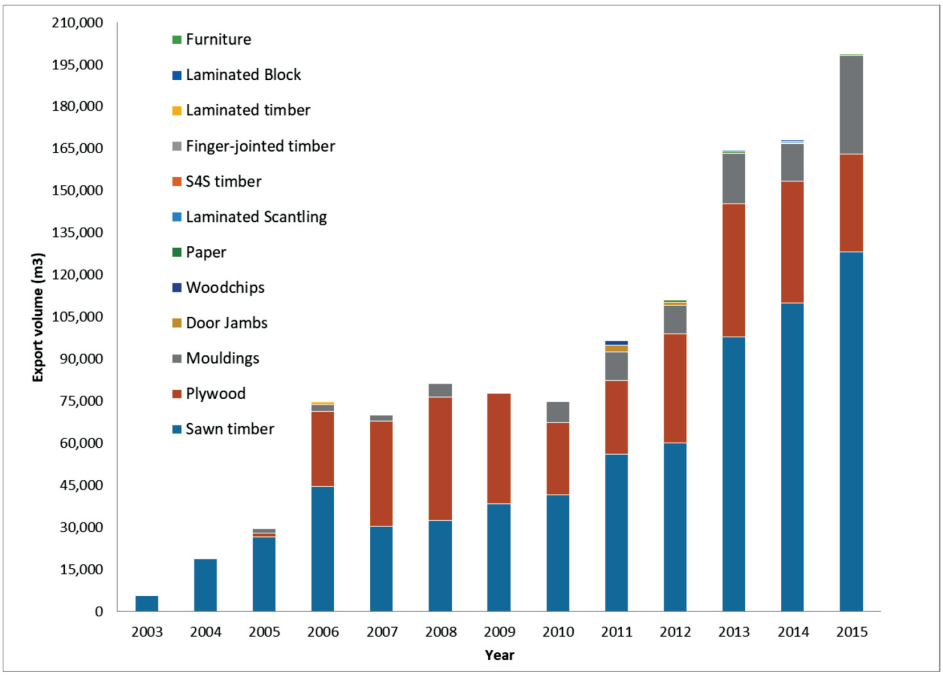

Figure 4: Export of timber products certified by MTCS from 2003-2015

Trend of Forest Areas Certified and Chain-of-Custody Certification under MTCS

Figure 5 shows the area of forest certified by the MTCS against CoC certificate holders from 2003 to 2015. Throughout the period, the certified forestarea was fairly stable, with 4.1 million hectares in 2003 to about 4.7 million hectares in 2015. The slight fluctuations of certified areas, particularly between 2007 and 2009, were due to certification suspensions, reassessments and recertifications in a few forest management units (FMUs). In addition, most of the certified forests were located in Peninsular Malaysia. In 2015, about 4.65 million hectares of natural forests in Peninsular Malaysia was certified, while Sabah and Sarawak accounted for 202,791 and 110,624 hectares, respectively. In Sarawak, the areas certified were mainly forest plantation management units (FPMUs).

The number of CoC certificate holders showed an increasing trend over the years, from 38 in 2003, to 354 in 2015. Over the years, although there were withdrawals of certification, the upward trend of CoC certification among Malaysian timber companies suggested a growing demand in the market place. In addition, this trend might also imply that over the years, more companies were becoming aware of ethical and sustainable practices.

Factors Influencing the Export Performance of Timber Product Certified by MTCS

The GLM results showed a significant positive relationship between CTP export volume and number of CoC holders, with 95.86% of the variation explained by the model (Table 2). The results suggested that as the number of CoC certificate holders increased, the export volume of CTP also increased (Wald statistics = 246.2, $P<0.01$). This result corroborated with Guan *et al.,* (2019), who found that application of CoC certification would increase the export of wood products; consequently, the volume of certified wood products in the world market. While Guan *et al.*, (2019) considered FSC CoC certification and global wood products export, this study covered MTCS-certified products, a PEFC-endorsed scheme and utilized data on export of CTP.

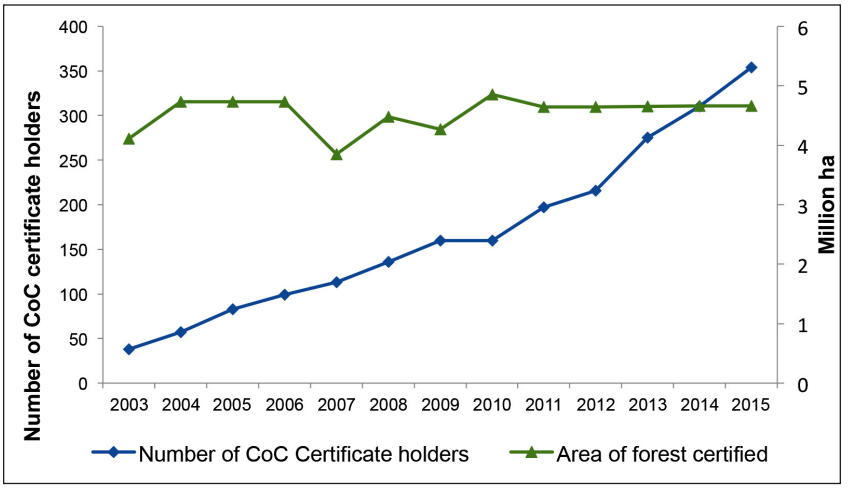

Figure 5: Forest areas certified by MTCS against the number of CoC certificate holders

Table 2: GLMresults on CTP export against supply factors

Variables	Parameter estimate	Wald statistic	*P* value
Area of forest certified	592.2	0.5	0.515
Number of CoC certificate holders	-0.0086	246.2	0.001

It was also evidenced from this study that although the area of forests certified under the MTC remained relatively stable, the volume of CTP export had increased with more participation of CoC certificate holders. This result signalled that concerted efforts should be focused on actively promoting CoC certification among harvesters, processors, manufacturers, distributors, printers, retailers and among those directly involved in the supply chain. Hence, this studyproposes an active promotional programme to encourage timber and timber product companies to obtain CoC certification and proactively source and trade wood materials from sustainably-managed forests.

Conclusion

The export volume of CTP under MTCS between 2003 and 2015 recorded significant positive growth with an estimated average rate of 22%. The positive trend could be attributed to several factors including increased demand for certified timber from the industrialised countries after the 2007 global economic crisis and endorsement of MTCS by PEFC scheme, which opened new market access, especially in East Asia. In addition to this, timber regulations and growing public procurement policy for legal and sustainable timber and timber products in developed countries might also explain the increasing number of certified companies.

EU countries, especially the Netherlands, were the largest export market for CTP that accounted for a cumulative 40.1% of the export volume over the period of study. While the Netherlands seems to be an important destination, efforts to diversify the market should be emphasized through promotions and acceptance of Malaysian certified tropical timber in other countries. During the study period, exports of CTPs were dominated by relatively low value-added products, such as sawn timber and plywood. Remedial measures were needed to increase exports of CTP with high value, such as paper and furniture.

Nevertheless, Malaysian furniture manufacturers would have to adapt to the changing consumer preference and buying behaviour, especially the use of green e-commerce marketing channels through the Internet. The increase in the number of CoC certificate holders significantly influenced the increase of CTP export volumes. This finding suggested that relevant timber industry development agencies needed to actively promote all companies that manufacture, trade or sell timber products to obtain CoC certification to increase Malaysia's export share in the world market.The data and results for growth analysis were based on aggregated volume because of insignificant and inconsistent data for a separate analysis of CTP growth due to lack of demand. Therefore, future research should examinethe trends and growth of each CTP under MTCS-PEFC endorsed scheme to get a detailed picture of a particular CTP export performance. Although this study had confirmed that the increase inCoC certification have had a significant and positive impact on certified product export, however, it must be noted that the real world market situation was complex and other factors might influence the export performance.

For future research, consideration of other supply-side factors, such as production cost factor (e.g., labour and capital), domestic transport infrastructure and macroeconomic environment (i.e., real exchange rate) using econometric models should be conducted to verify the results.

Acknowledgments

This study was supported by Universiti Putra Malaysia under the Putra Grant Scheme (GP/2018/961000). The authors would like to thank the Malaysian Timber Certification Council (MTCC) for providing assistance during data collection.

References

Adis, A. A. A. (2010). Export performance on the Malaysian wooden furniture industry: An empirical study, *Journal of International Food and Agribusiness Marketing*, *22*(1-2), 52-69.

Anderson, R.C., & Hansen, E.N. (2003). *Forest certification: understanding eco-label usage requirements*. Oregon, U.S.: Wood Science and Engineering Oregon State University.

Anderson, R. C., Laband, D. N., Hansen, E. N., & Knowles, C. D. (2005). Price premiums in the mist. *Forest Products Journal*, *55*(6), 19-22.

Brack, D. (2014). Promoting legal and sustainable timber: using public procurement policy. https://www.chathamhouse.org/sites/default/files/field/field_document/20140908PromotingLegalSustainableTimberBrackFinal.pdf,

Buongiorno, J., & Uusivouri, J. (1991). Pass-through of exchange rate on prices of forest product exports from the United States to Europe and Japan. *Forest Science, 37*(3), 931-948.

CBI (2017). Exporting certified tropical timber garden furniture to Europe. https://www.cbi.eu/market-information/timber-products/certified-tropical-timber-garden-furniture.

Dormann, C. F., Elith, J., Bacher, S., Buchmann, C., Carl, G., Carré, G., & Münkemüller, T. (2013). Collinearity: a review of methods to deal with it and a simulation study evaluating their performance. *Ecography*, *36*(1), 27-46.

ETTF. (2011). 2011 Statistics – EU totals. Timber trade monitoring in support of effective, efficient and equitable operation of the EU Timber Regulation (EUTR). https://www.ettf.info/sites/default/files/ettf_2011-statistics_eu-totals.pdf.

FAO. (2018). *Forest Products Annual Market Review 2017-2018*. Geneva, Switzerland. United Nation Publication.

Fernholz, K., & Kraxner, F. (2012). *Certified forest products markets, 2011-2012. In UNECE/FAO Forest Products Annual Market Review.* Geneva, Switzerland:

United Nations Economic Commission for Europe.

FSC. (2017). *FSC facts and figures December 1 2017*. Retrieved from https://ic.fsc.org/en/facts-and-figures.

Fugazza, M. (2004). *Export Performance and its Determinants: Supply and Demand Constraints.* UNCTAD Policy Issues in International Trade and Commodities. No. 26. Geneva, Switzerland: United Nations Publication.

Guan, Z., Xu, Y., & Sheong, J. I. P. (2019). The impact of application of FSC Chain of Custody certification on global wood products trade. *European Journal of Wood and Wood Products*, 1-11.

Harun, Z., Zaki, P. H., Ismail, M. H., & Awang, M. K. W. (2014). Trend of timber products export in Malaysia. In: *International Conference on Business, Management, and Corporate Social Responsibility (ICBMCSR'14),* Batam, Indonesia, pp. 45-49.

Johansson, J. (2014). Why do forest companies change their CSR strategies? Responses to market demands and public regulation through dual-certification. *Journal of Environmental Planning and Management*, *57*(3), 349-368.

Kaimakoudi, E., Polymeros, K., & Batzios, C. (2014). Investigating export performance and competitiveness of Balkan and eastern European fisheries sector. *Procedia Economics and Finance*, *9*, 219-230.

Karthick, V., Alagumani, T., & Anbarassan, A. (2015). Growth and Export Performance of Ginger in India-An Economic Analysis. *Economic Affairs*, *60*(2), 207-214.

Lewis, R. A., & Davis, S. R. (2015). Forest certification, institutional capacity, and learning: An analysis of the impacts of the Malaysian Timber Certification Scheme. *Forest Policy and Economics*, *52*, 18-26.

MTCC. (2012). *MTCC Annual Report 2012*. Kuala Lumpur, Malaysia: Malaysian Timber Certification Council.

MTCC. (2013). *MTCC Annual Report 2013*. *MTCC Annual Report 2012*. Kuala Lumpur, Malaysia: Malaysian Timber Certification Council.

MTCC. (2014). *MTCC Annual Report 2014*. Kuala Lumpur, Malaysia: Malaysian Timber Certification Council.

MTC. (2017). NATIP Export target revised to RM25-30 billion by 2020. *Timber Malaysia, 23*(4), 6.

Maplesden F., Attah, H., Tomaselli, I., & Wong, N. (2013). *Riding out the storm. Improving resilience of the tropical timber sector to the impacts of global and regional economic and financial crises*. ITTO Technical Series No. 41. Yokohama, Japan: International Tropical Timber Organization,

Martin, R. M., & Ghazali, B.H. (2015). *The impact of timber procurement policies: an analysis of the economic effects of governmental procurement policies in tropical timber markets.* ITTO Technical Series No. 44. Yokohama, Japan: International Tropical Timber Organization,

Masiero, M., Pettenella, D., & Cerutti, P. (2015). Legality Constraints: The Emergence of a Dual Market for Tropical Timber Products? *Forests*, *6*(10), 3452-3482.

Miles, M. P., & Covin, J. G. (2000). Environmental marketing: A source of reputational, competitive, and financial advantage. *Journal of Business Ethics*, *23*(3), 299-311.

MPIC. (2017a). Malaysia's timber industry exports expected to rise 5 per cent this year. Retrieved from https://www.mpic.gov.my/mpic/index.php/en/media-mpic-vbi/mpic-in-thenews/ 2889-

MPIC. (2017b). Forest and Timber dataset. https://www.mpic.gov.my /mpic/index.php/en/statistic-on-commodity/dataset/719-

Mohamed, S., & Ibrahim, M.L. (2007). Preliminary study on willingness to pay for environmentally certified wood products

among consumers in Malaysia. *Journal of Applied Science,7*(9), 1339-1342.

Mohd Shah wahid, H. O. (2004). Forest certification in Malaysia. In: *Symposium Forest Certification in Developing and Transitioning Societies: Social, Economic, and Ecological Effects*. School of Forestry and Environmental Studies New Haven, Connecticut, USA. June 2004.

Oliver, R. (2015). Europe's changing tropical timber trade: baseline report of the independent market monitoring initiative. *ITTO Technical Series No.45*. Yokohama, Japan: International Tropical Timber Organization.

Paluš, H., Parobek, J., Dudík, R., & Šupín, M. (2017). Assessment of chain-of-custody certification in the Czech and Slovak Republic. *Sustainability*, *9*(10), 1898.

PEFC. (2017). *PEFC Global Statistics* https://www.pefc.org/images/documents/PEFC_Global_Certificates_-_Dec_2017.pdf

Perera P., & Vlosky R. P. (2006). A history of forest certification. *Working paper number 71*. Louisiana Forest Products Development Centre.*https://www.lsuagcenter.com/NR/rdonlyres/5A792EEF-A1F5-4F468B5EFE2461F82A07/53415/ wp71.pdf.*

Rametsteiner, E., & Simula, M. (2003). Forest certification—an instrument to promote sustainable forest management? *Journal of Environmental Management*, *67*(1), 87-98.

Ratnasingam, J., Macpherson, T. H., & Ioras, F. (2008). An assessment of Malaysian wooden furniture manufacturers' readiness to embrace chain of custody (COC) certification. *Holzals Roh-und Werkstoff*, *66*(5), 339-343.

Ratnasingam, J., Ark, C. K., Mohamed, S., Liat, L. C., Ramasamy, G., & Senin, A. L. (2017). An analysis of labor and capital productivity in the Malaysian timber sector. *Bioresources.com*, *12*(1), 1430-1446.

Ratnasingam, J., Chin, K. A., Latib, H. A., Subramaniam, H., & Khoo, A. (2018). Innovation in the Malaysian Furniture Industry: Drivers and Challenges. *BioResources*, *13*(3), 5254-5270.

Rusli, M. (1996). Impact of tropical hardwoods campaign. *Pertanika Journal of Social Science & Humanities*, *4*(2), 147-154.

Samad, A. R. A., Ashhari, Z. M., & Othman, M. S. H. (2009). Determinants of MDF exports: A panel data analysis. *International Business Research*, *2*(3), 58-63.

Shukri, M., Sam Shor, N., Rahim, A., & Masfitriniza, M. S. (2013). Consumers' willingness to pay for environmentally certified timber products: a comparison between 2003 and 2012. *The Malaysian Forester*, *76*(1), 1-8 (2013).

Shukri, M., & Sam Shor, N. Y. (2015). Forest certification in Malaysia: current status and challenges. *The Malaysian Forester*, *78*(1-2), 1-10.

Sun, C., & Zhang, D. (2003). The effects of exchange rate volatility on US forest commodities exports. *Forest Science*, 49 (5), 807-814.

Suryani, A. N., Shahwahid, H. M., Fauzi, P. A., Alias, R., & Vlosky, R. P. (2011). Assessment of chain-of-custody certification costs for sawn wood manufacturers in Peninsular Malaysia. *Journal of Tropical Forest Science*, 159-165.

Thanh, N. C., & Singh, B. (2006). Trend in rice production and export in Vietnam. *Omonrice*, *14*, 111-123.

UNCTAD. (2005). *Developing Countries in International Trade 2005: Trade and Development Index*. Geneva, Switzerland: United Nation Publication.

Upton, C., & Bass, S. (1996). *The Forest Certification Handbook.* London, England: Earthscan Publication.