

Review paper

Willingness to pay for certified wooden products: a critical literature review

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Abstract. Forest certifications aim to promote sustainable forest management through the certification of forest products derived from forests managed according to a set of guidelines. However, managing a forest following the sustainability benchmarks indicated by the different certification systems has a higher cost than non-certified forests. This cost difference is therefore reflected in products made from these certified forests. An *Environmentally Certified Timber Product* (ECTP), in fact, should be more expensive than its identical competitor made from non-certified wood because of its higher management and chain of custody costs. The purpose of this review is to highlight how, over the past decade (2010–2020), customer willingness to pay (WTP) for ECTPs has been estimated and what parameters lead consumers to choose ECTPs. Results revealed several methodologies for estimating WTP, the main one being Contingent Valuation, although Discrete Choice Experiments would seem to be more effective. In monetary terms, the average WTP obtained ranges from 17% for products with a higher base price, such as furniture, up to 68% for those with a lower price, such as paper. Finally, several parameters drive consumers to choose ECTPs, such as socio-demographic factors, prior knowledge of brands and labels, and choice of product attributes.

Key words: voluntary certifications, forest certifications, WTP, consumer, critical review.

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Introduction

Forest certifications aim to promote sustainable forest management through the certification of forest products derived from forests managed according to a set of guidelines. Since the 1992 Earth summit in Rio de Janeiro (Johnson, 1992), where it was agreed that the world's forests must be sustainably managed and that wood products entering international trade must come from sustainably managed forests,

certification of forest products has been significantly growing (Blanc *et al.*, 2019).

The main certification systems currently used are the *Forest Stewardship Council* (FSC) and the *Programme for the Endorsement of Forest Certification schemes* (PEFC). As of May 2021, the total FSC-certified forest area worldwide was approximately 226 million hectares (FSC, 2021) and almost 330 million hectares of forest area is managed in compliance with PEFC's internationally accepted Sustainability Benchmarks (PEFC, 2021).

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Managing a forest following the sustainability benchmarks stated by the different certification systems has a higher cost compared to non-certified forests, with a difference ranging from 5% to 25% (Hoang *et al.*, 2015; Nussbaum *et al.*, 1996). Consequently, this difference is also reflected in the price of the products. An environmentally certified timber product (ECTP) is therefore expected to be more expensive than its identical competitor made of non-certified wood because of its higher cost of management and chain of custody (Aguilar & Vlosky, 2007; Boyer *et al.*, 2021), and also because it contains a higher value component, which well-informed and sustainability-sensitive consumers recognise. Precisely because of this higher value component, ECTP manufacturers and traders seek to recover additional costs by adding a price premium (PP) to the base price of the certified product (Daniels *et al.*, 2010; Higgins *et al.*, 2020).

In this context, it is important to identify the most effective and efficient methodology to evaluate the willingness to pay a PP. There are several methodologies used to assess individual and collective preferences, among them are those based on revealed preferences, which are based on the actual behaviour of individuals in related and correlated markets, such as hedonic price and travel cost (Xu *et al.*, 2022; Sinclair *et al.*, 2022) and those based on stated preferences, which instead stem from the creation of a hypothetical market and the declaration of preference, such as contingent valuation and discrete choice experiments (Abdeta, 2022; Brain *et al.*, 2022).

Due to the generally negative media coverage of logging, primarily involving the illegal timber trade, and the loss of forest due to extreme events, consumers' perceptions of logging are threatened, while one fifth of the world's forests are under-managed or not managed at all (Bruzzese *et al.*, 2020). Consumers have developed a growing concern for sustainable forest management (Solomon *et al.*, 2010);

in particular, in Europe and North America young people between the ages of 18 and 35 are showing increased awareness towards the issue (Notaro & Paletto, 2021). Several studies have demonstrated that a higher level of education usually entails a higher degree of attention to and knowledge of environmentally sustainable practices (Dettmann & Dimitri, 2009; Migheli, 2021; Panzone *et al.*, 2016). This increased consumer focus on more environmentally sustainable products has enabled the existence of a niche ECTP market (Hansen *et al.*, 2006).

In the past, as stated by Forsyth *et al.* (1999), the certification of wood products was based on the premise that the end consumer, aware of the benefits of sustainable forest management, when given a choice between two identical products, would choose the certified one. In recent years, several scientific studies have analysed consumer behaviour in relation to products with forest certifications (Anderson & Hansen, 2004; Mohamed & Ibrahim, 2007; Notaro & Paletto, 2021); these studies have shown the consumers' inclination towards purchasing environmentally friendly products. The drivers that lead the consumers surveyed to choose ECTP are related to sustainable forest management, but also to the benefits that this type of management brings to human health.

The purpose of this review is to highlight how, over the past decade (2010–2020), academic research has focused on the topic, with regard to the consumers' study. This time interval was chosen because another review on the same topic was conducted in the previous decade by Cai & Aguilar (2013), in which papers published between 2000 and 2009 were considered.

The study specifically developed the following points:

- analyse the relationships among research groups dealing with wood products certification, highlighting which countries are giving more attention to the issue;

- verify whether there is still academic interest in the willingness to pay for certified wood products;
- understand which characteristics, among those reported in the literature, show a significant influence on the consumers' WTP for certified wood products.

The structure of the paper first contains a bibliometric analysis of the results obtained from the use of the search strings, assessing both the interest in the topic by the scientific community and the spread of active research groups. Next, a critical selection of the products was carried out, according to their relevance to the topic explored. This was followed by a specific qualitative review of WTP for certified wood products, exploring the statistical methodologies used and key consumer drivers highlighted in the literature.

Materials and Methods

The review and data collection involved two steps: first, we conducted a quantitative bibliometric and network analysis on the records obtained in the Scopus database. The second consisted of a systematic literature review in which the role of consumers' WTP for certified forest products was investigated in more depth.

In order to carry out both analyses, several search terms and topic groups were identified. The terms were selected to compose the query strings and were grouped into three mains clusters on which the research focuses (see Table 1): a) product, b) certification and c) consumer.

Table 1. List of keywords used in the search.

Clusters	Product	Certification	Consumer
Keywords	wood product	forest certification	willingness-to-pay
	forest product	PEFC	WTP
	certified wood	FSC	

Quantitative bibliometric and network analysis

The objective of the first analysis was to gather general information on the topic of wood certification. Indeed, in order to have an overview of the general topic, the first search query was less restrictive than the string used in the systematic literature review. In the quantitative bibliometric and network analysis phase, the search query was composed of the certification topic and the search string applied was as follows:

(TITLE-ABS-KEY (“forest certification*))

The records obtained can be considered as a macro set that includes not only consumer aspects, but also others that will be delimited by a social network keyword analysis to understand which search lines involve the topic of forest certification.

The quantitative bibliometric and network analysis consisted of an introductory first part where the map of publications for countries was provided and used to introduce the core of the analysis, and where bibliometric indexes, graphs and tables were discussed.

The network analysis consists of a co-occurrence network analysis (Goyal & Kumar, 2021; Martinez *et al.*, 2019), performed using VOSviewer: a free software for building and visualizing bibliometric networks (van Eck & Waltman, 2010). Such analysis allows highlighting relationships and the relative strength of connections among certain items (van Eck & Waltman, 2010). The elements selected in this study were the countries from which publications on the investigated topic originate and the keywords that appear in the publications.

The country network analysis aims to assess the strength of the link between them, based on the number of citations received from other countries. To include countries that contributed significantly to the topic, a minimum number of 10 publications in the reporting period was used as

a selection criterion. The keywords analysis was based on the co-occurrence of the indexed keywords aimed at assessing the link between them to build clusters highlighting possible lines of research. Also in this network, it was necessary to consider only the keywords that appear at least 10 times in the search articles to avoid the irrelevant ones.

The indices selected in the network analysis are those proposed and used in the review carried out by Martinez *et al.* (2019):

- the "Occurrence value" indicates how many times an item occurs in the dataset;
- the "Total link strength" allows to assess the strength of connection between two countries or two keywords (van Eck & Waltman, 2010);
- the "Average citations" assesses the influence of the research on the literature for a specific item or topic;
- the "Average normalized citations", like the third index, gives an assessment of the relevance on the research field for a specific item and is obtained by dividing the total citations for an item by the average citations per year for that item (Jin *et al.*, 2019).

The analysis provides graphical results that were further explored through tables showing the different bibliometric indexes selected (Martinez *et al.*, 2019).

Systematic literature review

In the second phase, a systematic literature review was conducted on the role of the consumer's WTP for certified forest products. The search string was more restrictive and consisted of any of the clusters previously described in Table 1, as follows:

(TITLE-ABS-KEY ("wood product*" OR "forest product*" OR "certified wood") AND TITLE-ABS-KEY ("willingness-to-pay" OR WTP) AND TITLE-ABS-KEY ("forest certification*" OR PEFC OR FSC))

Terms were linked using the Boolean operator "AND", whereas search terms belonging to the same group were linked using the Boolean operator "OR". This resulted in finding documents that included at least one term from each topic group.

We adopted a systematic literature review approach to ensure reproducibility and to avoid bias. The query strings were first searched on the Scopus database in "Titles, Abstract and Keywords" of published articles, reviews, book chapters and conference proceedings, limiting the search to the English language.

To obtain more information about the main topic of the review, the search was integrated with the Web of Science (WOS) with the following search string:

TOPIC: ("wood product*" OR "forest product*" OR "certified wood") AND TOPIC: ("willingness-to-pay" OR WTP) AND TOPIC: ("forest certification*" OR PEFC OR FSC)

In addition, we also deepened the research in the Google Scholar search engine, to look for whether additional papers could be found that had not yet been indexed on Scopus or WOS. The results were added to those extracted from Scopus and then a qualitative analysis of the publications was performed. Subsequently, through an abstract and title analysis, papers concerning consumers and consumer's WTP for certified forest products were selected, read, and analysed.

The search was conducted in June 2021 and included all results ranging from 2010 to 2020. All eligible and ineligible articles emerged from the systematic survey era reported in Annex 1.

Results and Discussion

The search conducted on Scopus using the terms "forest certification" shows a higher concentration of studies on the topic in

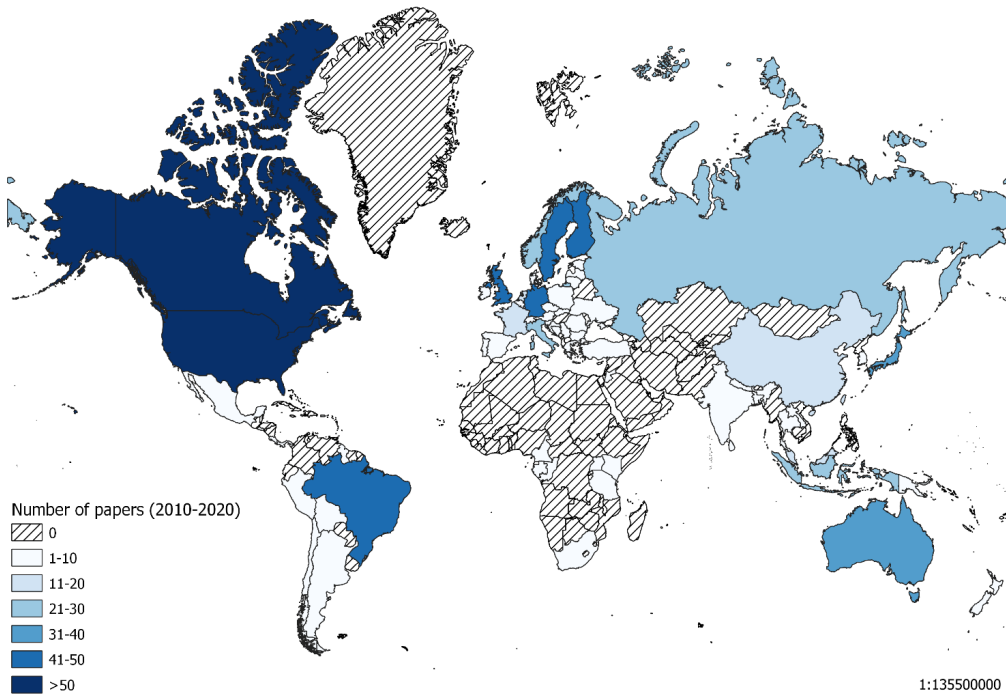


Figure 1. Published articles on forest certification per country.

North America, particularly in the U.S.A. (Figure 1). Moreover, in Europe the number of publications on the topic is high, especially in Germany. This result is not surprising, because Germany is the country where the PEFC standard was developed and where FSC is now headquartered.

As explained above, the analysis of the citation network makes it possible to investigate the scientific relationship between research groups from different countries, highlighting their productive capacity and international relevance in terms of citations.

According to the results obtained in the second analysis, scientific production is more concentrated in the United States, China, and Canada (Table 2). The average number of citations, on the other hand, allows an estimate of the scientific relevance of a country's publications. From this point of view, countries with fewer publications, such as Germany, Norway, Denmark, and South Korea, have a high average number of citations.

Country linkage expresses the relationship and intensity of this connection between two countries in terms of mutual citations. In Figure 2, one can see a group of countries that are strongly interconnected with the United States, which plays a key role. Other countries have multiple but weak ties, such as India, the Czech Republic, Indonesia, and Slovakia, suggesting a more contained role in the international context.

Considering the network of countries obtained, three nations play a nodal role, that is, the U.S.A., China, and Canada, which are also the ones showing the highest value of total linkage strength, connecting more other nations to each other. Once again, the U.S.A., China and Canada are the most productive countries by the number of publications and have the highest number of citations for their scientific output on the topic of interest.

Focusing on the research influence of different countries, which is evidenced by the

Table 2. Co-occurrence analysis of countries who research on this topic (by total citations).

Country	Publications	Total citations	Total link strength	Avg. citations	Avg. norm. citations
United States	126	3114	280	24.7	1.2
China	40	949	80	23.7	1.9
Germany	26	872	73	37.4	1.4
Canada	35	738	91	21.1	0.9
United Kingdom	30	687	51	22.9	1.3
Norway	10	603	38	60.3	2
South Korea	12	564	8	47	1.7
Denmark	12	481	27	40.1	2.1
Australia	27	477	24	17.7	0.8
Italy	20	417	28	20.9	1.4
Finland	22	374	78	17	0.8
Japan	20	332	62	16.6	0.8
Malaysia	24	221	29	9.2	0.5
Spain	11	188	14	17.1	0.8
Indonesia	16	159	17	9.9	0.5
India	16	143	19	8.9	0.7
Slovakia	12	100	14	8.3	0.7
Czech Republic	12	64	11	5.3	0.5

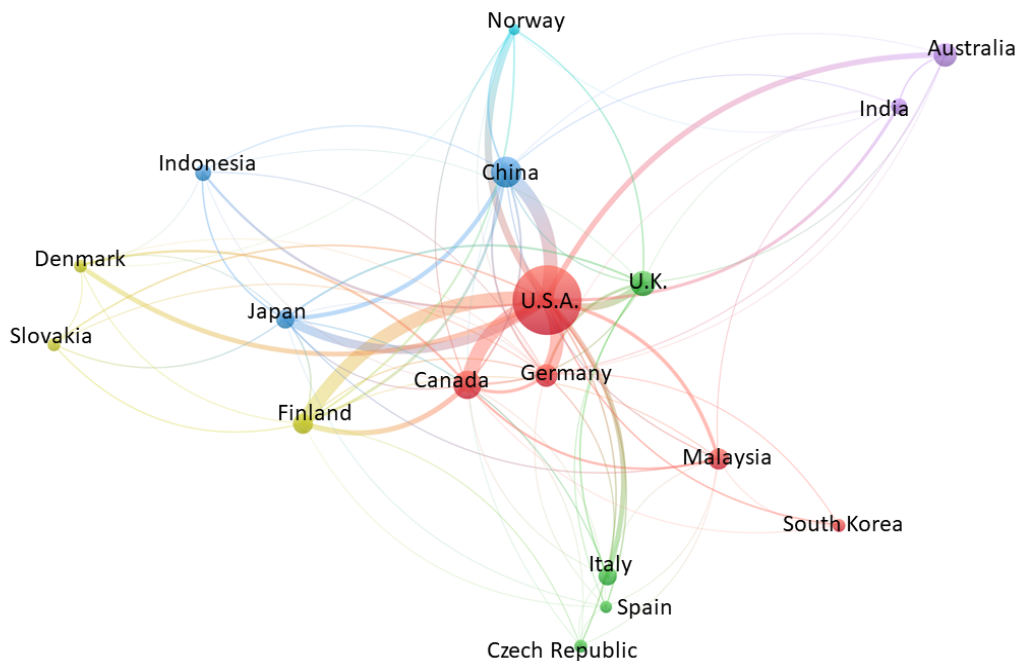


Figure 2. Network of countries expressing the relationship and intensity of connection in terms of mutual citations.

bibliometric indices of *average citations* and *average normalized citations*, European countries, and in particular Norway, Denmark, and Germany, are the most influential.

The bibliometric indexes also show that there are two main areas of influence worldwide: the European area, led by the three countries mentioned above, and the Asian area, guided by South Korea and China.

Regarding the nodal keywords, "Forestry", "Certification" and "Commerce" are the most occurred and connected keywords, showing the highest total link strength value (Table 3). Moreover, con-

sidering the connection lines between the words, it seems that the most relevant node of the network occurs between the aforementioned three words, "Forest management" and "Wood products".

Focusing on the bibliometric indices and on the scientific relevance and influence of different indexed keywords, it becomes clear that those related to supply chain management and decision-making are the most important. It seems that, more than other research topics, the decision process and integration of eco-labels into the forest supply chain is the field with the highest research interest.

Table 3. Co-occurrence analysis of indexed keywords related to the topics of forest products trade and voluntary certification (by occurrence).

Keyword	Occurrence	Total strength link	Avg. citations	Avg. norm. citations	Cluster
Commerce	54	244	19.9	1.3	2
Certification	53	263	15.6	0.7	1
Forestry	53	305	12.6	0.7	1
Sustainable development	45	197	27.6	1.5	2
Forest management	34	189	15.7	0.7	1
Wood	33	175	12.6	0.7	1
Wood products	33	197	9.4	0.6	1
Willingness to pay	31	132	19.4	1.2	3
Sales	30	132	18.4	1.6	2
Environmental protection	29	149	14.9	1.1	3
Consumption behaviour	28	106	13.5	0.9	3
Decision making	26	119	32.8	1.5	2
Sustainability	26	107	24.4	1.4	3
Forest certification	24	149	14.8	0.7	1
Marketing	23	125	22.3	1.2	2
Surveys	23	116	8.2	0.9	2
Timber	22	144	11.9	0.7	1
Supply chains	22	111	26.6	1.8	2
Costs	21	107	16.0	0.9	2
Manufacture	18	81	37	2.2	2
Competition	17	101	23.6	1.4	1
Sustainable forest management	16	114	18.7	1	1
Forests	16	137	15.9	0.8	1
Sustainable forestry	16	97	11.8	0.6	1
Timber certification	16	69	13.6	0.7	1
Consumer behaviour	16	82	13.1	1.5	2
Ecolabelling	15	60	35.3	1.3	3

Keyword	Occurrence	Total strength link	Avg. citations	Avg. norm. citations	Cluster
Perception	13	57	23.1	1.3	1
Forest product	13	103	17.4	0.6	1
Economics	13	56	22.5	1.8	2
Environmental economics	13	68	21.7	1.2	3
Climate change	13	45	13.6	1.7	3
Environmental policy	13	71	10.1	0.6	3
Environmental impact	12	73	25.8	1.6	3
Supply chain management	11	65	33.2	1.5	1
International trade	11	56	6.7	0.4	1
Carbon	11	45	29.1	2.7	2
Furniture	10	39	9.7	0.8	2

Concerning the obtained keyword network, the analysis shows three clusters of keyword associations (Figure 3). The first one (red colour), is the most relevant in the network, as it mainly deals with issues related to management and the process of integrating eco-certifications into the forest supply chain, and also includes commercial issues about the forest. The second one (green colour) is more related to economic, cost and market issues that include, only marginally, consumer behaviour on forest products.

Finally, the third cluster (blue colour) has the highest connection to consumer issues and their WTP for forest products. In addition, this cluster includes the topic of

environmental analysis, impact and policy related to the forestry system.

In the next phase the selected bibliographic material was qualitatively analysed. Searching with the keywords listed in the Materials and Methods section allowed us to select 22 papers. After reading these papers, we further selected publications in which WTP was explicitly stated. With these limitations, the selection of articles for the qualitative part of the review was reduced to 7 papers, published on *Scopus*, *WOS* and *Scholar* between 2010 and 2020: (Elliott, 2014; Sakagami & Sakaguchi, 2018; Shoji *et al.*, 2014; Shukri *et al.*, 2013; Shukri & Awang Noor, 2012; Tan *et al.*, 2019; Wan *et al.*, 2018) (Table 4).

Table 4. List of publications analysed in the qualitative review.

ID	Authors	Publication year	Title
[1]	Shukri, M., Awang Noor, A.G.	2012	Malaysian consumers' preference and willingness to pay for environmentally certified wooden household furniture
[2]	Shukri, M., Sam Shor, N.Y., Rahim, A., Masfitriniza, M.S.	2013	Consumers' willingness to pay for environmentally certified timber products: a comparison between 2003 and 2012
[3]	Elliott J.	2014	An analysis of willingness to pay and reasons for purchasing certified forest products
[4]	Shoji, Y., Nakao, N., Ueda, Y., Kakizawa, H., Hirai, T.	2014	Preferences for certified forest products in Japan: a case study on interior materials

ID	Authors	Publication year	Title
[5]	Sakagami, M., Sakaguchi, D.	2018	Estimating preferences for wood products with environmental attributes
[6]	Wan, M., Zhang, Y., Ye, W.	2018	Consumer willingness-to-pay a price premium for eco-friendly children's furniture in Shanghai and Shenzhen, China
[7]	Tan, Q., Imamura, K., Nagasaka, K., Inoue, M	2019	Effects of eco-label knowledge on Chinese consumer preferences for certified wood flooring: a case study in Chongqing City

The first parameter analysed is the area of study: six of the seven selected articles were published in Asian countries, two in Malaysia, two in Japan and two in China. The other selected study was conducted in the United States. Based on the concentration found, it is interesting to analyse the

research question used for the studies located in the Far East. Unlike the work conducted in the U.S.A., where the objective was to test consumer knowledge of forest certifications, the studies conducted in Asia aim to assess a potential market for certified forest products.

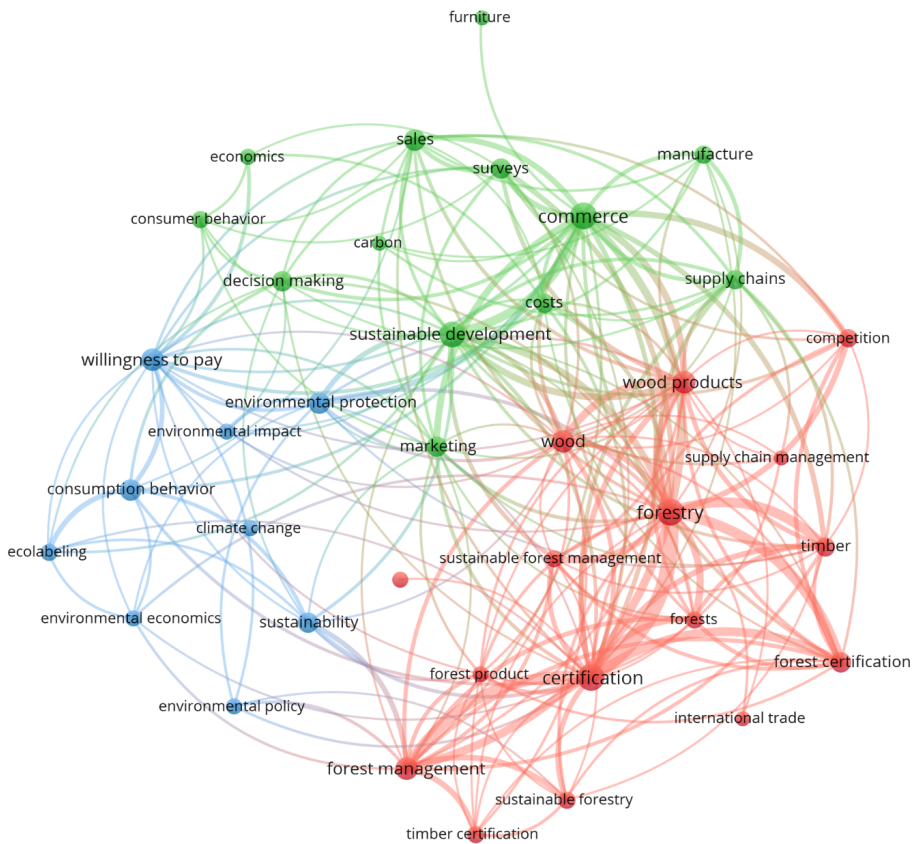


Figure 3. Keyword network: red line) association of keywords related to the management and process of integrating eco-certifications into the forest supply chain; green line) association of keywords related to consumer behaviour on forest products; blue line) association of keywords related to consumer issues and their WTP for forest products.

Table 5. Analysis of the methodologies used.

ID	Study area	Product studied	Survey method	Questionnaire submitted	Analysis method
[1]	Malaysia	Wooden dining furniture	Self-administered questionnaires	994	CV (Turnbull nonparametric Estimator)
[2]	Malaysia	Bookshelf	Self-administered questionnaires	102	PP (frequencies analysis) WTP (CHI squared)
[3]	USA	Printer paper	Face to face surveys	100	CV (logit model)
[4]	Japan	Wooden materials for wall renovations	E-mail based questionnaire survey	140	DCE
[5]	Japan	Paper notebook (5 notebooks per set)	Web survey made by a research company (survey panel of subjects with random sampling)	604	DCE
[6]	China	Eco-friendly children's furniture	Face-to-face questionnaires	299	PP (PCA + Ordered Probit)
[7]	China	Wood flooring	Face to face questionnaires	367	CV + Tobit model

The products investigated in the selected papers are diverse and have different base prices: from printer paper to more expensive wood products, such as dining furniture (Table 5). This allows us to assess how the PP is related to the base price of the product.

In all publications, the respondents were predominantly men, except for article [5], where the majority of respondents were women while the average age of the respondent was between 30 and 40 years old.

The most widely used methodology to detect willingness to pay and PP for certified products is undoubtedly *Contingent Valuation* (CV). This method, by means of the direct declaration of the consumer, expresses in percentage or monetary terms the price increase he/she is willing to pay for the addition of the eco-label attribute, starting from a base price and proposing additional prices for a forest sustainability certification on the product. The simplicity of detection with this methodology, however, is also accompanied by a limited explanatory capacity of the data collected.

Specifically, for study [1], CV was accompanied by a non-parametric estimate

of the average PP. This method allowed the estimation of the average value for the survey sample, but did not allow the identification of socio-demographic determinants that influence this price level, thus limiting the significance of the survey, despite having an adequate sample size (994 respondents).

Unlike the other studies reviewed, research [2] analyses and compares the WTP, in this case on a small sample of about 100 individuals, through another common non-parametric test, Pearson's Chi square, which highlights the statistical difference between respondents, relating it to sociodemographic variables and outlining significant differences for at least three of them. The average PP is evaluated in this case only as the average of the frequencies obtained from a base price. Again, this methodology has limited explanatory power, whereas statistical applications not based on stated preferences are better suited to evaluate the determinants of WTP for a product.

A methodology that analyses the determinants of WTP in depth is the one employed in study [3]: the binomial log-

it model allows to evaluate which choice attributes exert an influence on a dichotomous variable in determining the positive response. However, once again, the limitation of the statistical model lies in the loss of information resulting from the simplification of choices, which is only dichotomous. This does not allow to analyse the effect of covariates at different levels of expressed WTP, providing only a general parameter. This is the case, for example, in paper [6] where, following the detection of WTP expressed over 7 classes, an ordered probit model was developed, highlighting the statistical effect of covariates for each level of WTP investigated, and improving the explanatory power of the data. The application, however, was preceded by a Principal Component Analysis, which reduced the informative power of the covariates. Similarly, the study [7] also applied a similar information power methodology, the tobit model.

Of all the studies analysed qualitatively, those with the most effective and, at the same time, the most recent methodology are [4] and [5], in which the *Discrete Choice Experiment* (DCE) methodology is employed. In DCE models, the independent experimental design is intended not only to highlight choice attributes that are significant to the consumer, but also to accurately estimate the PP that a consumer

is willing to pay. Such analyses are considered the most reliable, although it is possible to overestimate WTP (Cai & Aguilar, 2013). In addition, from such models, it is also possible to perform a cluster analysis in order to link consumer characteristics to the attributes of the products being studied. Again, sample size plays a key role in the model's ability to analyse. From this point of view, study [4] has less information power than study [5], which includes over 600 surveys.

Table 6 provides an overview of the different types of drivers and variables used in the qualitative literature to understand the characteristics of consumers who are willing to pay an additional price for certified forest products. Papers [1], [4] and [5] used the additional premium method and choice experiments to estimate WTP, focusing on the willingness-to-pay and the role of product characteristics. Hence, the effect of consumer characteristics is not available.

From the findings, several areas can be identified for further investigation, either by including new sociodemographic variables, such as the number of family members, or by combining the role of sociodemographics with other consumption factors. In addition, studies [3] and [7] used a synthetic method based on a single question to assess the effect of knowledge. Con-

Table 6. Explanatory variables used in the studies.

ID	Socio-demographic aspects					Psychological aspects	Environmental aspects		
	Gender	Age	Marital status	Education	Income	Knowledge of certifications	Environmental perception	Lifestyle	Environmental concern
[1]	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
[2]	***	*	n.a.	n.s.	***	n.a.	n.a.	n.a.	n.a.
[3]	**	n.s.	n.a.	n.s.	n.a.	n.s.	n.a.	n.a.	n.a.
[4]	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
[5]	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
[6]	n.s.	n.s.	**	***	n.s.	n.a.	*	***	n.a.
[7]	n.s.	n.s.	n.a.	n.s.	n.a.	from * to ***	n.a.	n.a.	n.s.

***, **, * = p-value < 0.01, 0.05, 0.01; n.s. = not significant; n.a. = not available.

structs, such as subjective and objective knowledge are available in the literature that could make these analyses more reliable (Aertsens *et al.*, 2011; Flynn & Goldsmith, 1999).

It should be noted again that the analysis of sociodemographic variables and psychological aspects gave discordant results. This could be due to different products studied or the different countries in which the studies were conducted. However, further analysis is needed to clarify the role of consumption drivers.

In support of this, several studies emerge in the literature, such as those of Thompson *et al.* (2020) and Aguilar & Vlosky (2007), report that the female gender tends to be more inclined to pay a PP for ECTPs, although study [1] showed the opposite. On the other hand, additional elements also seem to influence WTP, such as lifestyles or cultural orientations, as in the case of LOHAS (*Lifestyle Of Health And Sustainability*) for middle-class Chinese consumers, education level, or even household composition. The latter, which was analysed in case [6], can be found in the type of product analysed. Single consumers were more willing to pay a PP for children's furniture compared to married families, both because of a simpler decision-making process, but also because of a greater availability of income to invest in such purchases. As lifestyles and education levels increase, it seems logical that the level of consumer knowledge and information will also increase, and hence there will be a greater focus on the choice and propensity to purchase ECTPs. Regarding eco-labels and forest certifications, only studies [4] and [7] made explicit reference, while the remaining articles merely explained the general principles behind these certifications and eco-labels. However, previous studies have shown that, for the same price between a certified and a non-certified product, consumers choose the certified one, because they are convinced it may have positive environmental

benefits (Notaro & Paletto, 2021). In addition, the WTP a PP and consumer *Purchase Intention* (PI) are not the same across different eco-labels and certifications. Paper [7], in fact, demonstrated how an FSC-certified product induces higher consumer PI and PP than a non-certified product. Conversely, a CEL (*China Environmental Label*) product had a positive effect only on consumer PIs and not on PPs. Prior knowledge of the eco-label or forest certification has a greater positive effect on WTP than a consumer who has never seen such labels.

Another element that influences consumer purchasing behaviour is the choice of product attributes. Study [4], conducted on the Japanese market, shows that although forest certification is an important attribute, the production area and dimensional stability of the product play a primary role for the Japanese consumer intent on purchasing wood products. On the other hand, study [5] on the Japanese market also showed that consumers preferred the "Conservation of biodiversity" and "Prevention of global warming" attributes more than quality attributes. The reason could also be related to the period in which these studies were conducted, demonstrating an increasing sensitivity, over the years, on aspects related to environmental sustainability and climate crisis issues.

Several aspects and some confirmation emerge from these elements of analysis, such as the importance of promoting effective communication and marketing campaigns to raise consumer awareness of the presence and meaning of eco-labels and forest certification. Another aspect is the presence of an evident geographic effect: it influences the attributes sought in a product on behalf of the consumer and the need for producers and suppliers of wood material and policy makers to segment the market, in order to encourage a massive entry of ECTPs.

Evaluating some monetary data, we observed how the average WTP obtained in

Table 7. Mean WTP for each product investigated in the selected studies.

ID	Product	Local currency		Local currency converted to current \$		
		Base price	PP	Base price (2021)	PP	WTP %
[1]	Wooden dining furniture	RM2000	RM359.27	\$558.65	\$100.35	18%
[2]	Bookshelf	RM100	RM17	\$27.56	\$4.69	17%
[3]	Printer paper	\$5.50	\$2.67	\$6.25	\$3.04	49%
[4]	Wooden materials for wall renovations	JPY100,000	JPY40,476	\$943.91	\$382.01	40%
[5]	Paper notebook (5 notebooks per set)	JPY400	JPY261	\$3.63	\$2.37	65%
[7]	Wood flooring (China)	CNY64.41	CNY43.6	\$10.42	\$7.11	68%

CNY: Chinese yuan renminbi; JPY Japanese Yen; RM: Malaysian Ringgit; \$ US Dollar.

the selected articles ranges from 17% to 68% (Table 7) and is higher in products with a lower base price, such as paper, while the PP is lower for more expensive products, such as furniture. WTP is therefore inversely proportional to the base price of the products analysed. This result, even with all the limitations imposed by the small number of the studies, confirms what has already been stated in other studies and reviews on the topic of the consumer WTP (Cicia & Colantuoni, 2010). This is also consistent with the review carried out in the previous decade by Cai & Aguilar (2013).

Another pattern observed is that, in studies in which the survey was conducted directly ([1], [2], [3], [6]), the mean WTP seems to be higher compared to those conducted via online questionnaires ([4], [5]). This result contradicts the finding of the meta-analysis conducted by (Cai & Aguilar, 2013). However, it can perhaps find an explanation in the *Social Desirability Bias* (Fisher, 1993) which in social science is a type of response bias explaining the tendency of the respondent to answer in a way that might be viewed favourably by others (Larson, 2019). In this case, it would justify the higher WTP of directly interviewed consumers, although, again, the small number of cases analysed does not allow us to establish the validity of this hypothesis.

Conclusions

Forest certifications have grown significantly since their establishment in the 1990s. These certifications, among which we find FSC and PEFC, have been adopted worldwide and the area covered by certified forests is still increasing nowadays. The increase in forest certifications has allowed the existence of a niche market of environmentally friendly wood products. The presence of an environmental certification, in fact, plays an important role in the consumer's choice of a product, even if the concept of sustainability also concerns the social and economic spheres, which are less often taken in consideration.

The purpose of this article was to review the literature on the topic published over the past decade, to evaluate consumer behaviour regarding ECTPs and their WTP a PP for a certified product. From what we gathered by the analysis of the selected papers, we could understand that consumers are generally WTP a PP for ECTP and that the PP is generally higher in products with a lower base price. This result reveals the importance of wise marketing campaigns, which are very important for this type of items, often related to everyday consumption. Through these consumptions it is therefore possible to convey messages that reach most consumers in the act of making

their usual purchases. Another interesting result of the review can be found in the geographical setting of the selected publications. Despite the opening of markets linked to globalization, and wood products having always had a very open market, specific local characteristics remain. This reflects an increase in the attention to the topic in a specific geographic area, the Far East, where researchers are studying the potential market for certified forest products.

The methodologies employed can be traced back to three groups of analyses. The most widely used methodology to detect willingness to pay turned out to be Contingent Valuation. In fact, this method, through the direct declaration of the consumer, allows to express in percentage or monetary terms the price increase he/she is willing to pay for the addition of the eco-label attribute. Typically, this method was accompanied by a non-parametric estimation of the average PP through a non-parametric test, such as Pearson's Chi Square, to highlight the statistical difference between respondents, or a binomial model to assess which choice attributes exert an influence on a dichotomous variable in determining the positive response.

The other method that was employed for these analyses was the Discrete Choice Experiment, which allows us to highlight the choice attributes that are significant to the consumer, but also to accurately estimate the price the consumer is willing to pay.

One application involved the combined use of a Principal Component Analysis (PCA), which reduced the information power of the covariates, with an ordered probit model, to highlight the statistical effect of the covariates for each level of WTP investigated.

Also due to the limited number of articles that met our stringent research requirements, the restricted area studied in these papers represents a strong limitation. In fact, we understood how the market

for certified wood products is expanding in Asia, but we have no elements to make an informed assessment of how the same market is developing in other countries, particularly in Europe. Here, unexpectedly, no studies were found on these topics, despite Europe being the cradle of sustainable forest management certification systems. However, this result reflects a topic already exploited in previous decades in this area.

For these reasons, it will be interesting in the coming years to study consumer behaviour and its evolution with regard to ECTP, especially in view of the increased attention of younger generations to the issues of sustainability and climate change, in order to verify whether these feelings will actually translate into greater willingness to spend.

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Annex 1. List of all articles emerged from the systematic review.

Browser	Author	Year	Title	Used for review
Scholar	Shukri, M., Awang Noor, A.G.	2012	Malaysian consumers' preference and willingness to pay for environmentally certified wooden household furniture	YES
Scholar	Shukri, M., Sam Shor, N.Y., Rahim, A., Masfitriniza, M.S.	2013	Consumers' willingness to pay for environmentally certified timber products: a comparison between 2003 and 2012	YES
Scholar	Elliot J.	2014	An analysis of willingness to pay and reasons for purchasing certified forest products	YES
Scholar	Shoji, Y., Nakao, N., Ueda, Y., Kakizawa, H., Hirai, T.	2014	Preferences for certified forest products in Japan: a case study on interior materials	YES
Scopus	Chen, J., Innes, J.L., Tikina, A.	2010	Private cost-benefits of voluntary forest product certification	NO
Scopus	Mohamed, S., Ghani A.N.A.	2010	Willingness to pay a price premium for certified wood products among consumers in Malaysia	NO
Scopus	Yamamoto, Y., Takeuchi, K., Shinkuma, T.	2014	Is there a price premium for certified wood? Empirical evidence from log auction data in Japan	NO
Scopus	Paletto, A., Notaro, S.	2018	Secondary wood manufacturers' willingness-to-pay for certified wood products in Italy	NO
Scopus	Sakagami, M., Sakaguchi, D.	2018	Estimating preferences for wood products with environmental attributes	YES
WOS	Chen, J., Innes, J.L., Tikina, A.	2010	Private cost-benefits of voluntary forest product certification	NO
WOS	Dauvergne, P., Lister, J.	2010	The prospects and limits of eco-consumerism: Shopping our way to less deforestation?	NO
WOS	Germain, R.H., Penfield, P.C.	2010	The potential certified wood supply chain bottleneck and its impact on leadership in energy and environmental design construction projects in New York state	NO
WOS	Chen, J., Tikina, A., Kozak, R., Innes, J., Duinker, P., Larson, B.	2011	The efficacy of forest certification: Perceptions of Canadian forest products retailers	NO
WOS	Cai, Z., Aguilar, F.X.	2013	Meta-analysis of consumer's willingness-to-pay premiums for certified wood products	NO
WOS	Bond, B., Lyon, S., Munsell, J., Barrett, S., Gagnon, J.	2014	Perceptions of Virginia's primary forest products manufacturers regarding forest certification	NO
WOS	Brusselaers, J., Van Huylenbroeck, G., Buysse, J.	2017	Green public procurement of certified wood: spatial leverage effect and welfare implications	NO
WOS	Holopainen, J., Toppinen, A., Lähtinen, K., Rekola, M.	2017	Forest certification and country of origin: choice experiment analysis of outdoor decking material selection in e-commerce market in Finland	NO
WOS	Wan, M., Zhang, Y., Ye, W.	2018	Consumer willingness-to-pay a price premium for eco-friendly children's furniture in Shanghai and Shenzhen, China	YES

Browser	Author	Year	Title	Used for review
WOS	Michal, J., Březina, D., Šafařík, D., Kupčák, V., Sujová, A., Fialová, J.	2019	Analysis of socioeconomic impacts of the FSC and PEFC certification systems on business entities and consumers	NO
WOS	Paluš, H., Parobek, J., Dzian, M., Šimo-Svrček, S., Krahulcová, M.	2019	How companies in the wood supply chain perceive the forest certification	NO
WOS	Tan, Q., Imamura, K., Nagasaka, K., Inoue, M	2019	Effects of eco-label knowledge on Chinese consumer preferences for certified wood flooring: a case study in Chongqing City	YES
WOS	Brusselaers, J., Verbeke, W., Mettepenningen, E., Buysse, J.	2020	Unravelling the true drivers for eco-certified wood consumption by introducing scarcity	NO

Note: Chen, J., Innes, J.L., Tikina, A. 2010. Private cost-benefits of voluntary forest product certification, appears twice in the table because using the same search string, in the systematic literature review process, the article was found in both databases.