TECHNICAL REPORT N0. 29

Bamboo Product Commercialization in the European Union

An Analysis of Bottlenecks and Opportunities

International Network for Bamboo and Rattan

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ISBN

Suggested citation:

van der Lugt, P.; Otten, G. 2006. Bamboo Product Commercialization in the European Union. International Network for Bamboo and Rattan, Beijing, China.

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Foreword

Instead of focusing on local markets and the production side of the supply chain for bamboo products, as has been done previously in several INBAR studies, this INBAR Technical Report focuses on potential markets in the European Union (EU) which are at the consumption side of the chain. It is the author's belief that aspects of the production chain closer to the final consumer, such as marketing and product development, are equally important as early components in the production chain, such as policy development, resource management and preservation technology.

This report is written as part of the PhD research of the main author for the Design for Sustainability Programme at the Faculty of Industrial Design Engineering at Delft University of Technology in the Netherlands. ProFound, a consultancy firm specialized in non-timber forest products (NTFPs) was asked by the author to share its latest experiences and knowledge of the commercialization of final products from NTFPs on the European Union market, and share its vision on the future development of the NTFP sector as a whole. This also provides important lessons for the bamboo sector.

The report is intended for stakeholders anywhere in the bamboo production chain who export or have intentions to export bamboo products to EU markets. It commences by providing the background, justification and its objective in chapter 1, before moving on to the methodology of the study in chapter 2. Available literature on key factors related to the commercialization process of new materials in general is discussed next in chapter 3, followed by references that are more specific to NTFPs (Chapter 4, written by ProFound). Readers who are more interested in bamboo-specific factors of the commercialization process would find such information in Chapter 5, reviewing existing literature on this subject. Chapter 6 presents the main results of interviews with over 30 stakeholders, in the Netherlands, on bamboo product commercialization in the EU. The concluding chapter 7 briefly reviews the main results and presents a vision for the bamboo sector for the development of export to the EU.

Many people provided support in the preparation of this report and I wish to offer my sincere gratitude to all of them – Mrs. Geertje Otten and Mr. Bert Jan Ottens of ProFound for their contribution to this report and their valuable suggestions for improving this report; all the respondents in the Netherlands who contributed their knowledge and time to this study; the Design for Sustainability Programme at Delft University of Technology and the Cartesius Institute for facilitating my PhD research of which this study is a part; and INBAR for publishing this report in order to promote dissemination of the key findings of this research. I sincerely hope that the results of this study would help strengthen export potential of stakeholders in the bamboo sector worldwide.

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Contents

Abstract

Despite the potential of bamboo as a fast growing renewable resource, the market for bamboo products in the West is still relatively small. Previous research had shown that various bottlenecks in the bamboo producing countries account for this to a large extent. There has hardly been any research on the commercialization of bamboo products from the perspective of consuming regions in the West, such as the European Union. This was highlighted by the literature research in this study on the commercialization of bamboo and other non-timber forest products in the European Union (EU). Literature search and qualitative analysis of the interviews of stakeholders in the Netherlands revealed that there are various key factors along the production chain that play, from the consumers' perspective, crucial roles in the commercialization of bamboo products in the EU: such as image, promotion, product development, increasing popularity of FSC wood, information dissemination, market choice, production capacity, trends, utilization, transport and market knowledge in producing countries. The results give a good overview about the most major constraints for bamboo product commercialization in the EU and provide concrete tools and suggestions for improving the situation.

Keywords: European Union; Netherlands; Bamboo products; NTFP; Commercialization; Production Chain; Qualitative research

1. Introduction

The market share of non-timber forest products (NTFP), such as bamboo and rattan, in the West is relatively small (CORPEI 2005). Bamboo is an NTFP that has, especially in industrial form, considerable potential as a wood substitute because of its high growth rate, good mechanical properties, eco-friendliness and potential use in a broad range of applications. Because giant bamboo species with most potential for commercialization grow mostly in developing countries, bamboo as a resource provides a lot of opportunities for local income generation in such areas through development of products for local and export markets. Problems related to various disciplines (such as management, marketing, product development and organization) in different parts of the production chain (such as plantation, harvesting, processing, transport, marketing) are the reasons for the small market share of bamboo products in the West (Belcher 1999; Held and Manzano 2003; Klop et al. 2003; Mathew 1998).

Previous research on the problems in the bamboo production chain was, in most cases, executed from the producing countries' perspective and was therefore focused on problems in the production chain at the producer's end. Little information is available from the perspective of stakeholders in consumer countries, such as in the West, about problems in the complete production chain that might hamper the commercialization of bamboo products in these markets, ultimately leading to the small market share. Some information, not publicly available, was found through this research covering certain aspects of this issue (see Chapter 5). Likewise, little information is available on specific opportunities for bamboo products in the Western market. Through this research we attempt to fill this knowledge gap.

The main objective of this research is to gain insight from the consumers' perspective, along the production chain, about the commercialization of bamboo products for the European Union (EU) market with respect to: (1) internal weaknesses and external threats causing the small market share, and (2) competitive advantages and external opportunities to increase the market share, with focus on the market side of the production chain.

2. Methodology

General Scope and Definitions

For delineating the research, this section refers to the various elements of the objective, together with some other terms of relevance that require deeper explanation.

Regions

The specific focus of the research is on the EU, in particular on the Netherlands where the interviews were conducted. Besides the Netherlands, most literature focuses on other EU countries, Germany in particular (Held 2003b). Each chapter mentions the regional focus that applies to the results covered in that chapter. If the results can be generalized, they are mentioned under the headings "EU" for the European Union, or "West" or "Western countries" if the results seem to apply to all other industrialized countries (please see below).

In this research, the terms "North" and "West" and "South" refer, unless stated otherwise, to a country/countries classified according to its/their industrial development, as used by the United Nations (United Nations 2005): "North" and "West" for industrialized countries (which give buyer's perspective) and South for least developed countries, developing countries or newly industrializing countries (which give seller's perspective). The terms "West" and "North" in this report are interchangeable; however, "North" is used only in combination with "South".

"European Union" or "EU" in this paper refers to EU-15, comprising 15 member states of the European Union in the period prior to enlargement in 2004 – Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, the Netherlands, Portugal, Spain, Sweden and the United Kingdom. Since 2004, ten more countries (mostly Central and East European) have been added to the EU.

Production chain

A production-to-consumption system (PCS) is defined as the entire set of actors, materials, activities and institutions involved in growing and harvesting a particular raw material, transforming the raw material into higher-value products and marketing the final products. The system includes the technologies used to grow and process the material, as well as the social, institutional and economic environment in which these processes operate. A PCS has three dimensions: (1) the vertical dimension, referring to the flow of the material from its production to the final consumer; (2) the intensity dimension, concerned with the physical transformations of the product at a particular stage; and (3) the horizontal dimension, referring to the scale of individual firms at a particular transformation stage and the linkages between them (Belcher 1999). In this report, the term "production chain" consistently refers to the vertical dimension, in which all the companies represented are involved in the flow of the material, from the initial harvesting to the final consumer.

Bamboo products

The focus of the research is on consumer durables, that is, products that yield services or utility over time rather than those that are completely consumed on use. This is an important delineation of this research because bamboo has potential for Western markets also in the other product type (such as food and charcoal). This research concentrates on sectors in which bamboo products are currently used in the West or where they have initial market potential as a possible substitute for wooden products. This applies to the interior furnishing market (furniture, accessories, interior finishing), the garden or exterior furnishing market (garden furniture, decorations, fences, decking), the building industry (window frames, façade cladding, doors, semi-finished products for flooring and finishing) and, to a smaller extent, to civil and water works (bridges, dam partitions, landings).

There is a broad range of processing technologies for bamboo products, both industrial and handicraft. This report focuses on bamboo products, and therefore also on technologies, that are already used in the EU. For this reason, and also to simplify the results and make them better comparable, the bamboo products have been categorized and clustered with respect to their processing technology (see Figure 1).

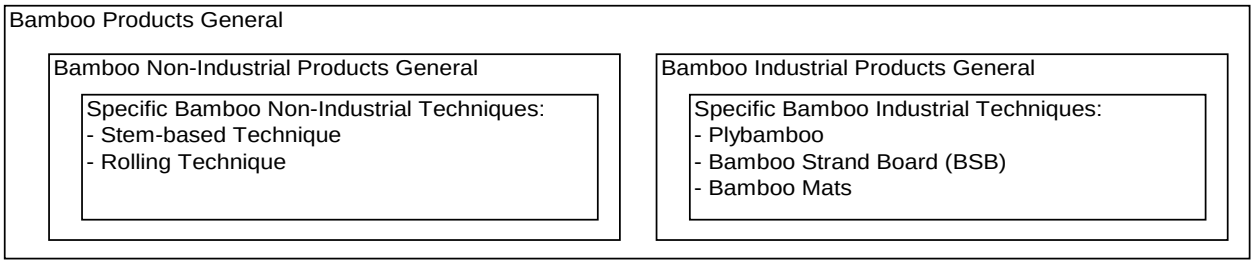

Figure 1: Categorization of bamboo products analysed in this report

The first differentiation is based on the level of industrialization: if the bamboo is processed without any machines, the products are categorized “non-industrial”; if the bamboo is processed using machines, the products are categorized as “industrial”. For the non-industrial bamboo products, if the bamboo’s basic form is still clearly recognizable, those products are categorized ‘culm-based’ (including bamboo strips). One such non-industrial technique that can be seen in products in the EU is the coiling technique, derived from Vietnam, in which long, thin bamboo slivers are coiled tight manually into a mould and then glued together. Industrial bamboo products analysed in this research can be categorized based on the technologies: Plybamboo, Strand Woven Bamboo and Bamboo Mats, which are all already used in the EU. All products (veneer, flooring, boards) that are based on high-quality strips laminated together, with the structure of bamboo still visible, are grouped together under the name “Plybamboo”. When these strips are assembled on a textile carrier, they are grouped under the name “Bamboo Mats”. Finally, coarse strips (strands) that are glued together under high compression forming a very hard board material in which the typical structure of bamboo is less recognizable are referred to as “Strand Woven Bamboo (SWB)” (see Figure 2). SWB is an interesting new product in which a large part of the material can be used, thereby utilizing the high biomass production of bamboo to the maximum.

Figure 2: An example of flooring panels based on the Strand Woven Bamboo technique

The technologies and products in this research cover the most important bamboo products in the mentioned sectors available in the EU, but do not cover all product and technologies available for industrial bamboo products (see Appendix 1 for an overview of all industrial bamboo products available).[1] The other, mostly low-end industrial bamboo products – such as bamboo mat board and bamboo particle board – are not deemed competitive yet with wood-based boards in the EU on the short term. However, for the medium to long term, if production capacity and availability of these products are improved, these products could also become competitive in the EU.

Since most stakeholders interviewed obtain their products from China and Latin American countries, the results of the interviews refer to the two most commonly used and industrialized bamboo species in these parts: *Phyllostachys pubescens* (referred to as 'Moso' in the remainder of this document) from China and *Guadua* spp. (referred to as '*Guadua*' in the remainder of this document) from Latin America. However, the results would also be applicable to various other giant bamboo species apt for industrial utilization like *Dendrocalamus asper*.

Product-related terms

1 The table in Appendix 1 combines and compresses the categorization of industrial bamboo products as used by some researchers (Ganapathy et al. 1996; Wang and Guo 2003; Zhang Qisheng et al. 2003), and clarifies which industrial bamboo products are taken into account in this report based on their short term potential for the EU (see bold printed rows in the table).

Product-related commercialization, innovation, development and design are best explained through the product innovation model developed by Roozenburg and Eekels (1995), which serves as one of the pillars of product development methodology at the Faculty of Industrial Design at Technical University Delft (see Figure 3).

“Commercialization of products”, as used in this research, builds on the definition of Roozenburg and Eekels (1995) for innovation: “The development and successful market implementation (realization) of a new activity”. For this study, the term “commercialization” is refined to mean “the development and market implementation of new or existing (bamboo) products”, and can be seen as a synonym for “innovation”.

“Product design” is the whole process of development of a new product (within an enterprise) till the description of the spatial and physical-chemical form of the product, including its intended means of use. There are many misconceptions about the term “design” (Kuilman 2004). A major one is assigning the term to the aesthetical appearance of a product. “Design” in this way can be better defined as the styling of a product. “Design”, as used in this research, is design in the form of “product design” in which styling is an intrinsic part. In contrast, the term “design products” in this report does refer to products for high-end markets in which the styling or aesthetical component is deemed most important.

“Product development” entails, besides the design of the product, the development of the strategic course of the enterprise, the fabrication process, required machinery, the production organization, logistics, marketing and financing related to the product to be developed. In this sense, “product development” is also referred to as “integral product development”. The relationship between the various terms is represented in the model presented in Figure 3.

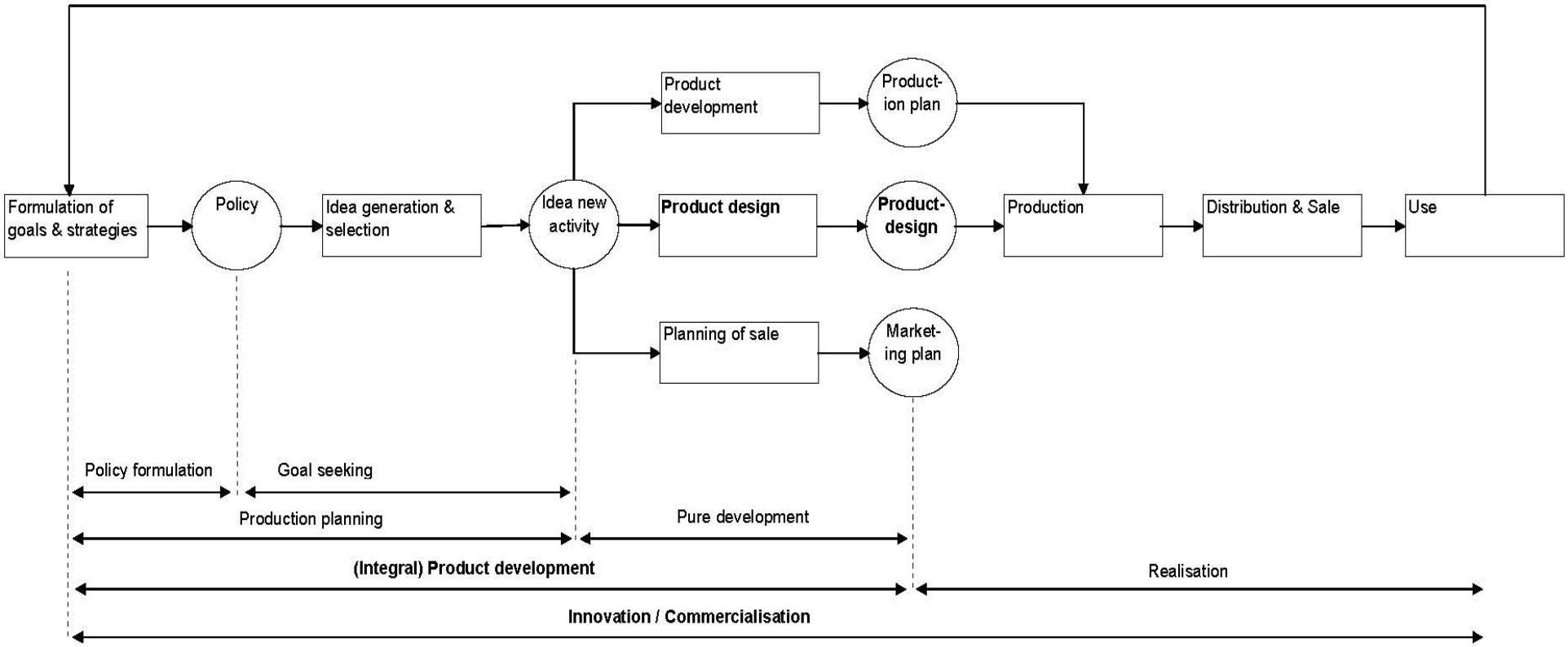

Figure 3: The relationship between product-related terms (Roozenburg and Eekels 1995)

The commercialization process is deemed successful once the new product can compete with similar products on the market, and take over market share of existing products. Whether the product can compete or not depends on the four P's in the marketing mix: product, price, place and promotion. Kotler (1997) refers to (the properties of) the product as "the most basic tool" of the marketing mix, forming the linkage between the technical and commercial development process.

Strengths, weaknesses, opportunities and threats (SWOT)

SWOT analysis is often used as a strategic marketing tool in business and is normally considered from the perspective of a company or organization. In this method, "Strengths" and "Weaknesses" are factors internal to the organization over which it has direct control. "Opportunities" and "Threats" are factors in the environment external to the organization and over which the organization does not have direct control but needs to respond to (Marijs and Hulleman 2000). For this research, SWOT analysis is applied from the perspective of bamboo products and the complete production process of these products as related to the EU market, and compared with competing products of natural materials like wood and rattan (as reference). Thus, instead of one company, SWOT analysis is used over the complete production chain in which various companies and stakeholders participate, and is therefore slightly adjusted for the categorization and clustering of factors found in the interviews and in the literature research. In this report a strength or weakness refers to a positive or negative factor, respectively, in the current production chain of bamboo products (fact), as compared with similar competing products of natural materials. An opportunity or threat refers to a factor in a possible future in the production chain of bamboo products, or to a current/future development in a competing sector/product like, for example, the wood industry (possibility, not fact).

The borderline between strength or opportunity, and weakness or threat for bamboo products, therefore depends on the amount of companies in the chain that already have reacted to an opportunity or threat (current versus future). For example, if only one company (early adopter) has utilized an opportunity, than for the market for bamboo products in the EU as a whole, this is perceived in this research as an opportunity and not as a strength, as it can be considered for the specific company itself. At times, this study refers to strengths and opportunities as factors of success, and to weaknesses and threats as factors of failure.

Technology

"Technology" has many definitions, but in the context of this research technology is defined as "a known and/or available tool to realize a function". There are various sorts of technologies that can be distinguished that play a role during the product development process (Poelman 2005): development technology (realization of the industrial product design), product technology (realization of product functions) and manufacturing technology (realization of the product). In this research, the term "technology" will be used referring to manufacturing technology and is synonymous with the term "technique".

Non-timber forest products (NTFP)

The term 'non-timber forest product' or NTFP encompasses all biological materials other than timber which are extracted from forests for human use, including edible and non-edible plant products, edible and non-edible animal products and medicinal products (NTFP exchange programme 2006). Bamboo and rattan are considered the two most important NTFPs (Belcher 1999).

Consumers

There are all kinds of potential consumers or end users that form the target market for bamboo products in the West. Consumers can be divided in "individual or private consumers" and "professional consumers" referring to any organization as end user, which

can be companies, governmental organizations, non-governmental organizations (NGOs) and other organizations.

Literature research

Before conducting the interviews, an elaborate literature research was performed. This literature research first focused on previous research about constraints and possibilities during the commercialization process of other NTFPs and lesser known wood species, and briefly for new materials in general to sketch the context, before focusing on previous research on the commercialization of bamboo products.

For the literature research, first an elaborate search was executed based on the keywords ‘commercialization’ (and synonyms), ‘bamboo’ and ‘NTFP’ (and synonyms) and ‘Western markets’ (and synonyms). Sources examined for literature (references) were various scientific search engines such as Web of Science, Scirrus, Science Direct and Google Scholar, websites of acknowledged institutes in the bamboo and NTFP sector such as International Tropical Timber Organization (ITTO), International Network for Bamboo and Rattan (INBAR), Food and Agriculture Organization (FAO), United Nations Industrial Development Organization (UNIDO) and the European Tropical Forest Research Network (ETFRN), and the experiences and observations of the authors and experts in these fields.

With the objective of the research in mind, the literature found was scanned for additional information about key factors during the commercialization process for the various resources and materials in the West.

Interviews

The main method for data collection was through the execution of interviews with various stakeholders in the Netherlands who are directly or indirectly involved in the commercialization of bamboo products.

Selection and characteristics of respondents

The stakeholders to be interviewed were selected based on the sectors in which bamboo is expected to have most potential for consumer durables: interior and exterior furnishing and the building industry. Within this, an optimal categorization of stakeholders was attempted based on certain criteria – kind of organization (for companies this includes the size), bamboo products as core business (or not), and level of industrialization – in order to gain the most comprehensive picture possible of factors causing the small market share of bamboo products. Various key stakeholders in retail chains were also approached for a 'fresh' look on the problems of the commercialization of bamboo products in the EU, in order to include the opinions of these entities, which have not worked directly with bamboo but have expertise in trends and requirements of the EU market.

Appendix 2 lists the 31 respondents of the interviews and provides information such as the type of organization they work for, their function and the categorization of their organization with respect to the criteria mentioned earlier. Respondents 1-24 answered the interview either in person or over the telephone, respondents 25-31 answered questionnaires based on the topic list used during the interviews. Of the 31 interviewed respondents, 18 were companies. Table 1 shows in which sectors/branches the various interviewed companies fit. As can be seen from Table 1, most respondents are companies selling final products, almost all for the interior or exterior (garden) furnishing market. The highest number of respondents represents furniture companies. Five interviewed companies also supply the project and building market.

Table 1: Categorization of companies interviewed according to product type

Type	Semi-finished products (mostly for building industry)		Finished products		
	Resource	Industrial	Flooring and interior finishing	Furniture	Accessories
MSE/SME company	1	3	3	3	1
Big company	1	-	3	9	4
Total	2	3	6	12	5

Note: As some companies have more than one type of products, the totals may not tally with the 18 companies interviewed.

Table 2 categorizes the respondents in terms of the kind of organization, knowledge about bamboo products and level of industrialization. Organizations can be categorized into various categories (for example, both industrial and culm-based bamboo products). The table shows that, as required for the broad perspective wanted, the respondents are distributed quite evenly over the various quadrants of the matrix for the various criteria and should therefore provide a comprehensive overview of factors influencing the commercialization of

bamboo products in the EU. It can also be seen from the table that almost two-thirds of the organizations approached were companies (18 of the 31 organizations interviewed).

Table 2: Categorization of respondents according to organization type, bamboo products and level of industrialization

Type	Bamboo		Non-bamboo	Total
	Industrial	Culm/Handicraft		
MSE/SME company	6	2	1	9
Big company	3	3	6	9
Others (designers, NGO, consultancy)	9	3	4	13
Total	18	8	11	

Note: As some organization fit in more than one quadrant in the matrix, the totals may not tally with the 31 interviewed.

Table 3 below categorizes the respondents according to the overview they have over the production chain. The chain is split into various segments from South (production) to North (consumption) based on the division of the production chain in the topic list (see Appendix 3). It may be noted that the borderline between product development in North and South can be rather vague; there are many examples in which products are developed in collaboration with partners both from North and South. Therefore, unlike the topic list, 'Product Development North' and 'Product Development South' are clustered under one heading 'Product Development' in this report. This also applies to the results of the interviews in Chapter 6. In Table 3, 'Product Development' applies to the phase when the product is not finished yet (to be designed, manufactured, etc.). The 'Marketing and Sales' process step applies to finished products. The categorization in Table 3 is based on the function of the respondent (for example, a salesperson usually knows less about production and transport details, but more about marketing and sales) and observations of the author about the answers given during the interviews that reveal the knowledge of the respondent about the production process. Respondents at management level have been approached for the interviews, as these people in general have overview of a larger part of the production chain. The table shows that in line with the objective of the study, most of the respondents' expertise lies on the market side of the production chain. However, still a fair amount of the respondents also have insight over the production side of the chain.

Table 3: Categorization of respondents with respect to overview over the complete production chain

Production chain	South	South / North	South / North	North	North
	Production / Processing	Transport	Product Development	Marketing & Sales	Utilization
MSE/SME companies	5	5	6	7	7
Big companies	8	9	9	9	9
Other (designers,	4	3	13	13	9

NGO)					
Total	17	17	28	29	25

Note: As some organization fit in more than one quadrant in the matrix, the totals may not tally with the 31 interviewed.

Procedure

Two-thirds of the respondents were interviewed in person after due preparation, while the other respondents were either interviewed over the phone, without any preparation, or via e-mail through a questionnaire based on the topic list structured along the production chain (Appendix 3). The first category of respondents were asked to prepare for the interview by brainstorming about factors influencing the commercialization of bamboo products in the EU in their sector, usually based on the topic list sent to them beforehand. Items in the topic list are included based on common sense, on literature about commercialization of products in general (Cooper 1996; Pugh 1990; Smulders et al. 1996) and on a questionnaire used for forest product development (Belcher and Ruiz-Pérez 2001)

The interviews conducted can be considered half open, focused interviews starting with an introduction of the research, a general inquiry about the organization of the respondent and his/her experience with bamboo products. After the introduction, the scope of the interviews narrowed, focusing on the knowledge of the respondent about specific bamboo products in their sector. For respondents without knowledge about bamboo products, the interview focused on their experience in their specific sector usually on similar materials such as FSC wood. From here on, the interview followed the SWOT methodology, focusing on positive (strengths and opportunities) and negative (weaknesses and threats) aspects influencing the commercialization of bamboo products (or similar products) over the complete production chain. The respondents were first interviewed about these aspects in an open way. Once the respondent ran out of answers, the topic list was used as a guideline to further discuss and analyse the production chain, before the interview was concluded.

The information received from the respondents, in the form of filled in questionnaires and through the interviews, was analysed using qualitative research methods. The data were labelled and categorized on strengths, weaknesses, opportunities and threats (SWOT), before being grouped and assigned to the various parts of the production chain and the product groups they belong to based on the processing technology. The summarized results of the interviews can be found in Chapter 6.

3. Context: Commercialization of New Materials

There are some generally known mechanisms, including factors of success and failure, for the commercialization of new materials and these might also apply, though not specifically, to the commercialization of bamboo in the EU. A brief discussion on them, rather than on the theory of successful commercialization of a new product in general (e.g. by Cooper (1996) and Montoya-Weiss and Calantone (1994)), would therefore be of use in understanding the context.

There are three main actors in the development process who play key roles in the commercialization of new materials (van Kesteren and Kandachar 2004): material scientists and technologists who develop new materials; industrial design engineers who, after familiarizing themselves with the benefits and drawbacks of the new materials, apply them in products; and consumers who decide to buy and use these products. Each of these stakeholders makes specific contributions during the new material commercialization process, which can be analysed in different ways. For example, Ashby and Johnson (2002) acknowledge five steps involved in moving a new material into a successful product. First, material technologists test the material and provide test data through statistical analysis. This test data is distilled into design data on which material selection by industrial design engineers can be based for their potential applications. Finally, the new materials are used by consumers in new products.

Alternatively, Manzini (1986) differentiates the moment of invention of a new material, the moment of first application and the moment of mass application. The process is referred to as “new material commercialization process” by van Kesteren and Kandachar (2004). Three sequential phases are distinguished in this process: development, introduction and acceptance. In the development phase, a new material is developed, tested and optimized by material technologists for maximum suitability for large-scale production. During the introduction phase, industrial design engineers start to use this new material for their products, and the first products become available for early adaptive consumers. The properties of material are evaluated in the field, and if successful, will result in growing design and manufacturing activities. If the material is accepted by the consumers, and widely applied by industrial design engineers in different products, the material has reached the acceptance phase.

One major obstacle for successful commercialization of a new material has been the failure to determine the time that this process would take. Although there is typically a 20-year interval between the invention of a new material and its widespread adoption (Eagar 1995), the speed of acceptance and the level of success might vary considerably for different materials. For example, in their historical review about the commercialization process of various sorts of plastics, van Keesteren and Kandachar (2004) show that the commercialization process for new materials varies from a few years for some materials (for example, Nylon and polyethylene) to more than 60 years for some others (for instance, cellulose acetate), while some new materials never make it to the market.

Musso (2005) found that delays in the commercialization process of thermoplastics in the United States were due mainly to technical deficiencies in materials and obstacles in application value chains, and to a lesser extent to material costs, competition from other materials and serendipity. As a major success factor for material technologists, Musso (2005) mentions strategic selection of application markets in order to shorten the commercialization time and improve the adoption probability. Early markets should be selected based on the ability of the material to solve unique problems and the simplicity of the application value chain. For any new material in general, van Keesteren and Kandachar (2004) found that many factors of success and failure during the commercialization process belong to the following categories: material properties, manufacturing, market strategy, economics,

legislation, information transfer, entrepreneurship and image. While some of these factors can be influenced, the main stakeholders do not have influence on various external factors like legislation, for example, during the development process. Based on the ascertained factors of success and failure, van Kesteren and Kandachar (2004) made various recommendations for material technologists and industrial design engineers (see Table 4), who are perceived as being the two most important stakeholders in the development process of any new material (including bamboo). Good communication between these two actors is important to positively influence the commercialization process.

Table 4: Recommendations for materials technologists and industrial design engineers for improving the success of new material commercialization process (adapted, van Kesteren and Kandachar 2004)

Category	Advice for material technologists	Advice for industrial design engineers
Raw materials	Make sure that raw materials are sufficiently available, and pay attention to - short delivery time - not getting drained	
	Make sure that the raw materials are competitive in price	
Material properties	Get to know the properties of the material	Get acquainted with the properties - of the material - of the possibilities of the material in products
	Try not to optimize only one property, but keep in mind all aspects of the material	Experiment with the new material
	Find applications for the new material	Find applications for the new material
	Try to make the material competitive with other materials:	Make use of the competitive properties of the material: - better or unique properties - good manufacturability - form freedom - good price
Manufacturing	Make sure that there are machines available for producing and manufacturing the material	Try not to use the new material the way the old material was used
	Control the chemical processes to produce the material	
Information transfer	Provide design aids to utilization the material	Employ design aids to utilization the material
	Advertise in magazines, visit fair shows	Read the advertisements in magazines, visit fair shows

	Make it possible to experiment with the new material	Attend symposiums for designers to get acquainted with the material
Market strategy	Organize symposiums for designers to get them acquainted with the material	Inform material technologists about new functions that can trigger material development
	Make use of scarcity of raw materials, it triggers development	Let the application and material grow up together
	Try to stimulate the need for new functions	
Image	Let the application and material grow up together	Focus on positive aspects
	Focus on positive aspects	Connect the image of the material with the material and not with a material group
	Connect the image of the material with the material and not with a material group	

Although bamboo is known for centuries as a traditional material, many of the recommendations mentioned in Table 4 and the factors of success and failure do apply to industrial bamboo, which is a fairly new material that is still in the introduction phase of its commercialization process in the West.

4. Context: Commercialization of Non-Timber Forest Products (NTFPs)

Before looking at the factors behind the successes and failures of the commercialization of bamboo on the European market in the next chapters, it is important to provide some context on non-timber forest products (NTFPs) – the product group of which bamboo is part – and discuss experiences in their commercialization.

NTFPs and their Local Relevance

NTFPs are basically all biological forest materials, other than wood used for timber, collected for human use. These are wide-ranging from gums and resins to bamboo and live animals, each with its specific attributes and use. The overview below shows more clearly how various NTFPs can be classified (Box 1).

Box 1: NTFP classification (ProFound 2005)

Edible plant products

Food

Edible oils

Spices

Fodder

Other edible plants

Non-edible plant products

Rattan

Bamboo

Sustainably produced wood

Ornamental plants

Chemical components

Other non-edible plant products

Medicinal plants

All medicinal products

Edible animal products

Terrestrial animals

Animal products

Fish and aquatic invertebrates

Other edible animal products

Non-edible animal products

Insect products

Wildlife products and live animals

Other non-edible animal products

NTFPs are derived not only from trees, but also from fungi and animals for which the forest ecosystem provides habitat. They make a significant contribution to the livelihoods of large numbers of people in developing countries. As NTFPs can be harvested with relatively little impact on the forest environment, it is widely suggested that NTFPs development might have a less destructive impact on forest and even lead to forest conservation. Forest conservation and rural development are widely recognized as both compatible and mutually beneficial.

Detailed regional statistics on the trade in NTFPs are not available, mainly because their (economic) value is rarely taken into account in land-use planning or in assessing Gross Domestic Product (GDP). However, some raw international trade data available show that NTFPs have a relatively important place in the world trade (Table 5).

Table 5: Examples of NTFP international trade values in 2001 with original data from UNCTAD database (Convention on Biological Diversity Secretariat/ UNEP 2001-2005)

Products from NTFP	World's import (million US$)
Natural rubber	4,221.8
Ginseng roots	389.3
Essential oils	319.4
Cork	310.7
Honey	268.2
Walnut	215.9
Mushrooms	206.5
Rattan	119.0
Gum Arabic	141.3
Brazil nuts	44.3
Total NTFP	11,108.7

When looking at recent literature and research on the relevance of NTFPs in development, there are mixed experiences. Some studies suggest that although trade in NTFPs has been widely promoted as an approach to rural development, NTFP commercialization is often not successful and not contributing to poverty alleviation or conservation of biodiversity. In some cases, for example, as described by Neumann and Hirsch (2000), "Sale of NTFPs often tends to provide a basic level of income for the poorest section of the communities, rather than providing a method of socio-economic advancement."

On the other hand, these findings cannot be totally generalized, as they are not supported by a comprehensive analysis of the commercialization of various types of NTFPs. Unfortunately, the NTFP sector is "characterized by a general absence of theory and a lack of explicit hypothesis testing" (Neumann and Hirsch 2000). However, if there are signs of NTFPs failing to make a positive contribution to sustainable development, there exists a need to carefully look at the factors that cause this failure.

Following this, the practical study of Marshall et al. (2003) could be referred to. The need for an appropriate framework that can be used for the comparison of different case studies and hypotheses testing has been a major goal of that study. Through workshops held in Mexico and Bolivia between 2000 and 2003, the commercialization success of the NTFPs has been defined and measured based on the local communities' and experts' perceptions. Socio-economic improvement of the communities involved is referred to in most of the definitions when looking at the success of NTFP commercialization. NTFP commercialization was found to be the most successful in terms of forest conservation (Mexico) and in terms of improving the economic situation of the women within communities (Bolivia). This study revealed that commercialization of the NTFPs has provided clear benefits for the society, such as strengthening the community organization, improving social justice and increasing the involvement of unprivileged members of the community such as women. It also brings out the significant contribution of NTFPs for the household income of rural areas of the developing world. Rural people, moving from a subsistence lifestyle to a cash economy, have relatively few options for generating income. NTFP collection is a commonly available option.

In India, for example, the share of NTFPs in the household income is as high as 49 percent (Table 6).

Table 6: NTFP share in household income (CBD 2001)

Site	NTFPs as % of household income	Reference
Zimbabwe	12-47	Lynam et al. 1994
Madagascar	47	Kramer et al. 1995
India	49	Bahuguna 2000
Sri Lanka	1-10	Bogahawatte 1999

Many researchers, donors, NGOs, community groups, governments and development agencies around the world are searching for new ways to establish sustainable production of NTFPs, as a tool for biodiversity conservation and poverty alleviation. These efforts have been concentrated mostly on interventions through policy, investment and "green marketing".

NTFP Commercialization from the Seller's Perspective

Although there is a growing interest in the opportunities of NTFPs all over the world and increasingly success stories are published, organizations working in this field often encounter bottlenecks in the development of NTFPs. A list of main problems can be prepared based on the experiences of non-governmental organizations (NGOs) and consultants actively engaged in NTFP advocacy and lobbying activities (see Box 2).

Box 2: Main factors of failure during NTFP commercialization from the seller's perspective (ProFound 2006)

I. Institutional capacity and policy development

Common weaknesses (problems) are:

- Lack of coordination regarding NTFP development among various institutions and organisations (for research, education, policy development and implementation).

- Lack of understanding of the role of NTFP on the part of natural resource management agencies.

- Improper or incomplete valuation of NTFP vis-à-vis other products.

- Inadequate local control and participation in resource management and decision making.

- Lack of clearly defined resource tenure and access rights.

- Weak implementation of laws and regulations governing biodiversity product extraction.

II. Resource management and product development

Common weaknesses (problems) and threats (risks) are:

- Lack of information about the NTFP resource base and uncertainty about resource sustainability.

- Lack of methodologies and institutional capacity regarding NTFP resource assessment and biodiversity data collection – uniform and regionally/globally applicable terminology and appropriate definitions/classification of biodiversity products are essential

prerequisites for the development of a (national/regional) statistical information system for NTFPs, which in turn is a key requirement for the development/adjustment of sector policies/regulations.

- Inadequate local control and participation in resource management and decision making because of:
  - the lack of clearly defined resource tenure and access rights;
  - inequitable distribution of benefits derived from NTFP exploitation; and
  - weak implementation of laws and regulations governing NTFP extraction.
- Accelerated exploitation of NTFP entails the risk of over-exploiting the resource.
- Boom-and-bust cycles resulting from erratic production and demand patterns.
- Insufficient knowledge and expertise in the field of processing and product development.
- Lack of information on current and future demand for NTFP: lack of national and regional statistical data on NTFP (including related methodologies to gather and analyse these data); inefficiency of marketing systems; insufficient market analyses; inefficient credit availability; inadequate transportation and storage systems; poor management capability; and inappropriate government policies and regulations.
- Over-dependence on single-product markets.

iii. Social and cultural aspects

Some key weaknesses (problems) and threats (risks) are:

- Competitive exclusion of the poor as the demand (and therefore the price) for NTFP increases (i.e. inequitable distribution of benefits derived from NTFP exploitation).
- Implications of moving from subsistence-based economies towards a greater dependence on the cash economy.
- Threats to traditional cultures owing to the reorientation from subsistence lifestyles towards a cash economy.

From the above overview it becomes clear that an important part of the bottlenecks of NTFP development concerns resource management and product development. Ottens (2006a, 2006b) states that when asked why a certain design or type of product was chosen, NTFP producers in local communities often answer, “Because we are told so”. In theoretical terms, several case studies and experiences from different projects reveal a common element that can be distinguished on the trade chain. This is a bottleneck at lower layers – the lack of in-depth and updated market information.

The conclusions are even more detailed in the earlier discussed practical study of Marshall et al. (2003) on the factors influencing success of the commercialization of NTFPs. The outcome of this research was that marketing and sales are the two major processes constraining the commercialization. Unlike the common idea that production is the biggest constraining factor, both Mexican and Bolivian participants involved in the trade pointed out marketing and sales of products as the main factors. In Mexico, out of a long list of numerous factors, the lack of instruments for financial support, particularly for marketing, and the lack of market valorization for ecological goods and services are the highest scored factors of failure. In Bolivia, the biggest constraint was perceived to be lack of management capacity for marketing. Moreover, low product price and lack of transport infrastructure are mentioned. Tables 7 and 8 show more details on the outcomes of the Marshall research.

Table 7: Relative importance of processes and factors limiting success of NTFP commercialization - average scores (Marshall et al. 2003)

Process	Mean score	
	Mexico	Bolivia
Marketing	3.0	2.9
Sales	3.0	2.9
Processing	2.6	2.6
Transport	2.5	2.7
Production	2.5	2.7
Collecting / Harvesting	2.5	2.5
Storage	2.3	2.4

Table 8: Relative importance of marketing and sales factors limiting success of NTFP commercialization (Marshall et al. 2003)

Factor limiting success	Mean score	
	Mexico	Bolivia
Process: Marketing (market identification and product promotion)		
High cost of product promotion	2.9	3.2
High availability of substitutes	2.5	3.0
Lack of access to market information	3.5	3.5
Lack of contact with final consumers	3.1	2.9
Lack of financial instruments	3.6	2.8
Lack of technical support	3.1	3.2
Lack of community organization	3.0	3.3
Lack of market valorization of environmental goods and services	3.1	2.9
Lack of adequate quality control	3.0	3.1
Lack of attractive product presentation	2.9	3.2
Lack of management capacity	-	3.8
Lack of knowledge pertaining to consumer demands and needs	-	3.0
Process: Sale		
Low product price	3.3	3.5
Low returns to producers	2.7	3.1
Lack of market valorization of environmental goods and services	3.6	3.1
High producer dependency on market intermediaries	2.8	3.1

High numbers of market intermediaries	3.4	2.8
Lack of financial instruments	2.5	3.2
Lack of technical support	2.7	3.3
Lack of community organization	2.5	3.3
Lack of a favourable normative context	3.1	2.2
Lack of market valorization of environmental goods and services	2.8	3.0

Note: Data presented are mean scores based on assessments of 16 NTFPs in each of the workshops in Mexico and Bolivia. Scores were assigned on a scale of 1-4, where 1= Total failure, 2= Moderate failure, 3=Moderate success, 4=Total success.

When looking at the different factors limiting the success of NTFP commercialization, it becomes clear that part of the factors concerns the internal organization of NTFP development, such as community organization and management capacity. On the other hand, the limiting factors concern factors directly related to access to the (Western) export market: access to information regarding consumption, prices, trends, quality requirements, competitive goods and alternatives and access to trade intermediaries. The following section shows that these failures on the supply side can be directly linked to factors on the demand side.

NTFP Commercialization from the Buyer's Perspective

In general, export size and conditions of the NTFPs vary greatly from product to product, as some can be linked to the food sector while others to the furniture and construction sector. Experience shows that overall NTFP exports into the EU from developing countries can be described as in infancy and limited to sectorial level. Relatively small number of buyers are involved in the sector. The reasons most often heard during interviews with European buyers of NTFPs for not trading with NTFP-producing communities are presented in Box 3.

Box 3: Main factors of failure during NTFP commercialization from the buyer's perspective (ProFound 2006)

Price: Often the price of the NTFP is too high in relation to its quality. High prices are usually due to a common handicap on the supply side – the transport and handling costs.

Supply guarantee: An importer deciding to start putting an NTFP on the market requires the guarantee that a sufficient amount of the product can be supplied all year through. In other words, the NTFP exporter needs to guarantee sufficient volume and continuous supply.

No demand: There is already sufficient supply of the NTFP product itself, or a cheaper substitute is available. Examples of substitutes are synthetic materials for flavouring, rubber, furniture made of rattan-like plastic instead of natural rattan.

Quality: The offered NTFP does not meet the quality requirements, including in packaging. Exporters in developing countries wishing to penetrate the Western market should be aware of the many requirements of their trading partner countries. Standards are increasingly being imposed through legislation, codes, markings, labels and certificates with respect to quality, environment, safety, health, labour conditions and business ethics. Besides these, exporters need to meet the requirements of the importer.

To a lesser extent, the following reasons are also mentioned by European buyers as reasons for failure of NTFP trade:

Communication problems – (different from language problem) communication problems related to contract terms; and

Reliability of the business partner – this relates to all earlier mentioned factors.

Besides the factors of failure presented in Box 2, there are often difficulties with product development and utilization of NTFPs. While the use of exotic plants is known locally, European processing industries are often unfamiliar with methods of converting them into a product suitable for the Western market. For example, Huacatay (*Pazote chenopodium ambrosioides*), a well-known herb in Peruvian and Bolivian kitchens, was not received very positively by European importers during a quick EU market scan executed by ProFound. The reason for this reaction is relatively simple: the importers expected the herb to be unknown to the processing industry and the consumer.

The processing industry might not always be willing to invest in research and development to develop a product. The lack of knowledge and acquaintance with the product at the demand side, most often seen in sectors such as food ingredients, cosmetics and pharmaceuticals, also affects the use of bamboo in the EU. Start-up ventures are difficult in NTFPs due to the large amounts of investment funding needed. First, the machinery required for processing NTFPs is usually costly. Second, an efficient and assured supply chain is required to ensure the continuity of volume and quality, and this is a major bottleneck.

On the other hand, the EU market increasingly offers opportunities for NTFPs. There is a growing demand for sustainable and natural products. Besides, the Datamonitor (2004) mentioned trends of 'connectivity' (as a reaction to being connected through technology innovations, people increasingly yearn to belong to a community) and 'sensory experiences' (the importance of experiencing, for example, authentic ethnic products), which perfectly match the profile of NTFPs. Concepts such as sustainable development, sharing of responsibilities and corporate social responsibility are also increasingly offering opportunities for producers in developing countries. Partnerships between North companies, NGOs and South companies are becoming more and more common. Finally, it is also expected that on-going innovations in the field of product development would also lead to a growing demand for NTFPs.

Conclusions

There are many factors that could play a negative role in the commercialization of NTFPs, especially in export markets, and much product development is needed before a stable and considerable market share can be gained. The difficulty for Western suppliers is in putting products on the market. They cannot yet take advantage of the economies of scale in the NTFPs sector. There is a need to achieve low volumes for higher value (value addition) on the side of the individual supplier and high volumes for lower prices on the side of exporter. Management and coordination through the whole production chain, for example through the use of the Value Chain Analysis method, are required to achieve these.

By becoming more vertically integrated with processing and marketing, NTFP gatherers can increase their knowledge on the product demands and trends, increase their chances to develop innovative products and thus increase their income and share risks. However, while local processing of NTFP offers a great deal of potential, it might not be workable due to costs, technical or managerial complexity, and the nature of the market. Technical assistance and financing are very important in this case, as ProFound has experienced on many occasions. NTFP gatherers can be securely and functionally organized into cooperatives for marketing unprocessed commodities to take advantage of economies of scale and to improve market information. Since export markets for an NTFP can be specialized or small, and change

rapidly, NTFP enterprises could benefit from market information systems that provide advice on trade logistics, prices and quality requirements in different markets (Hyman 1996).

An important first step in NTFP commercialization is to think about developing innovative new products in line with consumer culture trends in the international market. The two examples given in Box 4 highlight the importance of this factor.

Box 4: Two cases of rattan export

Success: The Philippines

While some are specialized, other NTFPs have large export markets. For example, the production of handicraft and furniture from rattan in the Philippines is a major success story of an NTFP generating US$275 million in annual gross revenue (Hyman 1996). Studies suggest that rattan cutting in the Philippines is controlled by local or provincial traders who identify production areas, organize collectors to gather a specific amount, pay advances, arrange government paperwork and so on. On this level, advertising, distributions of samples and test marketing could be provided. In the handicraft and furniture sector, the designs and characteristics of the products can be influenced at this level.

Failure: Indonesia

The handicraft and furniture production from the NTFPs is logically highly dependent on changing market trends. An example from Indonesia, the leading exporter of rattan to Japan, within the handicraft and furniture sector, shows that the decline of its exports was due to a change in trends. Japan shifted to other materials, such as bamboo or synthetic material, as there was a raise of Japan's bamboo product import in the same period. As the Indonesian export network was weak in Japan, exporters had direct contact only with big traders and not with customers. Thus, they did not have a clear understanding of the Japanese buying culture and trends (Otten and Ottens 2004).

The examples show that the NTFPs sector needs to turn into an industry and be integrated wholly into the economy. This must start at a local level. Donors, NGOs and other people working with NTFPs need a more in-depth understanding in this sense, through research, in order to create a broad focus at different levels: starting from local, then national and later international. Integrating the NTFPs into the local economy rather than only focusing on an export market will secure the sector and lead to growth. It will bring the economies of scale needed to also eventually be able to target possible export markets.

5. Information from Literature

As mentioned in the introduction, while a lot of research has been done on bottlenecks in bamboo production in bamboo producing countries, there is hardly any literature on factors related to bamboo consumption from the perspective of Western stakeholders. This chapter reviews the scant literature available on this subject and presents the main results.

Literature Review

Relevant literature has been scanned using the SWOT methodology for the production chain of bamboo products for the EU market. The results of the literature review have been incorporated into SWOT tables that also reflect the focus (country, sector, species). Besides the SWOT results, the tables also present some solutions for bottlenecks (weaknesses, threats) identified. The complete set of SWOT tables that contain solutions and remarks can be found in Appendix 4.

Most of the sources used in the literature review are not publicly available (CORPEI 2005; Garzon and Held 2003; Held 2002; Held 2003a; Held 2004; von Reitzenstein 2004). In all cases, the information has a qualitative nature, mostly based on explorative surveys (von Reitzenstein), and focuses on specific Western regions and sectors – Held on consumption of bamboo flooring in Germany, CORPEI on various bamboo products in the EU, Larasati on bamboo design products in the Netherlands and van der Lugt on the use of the bamboo culm in the building sector in Western Europe.

Sometimes it is difficult to assign particular issues to a specific part of the production chain – Production and Transport, Product Development, Marketing and Sales, and Utilization – since they sometimes apply to more than one part. As a rule of thumb, the categorization of specific issues here follows the categorization as used in the topic list in Appendix 3.

Production and Transport

The main weaknesses that apply to all bamboo products during this phase are the lack of quality of culms offered by providers, extra time and money investments because big bamboo poles always need to be imported from (sub) tropical countries to the EU, and the lack of production capacity and quality management of producers in bamboo producing countries (Larasati 1999; van der Lugt et al. 2006).

Currently only a few of companies in China (from where almost all EU bamboo board and flooring importers obtain their products) can meet the high EU demands for bamboo flooring. Main problems at the production side lie in the poor quality of the machinery, inadequate labour conditions, inability to meet delivery time, volume and quality requirements, and relatively high pricing of products. Nevertheless, with assistance from the EU partners in terms of quality assurance and investments in the partnerships, the Chinese companies would be able to deliver on time higher quantities in better quality. At the moment, the price-performance ratio of industrial bamboo products from China is superior to other bamboo producing regions like, for example, Latin America, where quality and capacity problems are considerably higher (CORPEI 2005; von Reitzenstein 2004).

Product Development

Main weaknesses during the product development phase of bamboo products in general are the lack of research about bamboo (products), a lack of market knowledge and product development and design skills in bamboo producing countries, and a lack of Western (oriented) designers working with bamboo (Larasati, 1999; von Reitzenstein, 2004).

A primary weakness with the commercialization of industrial bamboo products is the lack of knowledge and familiarity of EU consumers. This is because the industrial bamboo industry in the EU is still young and under development, with only a limited distribution network and hardly any bamboo industry organization that could promote bamboo and disseminate information about bamboo products (Garzon and Held 2003; Held 2002; Larasati 1999; von Reitzenstein 2004).

However, there would be opportunities if new market segments can be opened through product innovation based on new processing technologies that use the typical advantages of bamboo (Held 2002; Larasati 1999). In such a product innovation process, each bamboo producing country should use the competitive advantages of the region and the endemic species (CORPEI 2005; von Reitzenstein 2004). This will be more difficult for culm-based products, because when used in its natural form (culm) there is limited form variety possible for designers (Larasati 1999). Furthermore, bamboo culm-based products, in general, have a poor image and are perceived by EU consumers as being low in quality and durability (CORPEI 2005; Held 2004; Larasati 1999).

Associations with bamboo as a material and as products were evaluated by Industrial Design Engineering students at Technological University (TU) Delft. De Bruijn (2006) interviewed 50 respondents in an IKEA store in the Netherlands. When asked about first associations with bamboo, responses were quite diverse (see Figure 4), but the prevailing image is in accordance with the terms “Asian”, “panda”, “cheap”, “natural” and “rustic”. It seems that the association with Asia and panda acts as a strong symbol for bamboo. Bamboo’s association with Asia probably emanates from the extensive representation of bamboo in Asian arts and crafts, which might also explain the labels “exotic” and “cheap”, which are most likely inherited from its commercial history in the West – the reference to traditional craftwork, predominantly in the form of rustic furniture, is most frequent. Figure 5 illustrates this further, revealing the first associations respondents had when thinking of bamboo products. Furniture, basketry and fishing rods are most common associations.

Another image research executed by TU Delft students (de Goede and van Loon 2006) with over 52 respondents in a furniture mall in the Netherlands revealed that respondents associate bamboo furniture in 94 percent of the cases with culm-based furniture and not with furniture based on (semi) industrial processed bamboo such as bamboo boards. The study of de Bruin (2006) had shown that respondents, if acquainted with industrial bamboo products such as flooring, differ considerably with unacquainted respondents in their perception of bamboo as a material, describing it to a larger extent as an innovative, exclusive and high-end material (Figure 6). This implies that the market introduction of industrial bamboo flooring has had a positive influence on the image of bamboo as a material among those consumers who took notice of its existence. The problem, however, is that not many of the respondents (only 28 percent) were acquainted with bamboo flooring, showing the need for marketing and diffusion efforts.

The results of the image studies show that a material’s image is strongly linked with the type of products it is used in. The image of bamboo products in the EU, because of a lack of product innovation based on new industrial processes, is still mostly linked to traditional, culm-based products with a mediocre image.

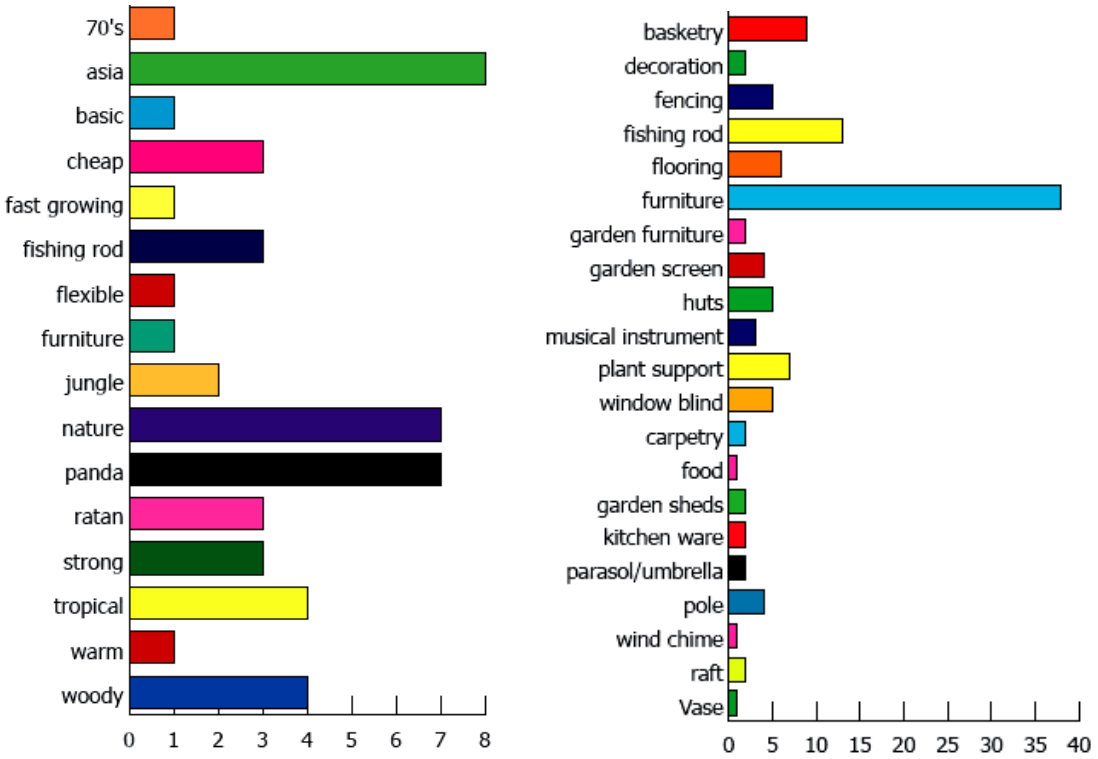

Figure 4 and Figure 5: First associations of Dutch consumers with bamboo (left) and bamboo products (right) based on a sample test of 50 respondents (de Bruijn 2006)

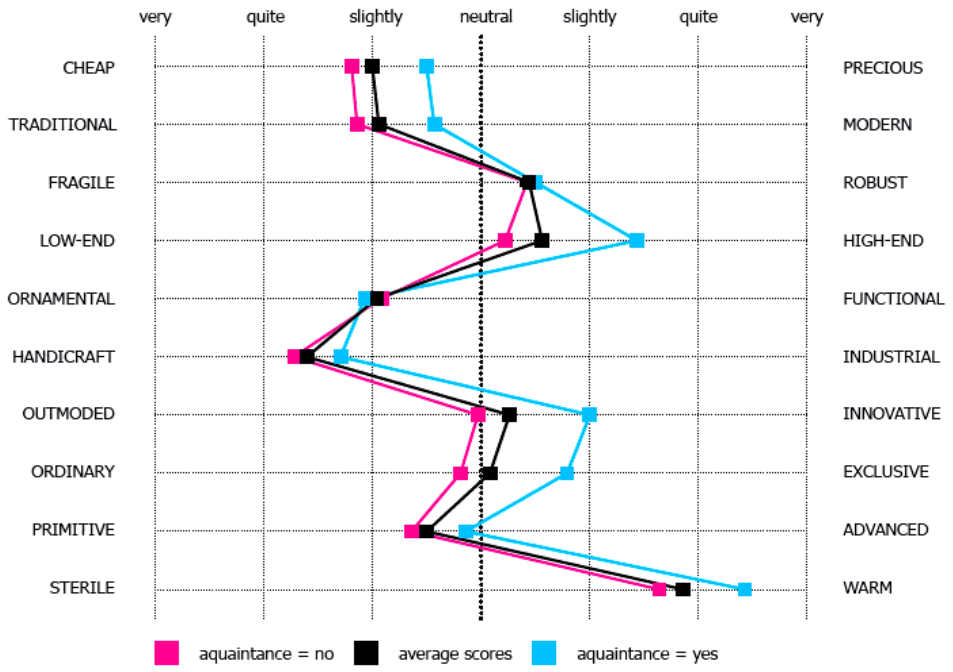

Figure 6: Bamboo's material personality vs. with acquaintance of industrial bamboo flooring (de Bruijn 2006)

Marketing and Sales

One of the strengths of bamboo as a material and culm-based products is the low price and the eco-friendliness (CORPEI 2005; Held 2004; Larasati 1999; van der Lugt et al. 2006). For industrial products, such as flooring, bamboo has both emotional (aesthetics), societal (sustainability) and technical (hardness, resistance, stability) properties that in various cases are superior over competing wooden products (CORPEI 2005; Garzon and Held 2003; von Reitzenstein 2004). However, differences in comparison with many wood products are not that big (Held, 2003b) and prices of good quality bamboo parquet are relatively high, while the very distinct look of especially plain pressed bamboo parquet and panels might not appeal to everyone (CORPEI 2005; von Reitzenstein 2004).

For industrial bamboo products in particular there are sufficient opportunities available, since the market for such products is not saturated and still has a good growth potential (von Reitzenstein 2004). There is also a strong and important impulse from designers and architects to use bamboo as a sustainable innovative industrial material in their projects (CORPEI 2005; von Reitzenstein 2004).

As the industrial bamboo industry is currently on the rise in the EU, it will have to confront certain undesirable developments. The first threat is the anti-bamboo lobby of the far larger and better developed and organized wood industry, which might portray bamboo as an inferior substitute to wood products. Another negative point is the presence of many Chinese producers of low quality bamboo parquet who try to push their product in the EU market directly, without the assistance of EU importers, damaging the reputation of bamboo because of the mediocre quality of their products. Finally, there is the threat that the rising popularity of industrial bamboo products could just be a passing fashion (von Reitzenstein 2004).

Utilization

A weakness of industrial bamboo products in the utilization phase is the unfamiliarity of sub-contractors with bamboo flooring resulting in installation problems (Garzon and Held 2003).

Most other weaknesses encountered in literature for the utilization phase refer to the use of the bamboo culm. First of all, bamboo culm-based products tend to crack over time. Hence, culm-based products have a low durability, especially when used outside (Held 2004; Larasati 1999; van der Lugt et al. 2006). Furthermore, because of the shape (round, hollow and tapering) and irregularity (protruding nodes) of bamboo culm, jointing is very difficult. This might result in either unstable joints or higher costs and hassles because of the need to deploy skilled workers (from abroad) with experience in making bamboo culm joints (van der Lugt et al. 2006). The lack of classification systems and the absence of reference in national building codes in the EU also hamper bamboo utilization. A direct result is the need for additional, costly and elaborate testing to be conducted on bamboo culms to determine various properties (strength, fire resistance, etc.) (van der Lugt et al. 2006). A strong point of bamboo culms during construction is the ease of erecting and dismantling because of the lightness of the culms (van der Lugt et al. 2006).

Figure 7: Temporary bamboo pavilion designed by Rocco Yim for the Festival of Vision in Berlin in 2000

Bamboo Product Commercialization in the United States

Besides the studies already mentioned, two studies (CORPEI 2005; Flanagan 2004) cover factors of success and failure of the commercialization of bamboo products in the United States of America (USA). Although this report is focused on the EU market, it is interesting to note the results of bamboo commercialization efforts in the United States, which, as another Western market, shares many similarities with the EU market.

Some of the main weaknesses in the commercialization of bamboo culms over the production chain mentioned by Flanagan (2004) and CORPEI (2005) are: insufficient drying, inadequate preservation, damage by insects, cracking, burn marks from sloppy bending, difficulty in jointing, problems with shipping and import, and a negative perception by much of the population. For building projects, the strictly enforced building codes in USA do not mention bamboo, which results in extensive and expensive testing if bamboo culms are to be used. These problems exist less for industrial bamboo products; however, chemical additives (adhesives, finishes, preservatives) used during production can damage the sustainable image of bamboo products (Flanagan 2004). It should be noted that the number of ecologically and socially responsible consumers in USA is quite limited at the moment (CORPEI 2005).

The two studies mention that, unlike in the EU, the bamboo culm is in general more appreciated by customers in USA, because of the colour, random nodes and round shape. In the southern states like California, Florida and Texas, bamboo culms are quite popular with individual consumers for outdoor applications (gazebos, garden decoration) and professional consumers (zoos, thematic parks, beach bars, etc.) because of their exotic, oriental look (CORPEI 2005). There are even celebrities who use and promote the use of bamboo products (Flanagan 2004).

Conclusions

The above discussion and the tables in Appendix 4 show that there is very little literature available on factors of success and failure of bamboo products over the production chain from a Western perspective. The available information shows that there are far more weaknesses and threats over the bamboo production chain than strengths and opportunities, and that these occur in all phases of the production chain. This shows that there are still many drawbacks to overcome before bamboo products can compete with products from already fully commercialized and established natural materials in the West like wood.

The tables also make explicit that in the literature there are no sources specifically covering a complete SWOT or bottleneck analysis, explaining the many 'empty spots' in the SWOT tables. This and the fact that most of the sources used were not publicly available and sometimes of inconsistent quality made the authors decide to execute another inquiry based on interviews with relevant stakeholders in the Netherlands to retrieve a more complete picture of the field.

6. Results of Interviews

This chapter summarizes the results of the SWOT analysis based on the interviews with relevant stakeholders in the Netherlands, and follows elaborates on the categorization as used for the topic list structured over the production chain(Appendix 3). from production issues through product development issues, to eventually, sales and utilization issues. Where deemed relevant some references to additional literature are mentioned.

Within each section, the responses and opinions of the respondents are arranged based on the validity for either general or more specific product groups based on processing technology (see Figure 1). This means that factors categorized under 'General bamboo products' also apply to all other product groups, whereas factors categorized under specific headings, such as 'Specific bamboo industrial techniques' apply only to that specific category. For example, for the section on 'Production', the factors mentioned in the sub-section on 'General bamboo products' apply to all bamboo products, both industrial and non-industrial. In the section 'Production' there is no sub-section on 'Non-industrial bamboo products' (both general and specific) implying that there were no factors mentioned by respondents that specifically relate to these techniques for that part of the production chain. The sub-section on 'Industrial bamboo products' records factors that were mentioned by respondents specifically about industrial bamboo products (not applying to all bamboo products or non-industrial bamboo products) or even more specific, applying to certain industrial techniques.

Since the focus in this paper is on the market side of the production chain, these aspects are covered more elaborately. The summary at the end of the chapter and Appendix 5 provide specific quantitative information on the number of respondents mentioning any specific factor.

Production

General bamboo products

Some respondents mentioned the general lack of organization in many production chains in developing countries as a weakness that applies to many commodities, including bamboo. Especially, enterprises in the small and micro sectors in these countries are unreliable, and are unable to meet Western demands for quantity, consistent quality and delivery time.

Since most respondents source their bamboo products from China, many of the factors mentioned (applicable for both industrial and non-industrial bamboo products) apply particularly to this country. The management system of the plantations in China in which individual farmers get responsibility over their own plot of land is considered a strength, although quality control of the resource is still a problem. One of the strengths of the bamboo production chain in China is that the complete bamboo culm is utilized for various applications (from high quality flooring to matchsticks and charcoal), making maximum use of the resource. Like in other countries, a strength of bamboo as a resource is its low price. With respect to production capacity, what applies to China applies even more to other bamboo producing countries: for high volume orders for large retail chains like IKEA, the capacity for both industrial and culm-based high-quality products is inadequate.

Furthermore, the first processing step of the resource – proper preservation and drying – is an essential prerequisite for further successful product innovation, but is not met in many cases (weakness). Additionally, in many cases, the preservation method employed is not acceptable from an environmental point of view (for instance, use of toxic chemicals). These results correspond with the results of the studies mentioned in the introduction.

Industrial bamboo products

General

Weaknesses in the production chain of industrial bamboo products (from China) are numerous because of the long and complex manufacturing process. In many factories the conditions and facilities are not sufficient to meet the required quality for Western markets. For example, many factories are fully or semi-open, resulting in high temperature and humidity variations, while dust from the sawing and milling machines that get dispersed in the open space also might affect the quality of the end products.

Figure 8: Bamboo strip processing facility

Furthermore, of the hundreds of bamboo processing factories in China, only a few have machines that meet Western standards. While most have simple, outdated machines requiring a lot of maintenance, affecting the quality of the industrial bamboo products in terms of exact dimensions, straightness and pollution in the end products. Additionally, the quality of the glue or resin used in many cases does not meet EU norms with respect to toxicity. As mentioned earlier, lack of capacity (especially for large volume orders from big retail chains) and limited quality of drying and preservation of the bamboo resources (culms, strips) serving as input for the industrial bamboo products are considered key weaknesses.

For entrepreneurs in the West, it is therefore very important to find the few factories that do live up to Western standards. Because of the high dependency on their suppliers and the importance to build up a solid, trustworthy relationship with them (essential in the Chinese business culture), many bamboo veneer and flooring companies in Western Europe invest in and maintain good business relationship with their suppliers. This investment and constant interactions help the producers understand what the required product quality is in the EU market, and help them understand the necessity for stringent quality control and product innovation. Although this process takes time, once a good partner has been found and a solid relationship established, it would give a competitive advantage compared with other industrial bamboo product importers.

A major threat for the Western partner is that the production partner, once the needs of the Western market are better understood, might export products by themselves, dispensing with the importer as the intermediary. This development can already be noted, for example, in the case of flooring products in trade fairs in the West (such as Domotex in Germany) where some Chinese producers exhibit their products. In addition, the relatively inferior quality of these products potentially damages the good image of bamboo products that the importers try to build up. This threat for Western importers can be diminished by establishing a joint venture in which the production partner requires inputs (for example,

technical know how, continuous market development and product innovation for the West) from the Western partner and sees this as value addition. Obviously, in such a joint venture a continuous mutual dependency is crucial to prevent one of the partners from continuing on its own, after extracting the knowledge of the other partner.

A good partner is important for Western importers since protectionism is prevalent in the bamboo production sector in China – acting more or less as a bloc and selling similar products at relatively high prices. In general, the producers at the moment are in a strong position because the market for industrial bamboo products is growing both internationally and locally. To reduce the dependency on a few suppliers, Western importers must tap suppliers from different countries. Problems in the production chain in such countries in general and lack of basic pre-requirements for development of industrial bamboo products [for cases related to bamboo boards from Ecuador and Colombia as examples, see van der Lugt (2005a)] are what is holding back the importers to look further than China.

Plybamboo

Most of the factors mentioned in the section on industrial bamboo products also apply to plybamboo products. An aspect specifically mentioned by respondents as influencing the quality of plybamboo products is the quality of the bamboo strips, which is the main input for plybamboo. There is considerable variation in the quality of the strips due to differences in the age of the culm, part of the culm from where the strips derive, and the plantation from where the culms are extracted. Once the strips are selected based on these parameters, higher quality plybamboo can be developed. For flooring, the oils used in China are in general too glossy for the market in the EU and sometimes not acceptable from an environmental point of view.

Strand woven bamboo (SWB)

The production of SWB needs high-quality, expensive machines, like high-pressure compressing machine. The environmental impact of the considerable amount of resin used will also be a crucial factor of failure or success for the product in the EU market. High-quality processing, leaving no holes in the cross-section, and high-quality finishing will be of extreme importance for this new product to have any chance in external applications. Besides external use, indoor flooring can be an interesting market for SWB, with intensive use triggering high demands.

Bamboo mats

Bamboo mats are interesting for various applications in the EU (also see the section on ‘Market Choice’). The product is inexpensive, which is one of its advantages. However, because it is usually made of green bamboo, the product shrinks unevenly when drying, resulting in irregular dimensions. Adequate drying the strips or laminating them are solutions, but will hike the price considerably. Another weakness is colour differences in each product caused by the use of strips from different parts of the culm.

Transport

General bamboo products

Since all giant bamboo species used for bamboo products grow in tropical climates, far away from the EU, high transport costs for bamboo products (by sea and over land) are a weakness, especially for bulky culm-based products and products for the lower market segments. Therefore, efficiently packed, stackable, knocked-down products are required to cut down costs. This requires sound logistics and management, and usually also brings other hassles like, for example, elaborate instruction manuals for assembling up the product.

Bamboo non-industrial products

Culm-based products

The inside of the bamboo culm is very susceptible to moulds, this is especially a problem during sea transport because of the high temperature and humidity differences. This can be prevented by the use of air-conditioned containers, or using silica bags or fumigants in containers. However, it is wiser to focus on more permanent solutions earlier in the production chain: good preservation and drying of the bamboo material.

Product Development

General bamboo products

Lack of knowledge on the part of producers and entrepreneurs, especially in the small and micro enterprises (SME) sector, about the wishes and demands of Western consumers – including the importance of marketing, presentation and adaptation to trends – is a common weakness in the production chain in bamboo producing countries. A good example of these problems is the very glossy finish that many (bamboo) products are given which is inappropriate for the current interior trends in Western Europe. Detailed guidance by the Western partners and the involvement of Western designers can play an important role in solving this problem.

Non-industrial bamboo products

Culm-based products

Designers mostly see a role for designing with bamboo in industrial form than in its natural form (culm). As a designer's material, the bamboo culm has very limited design options and many constraints (irregular, round, tapering material which splits easily).

Industrial bamboo products

Industrial design

While there are design limits imposed by bamboo in its natural form, there are also many virtues of using bamboo as a designer's material in other forms that derive from the special mechanical properties from bamboo. The few designers who have experimented with bamboo appreciate its flexibility in combination with its strength. As designer Anthony Marschak from Adapt Design puts it, "The material possesses a strength and lightness not found in many other natural materials" (van der Lugt 2005b). Marschak uses these characteristics in his product designs (Figures 9 and 10).

Figure 9 (left) and 10 (right): Bamboo product designs by Anthony Marschak (Adapt Design 2006)

Not many designers have experimented yet with bamboo because of the lack of knowledge and availability, as well as the bad image of bamboo products. This is a missed opportunity since (industrial) designers are the persons who can play a very important role in making innovative designs that capture bamboo's possibilities, linking into trends to create products with market potential that avoid bamboo's poor image. If a well known designer works with bamboo and uses a specific technique to create a special design that would function as an icon for bamboo, that exposure would improve the image of bamboo as a promising design material. Such a 'product champion' would also play an important role in the commercialization of bamboo, the way the 'Thonet chair' functioned as an icon for the wood bending industry in the 20th century (Figure 11).

Figure 11: Rocking chair by Thonet based on the famous wood bending technique

Design products setting a trend are usually launched in high-end markets and later copied by the lower market segments. Therefore, it is a good strategy for bamboo to focus on designer products to gain status and receive exposure that will automatically trickle down to lower end mass markets at a later stage. The introduction of bamboo as a designer material to

Western designers could be facilitated by organizing design competitions and workshops. Besides designers, prominent companies, brands or famous personalities can also serve as product champions (also see the section 'Promotion').

For sustainable integration into the production chain in bamboo producing countries, it would be best to link Western designers (who will more readily understand market trends and wishes of consumers in the West) with producers in developing countries, who largely lack this product design and product development capacity for such markets. To make this solution a lasting one, the designers would need to either return on a regular basis to keep nourishing the innovation cycle or capacitate the producers to design for the West (this is usually very difficult because of the very different cultural backgrounds and understandings of design). Design initiatives like Dutch Design in Development (2006) in the Netherlands try to foster this interchange between designers in the North and producers in the South.

Bamboo-based product innovation

New industrial bamboo products rely too much on copying wood processing techniques, not utilizing specific competitive qualities of bamboo (such as bendability) as a material. As mentioned above, material-focused designers could play an important role in correcting this, and should be introduced more to bamboo as a designer's material. For example, designer Jared Huke believes in the competitive advantage of the use of bamboo in composites: "When you combine the material with various modern resins, finishes, etc. you create something that is much more than the sum of its parts. I think as a material, we have barely touched the surface of its possibilities" (van der Lugt 2005b). In product innovation also, differences between the various bamboo species should be taken into account, taking advantage of specific properties of each particular bamboo species. For example, because of the its thicker wall, *Guadua* species can provide larger and thicker strips than Moso species from China, which can provide competitive advantages in products that need a lot of material input like laminated beams. However, because of its entwined fibre structure, cutting *Guadua* poles wears down saw blades quicker than most other species.

Many stakeholders mentioned that many new market opportunities could be created for bamboo products through product innovation based on new techniques. This is necessary since the range of industrial bamboo products is still very small according to some respondents. Besides the new products mentioned in the various sub-sections (strand woven bamboo, bamboo mat), there are various new processing technologies that could provide new marketable products like, for example, 'crushed bamboo' (a coarse product made of boards of crushed bamboo culms glued on a wood carrier). Developing technologies – such as those based on bamboo composites, bamboo chips and heat-bending of bamboo – are also expected to provide new opportunities. Exploring modifications of existing products for new applications could also provide opportunities. However, all these innovations require extensive research, which is currently one of the weaknesses in the bamboo sector.

Strand woven bamboo

For Latin America, home to the endemic species *Guadua*, strand woven bamboo (SWB) could be a very promising product because of the high biomass production of the species (material input for SWB is high) and the coarse intertwined fibre structure (possibly providing better adhesion of the glue and therefore higher strength). Furthermore, the quality requirements of the strips serving as input for SWB are less strict than for other industrial bamboo products, posing lesser demands on the production facility, which is one of the weaknesses in Latin America (van der Lugt 2005a).

Linking to FSC Certification

General bamboo products

A very important trend in the EU, particularly in the Netherlands, which was mentioned by many respondents as an important opportunity for bamboo products, is the growing importance of Forest Stewardship Council (FSC)[2] certification for sustainably produced forest products (especially tropical timber). This opportunity applies especially to industrial bamboo products available in rectangular dimensions and to a lesser extent to culm-based bamboo products.

Because of consistent lobbying in the media, as well as policies promoting sustainability on the part of government and various public organizations and NGOs, the importance of FSC for wood in the Netherlands has grown considerably in the last five years to make it the leading FSC wood implementing country in the EU. The consumption of FSC wood is growing fast with a market share growing from 4 percent in 1999 to 11 percent in 2003 (770.000 m^3) and 13 percent in 2006 (FSC Netherlands 2006; Kriesch 2004; FSC Netherlands 2006). Many companies in the wood industry have started to use only FSC-certified wood, since experience has shown that campaigns and demonstrations by environmental groups against retail chains that consistently sell unsustainably produced wood can severely damage the company's reputation and influence buying behaviour of consumers. The current trend in which various key parties – like local governments, contractors and retail chains in the building industry and in retail sectors – sign agreements assuring the use of a certain percentage of FSC wood in their projects and products indicates that the importance and acceptance of sustainable produced wood in the Netherlands will keep growing. The local and national governments in the Netherlands play an important role in promoting the use of sustainable materials by the construction industry by setting examples in the buildings administered by the Rijks Gebouwen Dienst (Governmental Building Organization of the Netherlands – RGD). In this context, the importance of influencing decision makers in local government bodies that issue building permits should be mentioned. Even one civil servant supporting the use of sustainably produced wood in building projects can play a major role in a municipality. Because of the FSC lobby, individual consumers seem more open-minded towards alternative wood species (most consumers consider bamboo as a 'wood' species) than in the past when established wood species like teak had more or less a monopoly. However, for many distributors in conservative markets like the flooring industry this is still an issue (also see the section on 'Promotion'). Compared with other solutions for the most pressing environmental problems, increasing the availability of sustainable hardwood (even with price increase) has the largest support base among Dutch consumers (Mulder et al. 2005).

The stringent FSC requirements necessitate complex logistic and management systems in the production chain. Because of this, the availability of FSC wood is low and demand considerably exceeds supply [a global market survey by FSC (2005) reported demand exceeding supply by at least 10 million cubic metres of round hardwood], keeping the prices relatively high.

The increasing importance of sustainably produced wood products in combination with the current high price and low availability of these products offer considerable opportunities

[2] Besides FSC, various other schemes for sustainable forest production exist – such as PEFC, CSA and SFI. There are major differences in adoption rates of these certification hallmarks among various countries. For the Netherlands, FSC is the most adopted hallmark. Although information in this section is related to FSC in the Netherlands, it might apply as well to other acknowledged certification hallmarks for other EU countries.

for bamboo as a sustainable alternative for unsustainably produced (tropical) timber. Once bamboo products are adopted for these reasons by large retail chains supplying FSC products – such as Carrefour, Migros and HEMA (Netherlands) – the market share of bamboo products might rise considerably.

A specific strength of bamboo is that it is perceived, in contrast to wood, by many consumers as being an inherently sustainable resource because of its fast growth rate and abundant availability. For example, RGD, which requires the use of a certain amount of sustainably produced forest products in their buildings, considers bamboo products as sustainable (on the same level as FSC wood) and does not demand FSC certification for them. This brings up an important question: is it necessary for bamboo products to acquire FSC certification or are the efforts required to meet the stringent chain-of-custody requirements of the FSC scheme redundant in bamboo's case? In this context, it must be mentioned that bamboo has not been integrated as yet in the FSC country standard of any country, except Colombia (Grooten 2006). Furthermore, since most bamboo resources in countries such as China are in plantations, these will not come under FSC certification, which applies mainly to resources from natural forests.

Nevertheless, marketing-wise it seems a smart strategy to market bamboo like FSC wood, as a sustainable alternative for (tropical) hardwood, and take advantage of the FSC wood lobby and campaigns, as well as the growing popularity of FSC wood in the EU. If the organizations lobbying for FSC (especially World Wide Fund for Nature – WWF – which sees bamboo as an important resource for sustainable development) also adopt bamboo as a sustainable alternative for unsustainably produced wood, this will raise the acceptance of bamboo products in the EU. The activities used for enhancing the market share and acceptance for FSC wood – like the establishment of brokers linking supply and demand, advertisement and lobbying campaigns, involving celebrities as ambassadors, active involvement of the government, and persuading parties to sign agreements for implementation – can be used for the promotion of bamboo products. Once this pro-bamboo lobby is put in place, it will be easier for bamboo products to be adopted by the two main target markets: the interior and exterior furnishing market, and the building industry.

Image

General bamboo products

The image of bamboo and its products is one of the most crucial factors influencing the commercialization in the EU. Bamboo as resource, and in products, invokes in the EU consumers some strong associations ranging from very negative to very positive. One of the strengths of bamboo products is their green, environment-friendly image. Furthermore, bamboo products are usually perceived as being exotic and mysterious products from far away. This attribute should be used in marketing bamboo products to those consumers who view the mysterious image of bamboo as an added value. Many respondents expressed the view that for consumers in general the negative associations for bamboo products (cheap, low-quality, susceptible to decay and insect attacks on outside use) overrule the positive associations mentioned above. These prejudices apply especially to culm-based products. Furthermore, bamboo is mostly associated with China, a country that currently has a poor image in terms of sustainability (deforestation, rapid industrial development, toxic wastes and pollution, bad labour conditions) and quality (low durability, poor finish). People, in general, also believe that giant pandas feed only on bamboo and they could get extinct because of the mass harvesting of bamboo for production in China. One respondent mentioned the threat for over-exploitation of bamboo resources if the demand for bamboo products grows too fast.

The negative association with China could serve as a competitive advantage for bamboo products from other countries, which could brand and design their bamboo products with a focus on their culture (for example, *Guadua* products from Ecuador with specific regional

style). Like China, there are other bamboo growing countries that suffer from prejudices that also affect their bamboo products. In Colombia, for example, culm-based products are sometimes broken open by customs officials checking for drugs.

Non-industrial bamboo products

Culm-based products

Consumers usually think about culm-based products when thinking about bamboo products. Culm-based bamboo products, as mentioned earlier, are not associated with very positive characteristics in the EU (cheap, traditional, unwieldy, low quality, low durability). In general, culm-based bamboo products (especially furniture) do not fit in with the latest design trends and are considered unsuitable for the main EU market.

Industrial bamboo products

Since plybamboo products are the only common spread industrial bamboo products that some EU consumers know of, only the image of such products is covered in this sub-section.

Plybamboo

While most consumers have negative associations with culm-based bamboo products, the perception is very different in the case plybamboo products (mostly used as flooring, veneer and board material). Consumers are often positively surprised that these products are made of bamboo, and perceive the product as being innovative, sustainable and special. Probably, the huge difference that the high quality of plybamboo products has with the initial negative impression about bamboo products in the minds of the consumers facilitates a positive shift in perception. Some consumers also like the fact that they can still recognize features of bamboo (such as the nodes) in plybamboo. However, it may be noted that in the sample test conducted by de Bruijn (2006) of all industrial bamboo flooring and wooden flooring samples, the aesthetics of SWB, in which bamboo's typical appearance is largely lost, scored the best (sample E in Figure 12).

Figure 12: Samples used in consumer research in IKEA by de Bruijn (de Bruijn 2006)

While many consumers are attracted to plybamboo products, the rich and sleek character of plybamboo products appeals less to others, as consumer tastes are influenced by trends. In general, plybamboo from the Chinese species *Moso* gives a more homogeneous appearance than plybamboo from other species like *Guadua* or the Vietnamese bamboo used by IKEA for its flooring. Again, depending on the taste of the consumer this can either be considered a strength or weakness for these specific species.

With respect to the texture, side-pressed plybamboo is currently preferred over plain-pressed plybamboo. In terms of colour, carbonized plybamboo is preferred over bleached plybamboo, as the latter closely resembles the colour of cheap pine wood. However, there are differences in preferences depending on the age group targeted. For example, younger consumers surprisingly seem to prefer plain-pressed plybamboo over side-pressed (de Bruijn 2006). The fact that plybamboo product can now also be supplied in other colours provides more opportunities.

Some respondents consider plybamboo as being so sleek that it can only be used in very modern interior environments. For use in high-end furniture, the visual effects of solid plybamboo boards are preferred over plybamboo veneer on a cheap wooden carrier like multiplex.

In general, it can be concluded that the image problem of bamboo products only applies to culm-based products. Once processed (coiling, laminating), the very fact that the products are made of bamboo becomes a strength instead of a weakness, especially in high-end markets. The problem is that the first association with bamboo products of consumers is about culm-based products which carry a negative image. This should be taken into account

while marketing industrial bamboo products. A strategy could be to categorize and market industrial bamboo products as a hardwood (assimilation[3]) or as a totally new innovative product like grass flooring (accommodation). Both strategies have pros and cons (de Bruijn 2006). Most respondents see the former as the best marketing strategy.

Knowledge and Information

General bamboo products

One of the main weaknesses of bamboo products is the lack of knowledge among consumers and distributors in the EU about their specific characteristics (hardness, strength, durability) and behaviour in various circumstances (outdoors, on fire). This is of greater importance for markets that impose stronger demands on the properties of bamboo products, like the building industry, than for the lower segments of the private consumer market. The reasons for the lack of knowledge are the deficiency of research (information is unknown) and the absence of information dissemination (information is available but does not reach clients).

Much research is needed in order to obtain unambiguous information about various aspects of bamboo products, and for this a leading role is required from bamboo promoting institutions such as INBAR and bamboo associations in various countries. In the EU, the bamboo associations are still too small to unite to become a strong organization like the ones for more known commodities such as wood.

A lot of information about bamboo products is available but does not reach the customers, most of whom have a slightly negative image of bamboo products. This is worsened by a lot of incorrect or oversimplified information about bamboo (for instance, 'bamboo is stronger than steel'[4]), raising the expectations of bamboo products to an extent they cannot live up to.

Industrial bamboo products

General

As with any new industry, especially one that is based on a resource from another country, distributors would need to be convinced in the beginning to adopt the new product into their stock. As a new product on the market, the same applies to industrial bamboo products. Distribution channels and market outlets in the EU for industrial bamboo products are still too few. Therefore, for bamboo products to get a sound footing, EU bamboo importers need to actively create support by convincing distributors and retail outlets about the product. The importer must nurture and invest in this relationship, for example, by providing detailed technical and practical information and samples. As mentioned in the section on 'Promotion', the first introduction of a product can make or break its reputation.

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[3] Human beings have an innate tendency to create order in a world of chaos. The process of categorisation helps us to reduce the complexity of the world around us, this also applies in distinguishing consumer products in various categories. Two main scenarios are possible in this categorization process: assimilation and accommodation. Assimilation refers to consumers placing a new product in an existing product category, adopting the perceived features of this category (e.g. positioning bamboo flooring through marketing as a kind of hardwood flooring). A process of accommodation takes place when a new product differs too much from any existing product category, resulting in the conception of a new product category (Van Raaij et al. 1999).

[4] This applies only in the case of the tensile strength of individual bamboo fibres.

Once the large warehouses and other outlets are convinced and believe in the potential of the product, they will, in turn, be able to convince the consumers and push the product in the market. A promising development in this light is the growing implementation of industrial bamboo products by large retail chains like IKEA.

Lack of sufficient outlets and exposure for bamboo products is the reason for the lack of knowledge among consumers, distributors and retailers about the qualities and (industrial) possibilities of the material. This helps negative associations that most consumers have about bamboo products to persist. When more industrial bamboo products make it to the shelves in retail outlets (prerequisite), more consumers will get exposed to them. This first exposure to industrial bamboo products was mentioned by many respondents as a key moment. As was mentioned in the section on 'Image', the initial response of many consumers when seeing industrial bamboo products for the first time is one of positive surprise. It is at this moment that the consumer can be convinced and should receive all the appropriate information about the product (technical data, maintenance, price, etc.) from the salesperson.

As mentioned before, a key prerequisite for bamboo wholesalers is to convince the distributor of the virtues of bamboo products and he will, in turn, inform his sales staff – information dissemination is the key issue. The means to convey this information (brochures, samples, verbal information, advertisements, media exposure) is also very important, as is the story and philosophy of the product which could be focused on a linkage with sustainability and FSC certification. From the point of view of the importer, it would be most efficient to focus promotion activities on less fragmented markets in which only few players play a role.

Finally, the lobby against bamboo products would grow stronger as the threat from industrial bamboo products to competing products (such as wood products) grows larger. Therefore, it is all the more important that the first products to be launched meet the standards of the EU market. Later, it would be important for the bamboo industry in the West to unite in an association. Currently, the industrial bamboo products are too young and the companies (importers, warehouses and retailers) in bamboo business too few to unite in order to protect interests, foster research and promote bamboo products. Nevertheless, bamboo industry pioneers in the EU could try to join their strengths in order to convey correct information about their products as widely and as professionally as possible.

Market Choice

General bamboo products

The market for bamboo products is growing in the West in various applications ranging from textiles to decorative vases to high-quality parquet floors, with the USA being currently the largest market. The high-end markets in the bamboo producing countries could be another interesting target for bamboo design products. Information in this section is provided in qualitative terms, for quantified market information for bamboo products is referred to van der Lugt and Lobovikov (2006).

Non-industrial bamboo products

General

Respondents agree that there will always be a niche market available for non-industrial bamboo products based on bamboo culm produced using non industrial techniques such as weaving or coiling. Depending on specific trends – for example, increasing interest in ethnical and fair trade products – the demand might increase or decrease over time, but is not expected to become significant in the future. For instance, there is a niche market available for decorative accessories, like vases and baskets, from natural materials like bamboo. In the low-end retail chains there will always be an outlet for these products because

of their low prices. However, as mentioned earlier, this does not help strengthen the image of bamboo products.

Culm-based products

Although the market for bamboo culm-based products is small, there are various niche markets and trends that offer possibilities. Currently, culm-based products are used in various decorative ways in interiors (screens) and exteriors (fencing, garden décor, garden furniture), and especially in low-end markets (vases, baskets). Because of its rustic look, bamboo culm-based furniture will only appeal to small market segments in both low-end and high-end markets (exclusive designs). There would be more possibilities for the bamboo culm when designers start to work with the material and come up with innovative product designs. It may be noted that the market for culm-based products, especially for external use, is larger in the USA and Southern Europe than in the rest of Europe.

As a building material, there is a small niche market for bamboo culms, especially for green architects, since the bamboo culm is one of the most sustainable building products available. However, the culm needs to be used in the right way (no direct exposure to the elements, proper preservation and drying, etc.). Sadly, because of a common lack of knowledge among the Western parties involved (distributor, architect, contractor), this is usually not the case resulting in the wrong use of bamboo and malfunctioning of the material, which worsens the image of bamboo. There are some building systems that have developed special components (Figure 13) in order to facilitate jointing, which is one of the bottlenecks with bamboo culm-based construction (van der Lugt et al. 2006).

Figure 13: The jointing technique of the CONBAM building system developed by Christoph Toenges (CONBAM 2006).

Industrial bamboo products

General

As mentioned before, two main markets are appropriate in the EU for industrial bamboo products: the building industry and the interior and exterior furnishing markets. If the objective is to have as much offset of bamboo products as possible, the best strategy might be to focus on the building industry (higher volumes), although higher margins are possible in the individual consumer markets. Civil and water works is initially a difficult market for industrial bamboo products because of the high demands on the products – performance standards, low prices and large volumes. For industrial bamboo products that resemble various wood products, adoption will probably be easier in countries such as Austria, Germany and the Scandinavian countries where wood is more popular.

Respondents agree that the interior furnishing market, focusing on furniture and accessories, is significant and stable for natural materials like wood and bamboo. This market can be divided based on the production criteria – small batches for low-end markets and large batches for high-end markets. For low-end markets, the price is the most important criterion and materials, aesthetics and styling are less important. If interior products from bamboo can be mass-produced, in consistent quality, short time and lower price than competing products (while linking to FSC certification), both private consumer markets and

project markets (restaurants, schools, public buildings) can be targeted. This requires simple products that can be mass-produced in the bamboo producing countries and can be transported efficiently (knocked down) to the Western markets.

On the other hand, for high-end markets styling and exclusivity are more important criteria besides the price. Such products can be developed when Western designers start to work with bamboo, utilizing its strengths in specific designs. Quality demands on the product are usually a lot higher for high-end markets. This is especially so for products like office furniture, the reason why many high-end furniture companies execute final production in Western countries. To meet the objective of increasing the share of bamboo products in the interior furnishing market as a whole, the best strategy probably is to first focus on high-end markets with designer products, significantly improving the image and exposure of bamboo products. Once successful, the bamboo products will be copied by the more trend-following low-end market chains and trickle down to all possible market segments.

From the point of view of providers of semi-finished bamboo products, it would be more interesting to focus on the building industry than on the interior furnishing market, which is usually more fragmented and requires more marketing investments for smaller volumes. Bamboo boards and veneer are increasing in popularity, particularly for interior finishing (flooring, wall covering, ceiling). For exterior applications, bamboo products under development, such as strand woven bamboo, could find use in the building industry as well as in the civil and water works industry.

Strand woven bamboo

Although strand woven bamboo (SWB) still needs further development and optimization with respect to splintering, finishing, coatings, impregnation, use of correct glue and other aspects, the product potentially has a wide range of market opportunities as a sustainable alternative (like FSC wood) for tropical hardwood in exterior applications such as decking, façade covering and garden furniture. These markets use very high volumes of material. SWB can also cater to certain exclusive, high-value niche markets such as the yacht market. Like SWB, other semi-finished bamboo products like plybamboo can also be developed for exterior use. However, the durability of bamboo products in exteriors needs to be ensured through technological interventions that address either the effects (development of coating) or the causes (impregnation with chemicals, high-temperature treatment, chemical treatment such as acetylation). Knowledge on this subject is still very inadequate and needs to be bolstered through research. A danger with some of these treatments is that they are not environmental friendly, which nullifies a main advantage of bamboo products – eco-friendliness.

For interior use, SWB can fulfil all the applications (flooring, wall covering, furniture) that are suitable for plybamboo. Because of the high degree of hardness of this product, it can also be used in very intensive applications such as stairs in commercial establishments. In the USA, the market for SWB for interior flooring is growing considerably.

Bamboo mat

Bamboo mat, being a relatively cheap product with a nice appearance, has a lot of potential in many applications in the furnishing market (carpet, wall covering, furniture covering). An interesting example mentioned by one respondent is the use of bamboo mats in the form of floor tiles, especially for large events such as trade fairs, since the product is cheap and is very easy to assemble and disassemble.

Promotion

Various respondents mentioned the importance of good quality of any new bamboo product launched on the market, or as one of the respondents put it, “Usually you have only one chance to make or break the reputation of a product”. The image of bamboo flooring has

seen some damage a couple of years ago when the first bamboo floors lacked the quality of the products now available. The first launch is especially important for bamboo products because of the already slightly negative consumer perception of these products.

General bamboo products

General

Besides bamboo-specific marketing, there are also various general marketing instruments that should be used for the promotion of bamboo products like exposure through fairs, advertisements in media (magazines and television shows are playing an increasingly important role for interior products), including a good presentation and branding of the products. A good example of attractive branding of bamboo products is the branding of the company 'Bambu' based in Shanghai, China (Figure 14). For both private consumer markets and professional markets, bamboo products should try to stand out based on emotions as being different and special (also see below), as well as the story around the product (sustainability – FSC, spirituality, cultural aspects).

Figure 14: Branding of bamboo products by the company 'Bambu' (Bambu 2006)

Bamboo as an emotional product

Bamboo is often seen as exotic and mysterious. In general, these associations are a weakness for culm-based products while a strength for industrial bamboo products. However, there are small consumer groups that appreciate the culm-based products for what they are.

Therefore, for industrial bamboo products and to a lesser extent for culm-based products that target private consumer markets, the approach could be to link to emotional aspects of bamboo (exotic, mysterious). This applies especially to specific product groups and trends in the private consumer market in which the sentiment of the consumer is touched (emphasizing the emotional qualities of bamboo products instead of the functional ones) like, for example, increased interest in spirituality (bamboo as a spiritual Asian product) or globalization (bamboo as an ethnic cultural product). The marketing approach for various bamboo products would differ for various markets (for instance, private consumer versus professional consumers in the building products market).

Industrial bamboo products

Criteria for marketing bamboo products

In the previous sub-section, the interior and exterior furnishing market and the building industry were identified as two possible markets for industrial bamboo products. Here, the pricing of the product is usually the most important criterion: most industrial bamboo products are quite expensive and should therefore be marketed towards high-end markets in which pricing matters less. Since industrial bamboo products have specific qualities over competing products and because bamboo products in general have a negative image, the emphasis should lie on technical and functional qualities of the new bamboo products. This applies especially to the building industry, and the best strategy would be to position industrial processed bamboo as a superior alternative to wood. Obviously, this should only be done if this is correct and supported by hard data; otherwise, such a marketing strategy will only help damage the reputation of any new bamboo product introduced.

For the interior and exterior furnishing markets also the aesthetical and emotional aspects will play an important role in the marketing of industrial bamboo products. While sustainability is another criterion for industrial bamboo products, only a small group of 'believers' (1 percent in the Netherlands) will be convinced if the marketing is focused purely on the 'greenness' of products (Sanders 2003b). For most individual consumers, the 'greenness' of products will be the last influencing aspect in their purchase choice (Brezet and van Hemel 1997). If the focus is too much on the 'greenness' of products, it might even scare other consumers away as being too radical and alternative. Therefore, for the 'green' marketing of bamboo products, it is more important to emphasize on sustainability of the products in a broad way, covering environmental, social and economical aspects (corporate social responsibility). The focus on sustainability will have a higher success rate in undifferentiated markets with few products and competitors. Once the purchase decision becomes more complex, individual consumers will base their choice on price and taste instead of on sustainability. This also clarifies the lack of success of, for example, sustainably produced coffee and tea and the success of FSC wood in the Netherlands (Sanders 2003a). For marketing, this means that industrial bamboo products should focus on overall sustainability and should try to link to the popular FSC certification as the sustainability brand.

Branding

Besides the possibility of branding bamboo products as exotic, innovative and something special, the respondents mentioned other brand images for industrial bamboo products. Many respondents felt that industrial bamboo products should not be marketed as a grass (accommodation) because of the negative associations with grass (weak, cheap, non-durable), but under a new name (which does not refer to bamboo) as another sustainable hardwood (assimilation). This could also be integrated in the name of the product. However, as we have seen in the section on 'Image', many respondents appreciate bamboo once it is in industrial form and hence, this may not be a wise marketing strategy. The bamboo species *Guadua* is known as the strongest bamboo worldwide and, according to many respondents, is a good-sounding brand name for bamboo products. Although it is not scientifically proven yet that

Guadua is the strongest bamboo species, this perception can be used nonetheless as a marketing attribute.

Furnishing market

Creating a product champion is a very interesting option for the promotion of bamboo furnishing products. This can be a famous designer who creates a typical bamboo design (icon) that utilizes bamboo's special properties, a big company that creates a trend or a celebrity who uses and publicly supports bamboo products. Realizing this, various industrial bamboo product suppliers approach designers to experiment with bamboo semi-finished products, like plybamboo boards, hoping that the design will become popular and be taken up by retail chains.

Building industry

The building industry is a very interesting market for industrial bamboo products such as flooring, wall finishing and ceiling because of the large volumes used. For industrial bamboo product suppliers, the best way to include their products into the specifications of a new building project is to influence the architect or the official commissioner of the building project. Because architects and designers usually like innovative materials, they are amenable to experimenting with bamboo. By active marketing (approach by salespersons, good information material and, more important, many samples which help the architect see and feel the material) many architects can be convinced to use the material. Once this is achieved, the building projects in which bamboo is used would be the best advertisement possible. There would be plenty of exposure for the bamboo products through the media, as well as through the people who visit the building and see the material for themselves.[5]

It would be a smart strategy to take advantage of this 'snow ball' effect by focusing on projects where a lot of exposure of the product to potential consumers is expected (bars, restaurants, public buildings like bus/railway stations and concert halls, etc.). This promotion strategy should be implemented in combination with the marketing of bamboo as a sustainable natural product (link to FSC). Many companies (such as Shell, BMW, Toyota, Zara, the Body Shop and Rituals) have chosen bamboo for their products or offices because they want to be associated with innovativeness and sustainability (Figure 15).

[5] This applies also to all designed objects like furniture, for example. A bar at the waterfront in Amsterdam has installed bamboo furniture, the unique look and texture of which attracted many people. These people were referred to the supplier who saw his turnover increasing considerably.

Figure 15: Use of bamboo in the receiving lobby of Doll, an architects company in the Netherlands

Persuading the architect and/or commissioner for the use of bamboo in a building project is only the beginning of the process. Contractors, the executing arm of the building

industry, are normally very conservative and will resist bamboo with arguments against it (with respect to availability, quality, durability, etc.) and in favour of materials they are accustomed to. Usually, preferences tend to be strong towards traditional materials, making it hard for new materials to enter the market. Because of these reasons, several (expensive) tests with respect to the strength, durability, fire resistance and other properties become necessary before the industrial bamboo products would be used. Even more constraints apply for the use of bamboo culms in buildings.[6] It is also possible that the traditional suppliers to the building industry (such as the wood industry) might start a campaign against bamboo products. This, however, is a natural phenomenon for the introduction of any new product: if the new product is competitive with the product it is meant to substitute, it would be able to withstand any lobby against it.

Various approaches are possible to overcome the initial resistance and ensure the use of bamboo in the project. It is very important to convince the commissioner and the client about the suitability of the industrial bamboo product proposed for use. This can sometimes be difficult since many builders wield a lot of power and might threaten not to guarantee the project if bamboo were to be used. In such case, the supplier of the industrial bamboo product should guide the process and deliver all the information based on facts and test results from acknowledged institutes. Although a start is to be made somewhere, references to projects successfully executed will be of great use to convince a sceptical commissioner, architect or contractor. An increasing number of stakeholders in the building industry (contractors, property developers, housing cooperatives, governments) oblige, under public and political pressure, and use a certain amount of sustainably produced wood (FSC) in their building projects. As mentioned before, FSC wood is expensive and still not widely available, and the industrial bamboo product can be marketed as a sustainable alternative. Before the use of bamboo in building projects is promoted, one needs to ensure that the supplying partner has adequate capacity, quality and the logistics. Once these approaches are followed and the prerequisites are met, industrial bamboo products stand a fair chance of being utilized in the building project.

Like the building sector, the flooring sector too has a measure of conservative approach to new materials, with persisting preferences towards traditional materials (such as teak and oak for the parquetry). Although private consumers usually go by these preferences, some consumers tend to look for something different (“not again teak”). Therefore, in this sector too, ample guidance and adequate information supply from bamboo product suppliers are of importance to convince the distributors as well as customers.

Trends

General products

Trends can apply to any material, technique or product, and could be considered both a threat and an opportunity. For example, the bamboo bowls produced using coiling techniques (mostly from Vietnam, Figure 16) were considered trendy last years in the Netherlands. However, because of the wide availability of copied products in a broad range of low-end retail chains, this kind of bowls has gone out of fashion at present (2006) in the Netherlands, while they are more popular than ever in countries such as the United States, Japan, United Kingdom, Australia and France.

[6] More information on building with bamboo culms in Western Europe can be found in van der Lugt et al. (2006)

Figure 16: Bamboo bowl produced using coiling technique from Vietnam

Constant product innovation in combination with a diversified product portfolio would help soften the effects of such trend shifts: currently, the capacity for product innovation is very low for most bamboo companies. To get into the forefront of trends one could try to link to trend makers (big design houses, renowned designers, large retail chains, etc.) and establish a product champion for bamboo.

The increasing popularity of synthetic materials (lower maintenance and greater durability) as replacements for natural materials in interior and exterior applications (flooring, furniture, decoration) is a threatening trend for bamboo and other natural materials. The popularity of fake rattan chairs (Figure 17) is the immediate threat in the EU market. This shows that while the appearance and aesthetics of natural materials like rattan still have market potential in furniture products, it is the low durability that works against natural materials. Some respondents, however, were sure that certain consumers, mostly in the higher-end market segments, will always favour the 'real' over the fake one.

Figure 17: Fake rattan chair made of plastic

General bamboo products

Interior furnishing

Combining different materials, both natural and synthetic, in interior furnishing design in raw forms is a trend into which bamboo could be integrated. Raw and authentic materials are used in various designs, which could provide opportunities for bamboo in raw form (culm or strips) and less for laminated bamboo that might be too sleek for this trend. One respondent from a big Dutch design house mentioned: “The simpler the design, the better the material can show its qualities. The combination of local materials and techniques in combination with Western design capacity and creativity can provide new innovative solutions”. Besides the raw forms, industrial bamboo boards in combination with other materials are also getting more popular in the high-end market segment (Figure 18).

Figure 18: A good example of a design with a combination of materials: table with metal frame and bamboo top

Large sculptural designs from the 60s and the 70s are also making a comeback as a trend and bamboo designs could play a role in this (Figure 19). However, these designs have weaknesses, such as the impossibility of knocked down packaging, high volume, low stackability, which contribute to high transportation costs.

Figure 19: Bamboo chair developed by Xeno objects (Xeno Objects 2006)

It may also be noted that the strengths of bamboo are not utilized in such designs. Very slim designs in which the specific properties of bamboo can be utilized are not a trend at the moment. Curved designs do fit in with current trends and can take advantage of the extreme bendability of bamboo. Respondents agreed that bamboo culm-based products, in line with the rattan trend that was popular years ago, do not stand any chance in the current interior furnishing market, expect in very small niche segments.

Utilization

Non-industrial bamboo products

Culm-based products

One of the weaknesses of bamboo – which also applies to many wood species – is degradation from mould and other biological agents and ultraviolet greying when used outdoors. Bamboo culms used outdoors also tends to crack because of tensions from shrinkage and expansion caused by changes in temperature and moisture content (Figure 20), particularly when directly exposed to sunlight and rain. The cracks, highly undesirable from the point of view of aesthetics and structural integrity, also expose the softer inner part of the culm wall, which is more susceptible to moulds.

Figure 20: Cracking of bamboo culm when directly exposed to climatic conditions

Rotting, mildew and cracking of bamboo culm can be prevented by proper preservation and drying, and taking care not to expose bamboo in its natural state directly to climatic conditions. There seems to be species-specific differences in the effects of climatic conditions. For example, the dark bamboo species *Gigantochloa atroviolacea* (Widjaja) is reported to be significantly less susceptible to cracking than other species (Bakker and Verhagen 2005). Therefore, knowledge of the resource, its characteristics and its proper usage is important for its successful and effective utilization.

Coiling technique

Products made using this technique, mostly decorative items like bowls and vases, are very susceptible to splitting when used in the dry interiors (dryness caused by central heating systems)[7]. Changes in the adhesive used and shrinkage of the thin bamboo strips are the causes. The adhesive used might also make the products unsafe for food-related applications.

Industrial bamboo products

Plybamboo

Plybamboo boards, while not recommended for outdoor use because of their high susceptibility to mould, are very suitable for indoor uses such as tabletops. Plybamboo tabletops in a busy restaurant in Amsterdam still look good after intensive use (very few

[7] Experienced in the Netherlands.

scratches, stains or moisture damage). Preservative treatments such as waxing will extend the durability of these tabletops, just as it does for other natural materials like oak.

Strand woven bamboo

As mentioned earlier, SWB is very promising but there is still very little information on how it holds up when used outdoors, especially in the colder, rainy climates. Initial tests show that the product still needs optimization because of its susceptibility to moulds.

Conclusions

Table 9 summarizes the interview responses on most important factors for the successful commercialization of bamboo products. The factors are clustered and prioritized according to the number of responses received. The quantification only gives an indication of where the interviewed respondents' attention lies, and is not meant for quantitative analysis. For nuances with respect to this prioritization is referred to the section 'discussion' below. A more complete categorization of all the factors mentioned during the interviews, arranged according to the stages in the production chain, can be seen in Appendix 5.

Table 9: Responses for the various clusters, arranged based on the number of responses

Issue & Rank	Number of responses (out of a possible 31 responses)[8]
1. Image	28
2. Promotion (total)	27
3. Product Development	22
4. Linking to FSC 4. Distribution/Knowledge	21 21
5. (Choice of) Market 5. Production Chain (total)	20 20
6. Trends (total)	17
7. Use in the EU (total) 7. Transport	9 9
8. Market Knowledge in South	7

The table shows that there are various issues that play key roles in the commercialization of bamboo products, translating into market share in the EU. Below the most important issues in the commercialization of bamboo products are commented upon, starting with the factors that are mentioned the most by the interviewees.

First of all, the image of bamboo is a factor that has both a positive and negative influence on the commercialization of bamboo products. Most consumers first associate

[8] Even if for one issue more than one response is given per respondent, a maximum of one is counted per issue for this table

bamboo with culm-based products that, in general, have an image of being cheap, traditional and low quality. However, industrial bamboo products tend to have a good image as being innovative and sustainable.

A positioning and promotion strategy for industrial bamboo products will be crucial to identify bamboo products as having added value over other products from natural materials. This can be done by the involvement of a famous designer or a large company (product champion) and emphasizing specific attributes of bamboo products for the two markets with most potential for industrial bamboo products: the furnishing market and the building industry. Emotional attributes (aesthetics, environment-friendliness, exoticism) might be more important for the private consumer market than for professional markets such as the building industry (functional and technical requirements and the idea of corporate social responsibility are paramount).

Inadequate product development is a major constraint. Only very few (industrial) designers are working with bamboo, resulting in too few bamboo products suitable for the Western markets. This non-involvement of designers also stymies product innovation. More opportunities are expected to be available once product development is based on the specific strengths of bamboo, distinguishing bamboo designs from that of other materials and avoiding copying of wood processing techniques.

Linking to the increasing demand for FSC-certified sustainable forest products could provide great possibilities for bamboo products. The demand for sustainably produced wood has grown considerably (and is expected to continue growing) and bamboo, considered as an intrinsically sustainable resource by most consumers, should take advantage of this trend.

An important cause of the low market share of bamboo products is the lack of knowledge of distributors, and therefore of consumers, about bamboo (especially about industrial bamboo products). This is common to any nascent industry. Through effective information dissemination, some receptive (early adopting) distributors need to be convinced about the virtues of bamboo products. These distributors will, in turn, convince potential customers to initiate a steady diffusion of bamboo products.

Various weaknesses and threats in the production chain in bamboo producing countries with respect to capacity, quality, plantation management and processing, hamper bamboo commercialization in the EU. Still, there are many markets in the EU where bamboo products (mostly industrial) have opportunities.

Another important factor is market trends, like a heightened interest in natural materials, which offer opportunities to push bamboo products on the market. However, trends can also be threats like the cheaper, low-maintenance synthetic imitations of many natural materials.

Problems associated with the transport of bamboo products to Europe also play a role in commercialization, as do problems related to the use – particularly outdoor use – of bamboo products in the EU, especially Western Europe.

Lack of market knowledge in bamboo producing countries is another major hurdle. Very few products are being developed that meet the tastes and wishes of the Western consumers. This weakness strongly relates to inadequate product development mentioned earlier in this section.

Discussion

A couple of factors should be mentioned that might have influenced the results of the interviews and explains why the prioritization of Table 10 is only indicative of the most important issues along the production chain during the commercialization of bamboo products in the EU market.

Every respondent has answered with his/her own company as reference. Since many of the respondents interviewed are active in the furnishing sector, conclusions in that sector are might have a higher validity than conclusions in other sectors. The same applies to other bamboo products categorized according to the production technology. Conclusions for plybamboo products have a larger validity than those for bamboo mat products because of the higher number of respondents acquainted with plybamboo products.

Since the respondents have answered with a focus on the market side of the production chain (instructions of interviewer) and since the number of respondents who have knowledge on the market side is higher than respondents with knowledge about the production side, there would be, in absolute numbers, more issues on the market side identified as important.

7. Summing Up

The main objective of this report was to gain insight, from a consumer's perspective and along the production chain, about the commercialization of bamboo products in the EU market with respect to: (1) internal weaknesses and external threats that cause the low market share; and (2) competitive advantages and external opportunities to increase the market share, with a focus on the market side of the production chain.

Literature research executed during this study showed that many of the factors of success and failure that are relevant during the commercialization of new materials and other NTFPs (the forest product group to which bamboo belongs) for Western markets also apply to bamboo. These cover supply chain management, institutional capacity, resource management, production capacity (reliability, quantity, quality), entrepreneurship, product development, competition from substitute products, legislation, communication and information transfer, knowledge and familiarity, distribution, price, promotion (marketing and sales), image, and market trends.

As most NTFPs (including bamboo) originate in underdeveloped sectors in developing countries, many factors of failure refer in particular to the supplier's side. Factors such as lack of market knowledge, lack of production and supply capacity, and mismanagement even amplify problems at the buyer's side (availability, quality, image, price, etc.). Besides literature research, additional interviews were conducted to distil the most important factors for successful commercialization of bamboo products from the perspective of consumers in the EU. These factors are (in order of importance): image, promotion, product development, increasing popularity of FSC wood, information dissemination, market choice, production capacity, trends, utilization, transport, and market knowledge in producing countries. Various of these specific factors overlap with general factors of success and failure during the commercialization of NTFPs, although there are also distinguing differences in the case of bamboo. such as the image of bamboo culms and bamboo production chain related items.

A majority of the mentioned key factors for successful commercialization of bamboo products into the EU – image, promotion, product development, increasing popularity of FSC wood, information dissemination and market choice – are related to the consumer's side of the production chain. Although this is to be expected because of the focus of the interviews, it emphasizes the importance of product development and marketing for the commercialization of bamboo products. Unfortunately, these are exactly the factors that still seem neglected currently in the bamboo development programmes in the South and bamboo research projects worldwide. Early integration of these aspects into the bamboo sector is essential, particularly since industrial bamboo products are in a critical phase – between the introduction phase and the growth phase – in their commercialization process in the West (Figure 21).

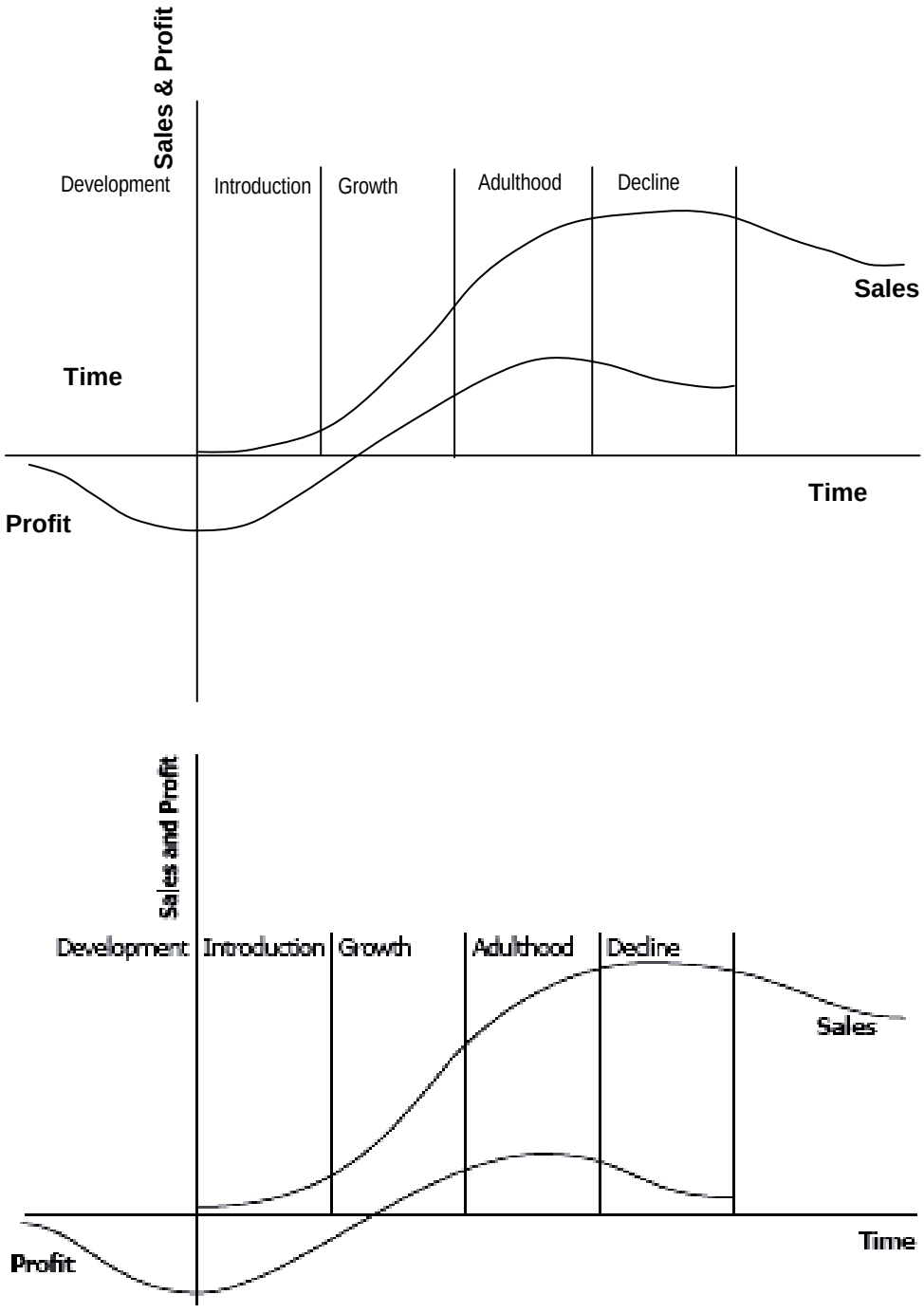

Figure 21: The life cycle of a product (Buijs and Valkenburg 2000)

The coming decade will therefore prove crucial for the industrial bamboo industry in the West. Can the bamboo product grow up to climb the S-curve into adulthood? Will it be widely accepted or will it never reach market maturity? Positive resolutions to these posers rest largely up on the bamboo industry itself. There are many bottlenecks and threats to be overcome, especially related to marketing and product development. In order to successfully introduce industrial bamboo products as promising substitutes for timber, all active stakeholders (entrepreneurs, governments, NGOs, etc.) in the bamboo sector need to join forces and put more focus on the integration of these two aspects in their bamboo development and research programmes. The recommendations given in this report can help

in this challenging endeavour and can hopefully contribute to the increasing future utilization of bamboo as a major cash crop for sustainable development.

References

Ashby, M.; Johnson, K. 2002. Materials and design: the art and science of material selection in product design. Butterworth-Heinemann, Elsevier, Oxford, United Kingdom.

Bakker, R.; Verhagen, G. 2005. Het splijtgedrag van bamboe. Hogeschool Inholland, Alkmaar, The Netherlands.

Belcher, B. 1999. The bamboo and rattan sectors in Asia: an analysis of production-to-consumption systems. INBAR Working Paper No. 22, International Network for Bamboo and Rattan, Beijing, China.

Belcher, B.; Ruiz-Pérez, M. 2001. An international comparison of cases of forest product development: overview, description and data requirements. Centre for International Forestry Research, Bogor, Indonesia.

Brezet, J.C.; van Hemel, C.G. 1997. Ecodesign: a promising approach to sustainable production and consumption. United Nations Environment Programme, Paris, France.

Buijs, J.; Valkenburg, R. 2000. Integrale productontwikkeling. Lemma, Utrecht, The Netherlands.

CBD (Convention on Biological Diversity) 2001. Sustainable management of non-timber forest resources. CBD Technical Series No. 6, Secretariat of the Convention on Biological Diversity, Montreal, Canada.

Cooper, R.G. 1996. New products: what separates the winners from the losers? *In* Rosenau, M.D. ed., PDMA handbook of new product development. John Wiley & Sons, New York, USA.

CORPEI (Corporación de Promoción de Exportaciones e Inversiones) 2005. Estudio de mercados internacionales para potenciales productos Ecuatorianos derivados del bambu. Corporación de Promoción de Exportaciones e Inversiones, Guayaquil, Ecuador.

Datamonitor 2004. Global Consumer Trends (Reference Code: DMCM0683). Datamonitor, New York, USA. (Synopsis on url: http://www.datamonitor.com/~cce1e2bfa7674448bd84c2947b928652~/products/free/Report/DMCM0683/020dmcm0683.htm).

de Bruijn, M.L.J. 2006. Cheap, Asian, rustic? The current image of bamboo and the attitude towards bamboo product innovations in Western Europe. Delft University of Technology, Delft, The Netherlands.

de Goede, P.; van Loon, M. 2006. The image of bamboo furniture. Industrial Design Engineering, Delft University of Technology, Delft, The Netherlands.

Eagar, T.W. 1995. Bringing new materials to market. Technology Review, February/March 1995, pp. 42-49.

Flanagan, D. 2004. The economics of bamboo products in the United States. Paper presented at the VII World Bamboo Congress, 27 February – 4 March 2004, New Delhi, India.

FSC (Forest Stewardship Council) 2005. Estimated size of FSC global market revised to US$5 billion, FSC News, 25 April 2005, published online, url: http://www.fsc.org/en/whats_new/news/news/40.

FSC Netherlands, 2006. FSC in de markt 2006. In Press. FSC Nederland, Utrecht, The Netherlands.

FSC Netherlands, 2006. Personal communication (Aad van Noort, August 2006).

Ganapathy, P.M., et al. 1996. Bamboo panel boards – a state-of-the-art report. INBAR Technical Report No 16, International Network for Bamboo and Rattan, Beijing, China.

Garzon, D.S.; Held, C. 2003. Resumen del trabajo de semestre academico: investigaciones en el mercado para pisos de bambu en Alemania. University of Freiburg, Freiburg, Germany.

Grooten, M. 2006. Global programme & policy of WWF. Personal communication.

Held, C. 2002. Mercados de bambu en Alemania. University of Freiburg, Freiburg, Germany.

Held, C. 2003a. Analisis de la encuesta sobre pisos de bambu y sobre Colombia durante la feria cientifica de la Universidad de Freiburg. University of Freiburg, Freiburg, Germany.

Held, C. 2003b. Documentos del proyecto Guadua-Bamboo de la Union Europea sobre las investigaciones en los mercados alemanes para productos de bambu. University of Freiburg, Freiburg, Germany.

Held, C. 2004. Observaciones sobre las importaciones de cana, artesanias y muebles de bambu. University of Freiburg, Freiburg, Germany.

Held, C.; Manzano, I.D. 2003. El sector productivo y el mercado regional de la guadua en el eje cafetero colombiano. Working Paper No. 51, International Network for Bamboo and Rattan, Beijing, China.

Hyman, E.L. 1996. Technology and the organisation of production, processing and marketing of non-timber forest products. *In* Ruiz Pérez, M.; Arnold, J.E.M. eds. Current issues in non-timber forest products research. Proceedings of the Workshop “Research on NTFP”, Hot Springs, Zimbabwe, 28 August - 2 September 1995. Centre for International Forestry Research, Bogor, Indonesia.

Klop, A.; Cardenas, E.; Marlin, C. 2003. Bamboo production chain in Ecuador. Journal of Bamboo and Rattan, 2 (4), 327-343.

Kotler, P. 1997. Principles of marketing. European edition. Academic service, Schoonhoven, the Netherlands.

Kriesch, M. 2004. FSC in de markt 2003. AIDEnvironment, Amsterdam, The Netherlands.

Kuilman, D. 2004. Four misconceptions about design. Premsela, Amsterdam, The Netherlands.

Larasati, D. 1999. Uncovering the green gold of Indonesia. Working Paper No. 31, International Network for Bamboo and Rattan, Beijing, China.

Manzini, E. 1986. The material of invention. The Design Council, London, United Kingdom.

Marijs, A.J.; Hulleman, W. 2000. Meso Economie en Bedrijfsomgeving. Wolters Noordhoff, Groningen, The Netherlands.

Marshall, E.; Newton, A.C.; Schreckenberg, K. 2003. Commercialisation of non-timber forest products: first steps in analysing the factors influencing success. International Forestry Review, 5 (2), 128-137.

Mathew, P.M. 1998. The bamboo economy of Kerala, India: an analysis of the production-to-consumption systems. Working Paper No. 12, International Network for Bamboo and Rattan, Beijing, China.

Montoya-Weiss, M.M.; Calantone, R. 1994. Determinants of new product performance: a review and meta-analysis. Journal of Product Innovation Management, 11 (5), 397-417.

Mulder, S.; Verhue, D.; Adriaansen, M. 2005. Uit: Wat is het milieu ons waard? De acceptatie van milieubeleid en milieumaatregelen. TNS NIPO, Amsterdam, The Netherlands.

Musso, C.S. 2005. Beating the system: accelerating commercialization of new materials. PhD thesis. Massachusetts Institute of Technology, Massachusetts, USA.

Neumann, P.R.; Hirsch, E. 2000. Commercialization of non-timber forest products: review and analysis of research. Centre for International Forestry Research, Bogor, Indonesia.

Otten, G.; Ottens, B.J. 2004. Factor 4 – bottlenecks, needs and opportunities related to the imports of renewable raw materials from developing countries & propositions for improvement of current mechanisms. ProFound, Utrecht, The Netherlands.

Ottens, B.J. 2006a. Steps toward NTFP product development & marketing – tales and tools on community-based NTFP enterprise development in Asia. ProFound, Utrecht, The Netherlands.

Ottens, B.J. 2006b. Sustainable NTFP product development & marketing – from resource to market: some principles, patterns and processes with reflection on the Vietnamese situation. ProFound, Utrecht, The Netherlands.

Poelman, W.A. 2005. Technology diffusion in product design. PhD thesis. Delft University of Technology, Delft, The Netherlands.

Pugh, S. 1990. Total design: integrated methods for successful product engineering. Addison Wesley, Wokingham, United Kingdom.

Roozenburg, F.M.; Eekels, J. 1995. Product design: fundamentals and methods. John Wiley & Sons Ltd., Chichester, England, United Kingdom.

Sanders, T. 2003a. Simplicity determines the success of sustainable products (in Dutch). Magazine for Marketing, 37 (4).

Sanders, T.P.J.B. 2003b. Duurzaamheid gaat niet via democratie. Het Financiele Dagblad, 11 juni 2003.

Smulders, F.E.H.M.; Kiers, M.H.; Engelen, J.M.L. 1996. Handboek voor commercieel technici. Samsom Bedrijfs Informatie bv, Alphen aan den Rijn, The Netherlands.

van der Lugt, P. 2005a. The bamboo sector in Colombia and Ecuador: a state-of-the-art analysis of opportunities and constraints. The Journal of Bamboo and Rattan, 4 (4), 421-440.

van der Lugt, P. 2005b. The quiet strength of bamboo (in Dutch). Items (5), BIS publishers, Amsterdam, The Netherlands.

van der Lugt, P.; Lobovikov, M. 2006. The potential and current market size of bamboo products in the West. (Manuscript).

van der Lugt, P.; van den Dobbelsteen, A.A.J.F.; Janssen, J.J.A. 2006. An environmental, economic and practical assessment of bamboo as a building material for supporting structures. Construction and Building Materials, 20. (In Press).

van Kesteren, I.E.H.; Kandachar, P.V. 2004. Commercialization of new materials in consumer goods. *In* Redmond, J.; Durling, D.; de Bono, A. eds. Futureground – Proceedings of the international conference of the Design Research Society, 2004, Melbourne, Australia. pp. 1-14.

van Raaij W.F.,;Oppedijk van Veen, W.M.; Schoormans, J.P.L. 2004. *Product & Consument*. Lemma, Utrecht, the Netherlands

von Reitzenstein, E. 2004. Market survey on bamboo parquet in Germany: procurement strategies, current market situation and market potential for new suppliers from Latin America. University of Freiburg, Freiburg, Germany.

Wang, Z.; Guo, W. 2003. Current status and prospects of new architectural materials from bamboo. INBAR Working Paper No. 47. International Network for Bamboo and Rattan, Beijing, China.

Zhang Qisheng; Jiang Shenxue; Tang Yongyu. 2003. Industrial Utilization on Bamboo. INBAR Technical Report No. 26. International Network for Bamboo and Rattan, Beijing, China.

Websites

Adapt Design: www.modernbamboo.com.

Bambu: www.bambuhome.com.

CONBAM: www.conbam.de.

CBD (Convention on Biological Diversity): www.biodiv.org (for NTFP trade statistics).

Dutch Design in Development: www.ddid.nl.

Hefeng Bamboo Products: www.hefeng-bamboopanel.com.

NTFP exchange programme: www.ntfp.org.

United Nations: www.un.org.

Xeno Objects: www.xenoobjects.com.

Appendix 1

Categorization of industrial bamboo products by various sources

Bamboo based panels, an overview of characteristics		Name used in Report / applicable to EU	Applications	Advantages	Disadvantages	Source
Products made of bamboo strips	Plybamboo		Boards for truck beds and bus floors, use in construction	Great dimensions, high strength, small deformation, good weather performance and stable form	For construction uses: 1. The thickest available board (2003) is 30 mm. 2. Need for standardized testing methods.	Wang and Guo 2003; Zhang Qisheng et al. 2003
	Laminated bamboo board (planed)	Plybamboo	Furniture, veneer. Based on bamboo square board: window and door frames	Great dimensions, fine grained surface		Zhang Qisheng et al. 2003
	Laminated bamboo flooring (planed)	Plybamboo	Flooring	Fine quality, good appearance	Very strict standards, complicated production process, high quality raw material needed	Zhang Qisheng et al. 2003
Products made of thin bamboo strips and slivers	Bamboo mat board		Thin boards: packaging material, covering material for railway wagons, shuttering. Medium boards: Ceilings and partitions (WP 47), small window and door frames. Thick boards: concrete formwork, truck beds, non-load bearing construction	Few equipment needed for weaving– good for socio economic development, all parts of the bamboo culm can be used	Emission of formaldehyde (adhesive used), very rough appearance (but this could also be considered a quality), time consuming process	Wang and Guo 2003; Zhang Qisheng et al. 2003

	Corrugated bamboo roofing sheets		A sub-product of bamboo mat board	Environment friendly compared with alternatives in other materials (Zinc, iron). However, the large amount of resin used might make it less environment friendly. Low price		
	Bamboo curtain board	Bamboo mat	Ceiling or wall covering, small window and door frames, etc.	Faster process than mat board		Zhang Qisheng et al. 2003
Products from reconstituted particles, strands or fibres	Bamboo particleboard (various types – regular, strengthened, overlaid)		In strengthened or overlaid form used for concrete formwork. Ceiling, roof board, various kinds of light partitions, door shutters, panelling, decorating board (mainly as basis overlaid by strips), small window and door frames, etc.	All parts of the bamboo culm (also waste) can be used, similar production process as wood particleboard, high utilization ratio of raw material. Comparatively high strength and MOE, low expansion rate when absorbing water, can be strengthened by adding several surfaces (coating, resin impregnated Kraft paper, wood veneer, bamboo mat, etc.		Zhang Qisheng et al. 2003
	Bamboo fibre board and medium density fibreboard (MDF)		Stair handrails, cross bandings, small window and door frames, doors, decorative panels (if overlaid with thin strips)	Various shapes and patterns possible		Wang and Guo 2003

Products of composite materials	Bamboo (ply)wood sandwich composites		Floors of containers and railway wagons, construction material, flooring	Low cost, simple production process, excellent wear-ability, great strength and high rigidity, low internal stress.		Zhang Qisheng et al. 2003
	Various bamboo-bamboo composites (e.g. bamboo mat / bamboo curtain board)		Various			Zhang Qisheng et al. 2003
	Bamboo-plastic composite board		Same as particleboard Flooring	Compared with regular particle-board, more water resistant, durable and better dimensional stability (no swelling or cracking), environment friendly when no formaldehyde basis resin is used (emission problems), waste plastics can be used		Wang and Guo 2003; Zhang Qisheng et al. 2003
	Bamboo cement bonded particleboard		Housing applications like insulation board, ceiling and partition	Fire resistance, no formaldehyde emission		Wang and Guo 2003
	Bamboo gypsum bonded particle board		Housing applications like use as insulation board, ceiling and partition	Fire resistance, no formaldehyde emission. Similar process as gypsum bonded wood particle board		Wang and Guo 2003
Innovations	Strand woven bamboo	Strand woven bamboo	Flooring, furniture, possibly various uses in construction (e.g. door and window frames)	High strength and hardness Aesthetical quality	Weight (very heavy), expensive	Hefeng Bamboo Products website

Appendix 2
Details of interview respondents

List of respondents interviewed and their including their characterization

Ref. No.	Respondents	Organization / function of respondent	Characterization*
1	Rene Zaal	MOSO (director)	Bamboo (Industrial), SME
2	Mark van der Wildt	Wild Navy (director)	Bamboo (Industrial), MSE
3	Antoon Oostherhuis	Bylsma (director)	Non-bamboo, Big
4	Andries van Ekkeveld	A van den Berg (marketing and R&D)	Non-bamboo (FSC wood), Big
5	Enrique de Mul, Jelle Maijer	Cocowood.nl (entrepreneur / director, designer)	Non-bamboo (coco wood), MSE
6	Thomas van Zijst	Winkel Wilhelmina (owner / director)	Bamboo (Industrial), MSE
7	Charley Younge, Pim de Blaey	Bamboo Information Centre (owner/director, consultant)	Bamboo (Industrial & Non Industrial), MSE
8	Geertje Otten	ProFound - Advisors in Development (consultant)	Bamboo (Industrial & Non Industrial), consultancy
9	Marion Vrijburg	Fair Trade (designer)	Bamboo (Non Industrial), NGO
10	Thierry Sanders	NCDO/Business in Development Programme (Programme director)	Non-bamboo (NTFP), government organization
11	Victor de Lange	CREM (managing director)	Non-bamboo (NTFP), consultancy
12	Andre Janssens	Nieuwe Maan Communicatie Adviesgroep (managing director)	Non-bamboo, consultancy
13	Gemma Boetekees	ICCO (programme director NTFP)	Non-bamboo (NTFP), NGO

* Definitions used for categorization:

- Company size: MSE till 1-15 employees, SME 15–250 employees, big over 250 employees (including employees in South)

- (Non) bamboo: If the respondent has directly worked with (or investigated) bamboo products, he/she is categorized under 'bamboo', if not under 'non-bamboo'. If 'non-bamboo', the categorization for the level of industrialization does not apply.
- (Non) industrial: follows the definition provided in the text (see Chapter 2: Methodology).

Ref. No.	Respondents	Organization / function of respondent	Characterization*
14	Ed van der Kleij	Intratuin (purchasing agent furniture)	Non-bamboo, Big
15	Theo Kruyer	Xenos (purchasing agent accessories)	Non-bamboo, Big
16	Glenn Berndtsson	IKEA (production technician NTFP)	Bamboo (industrial & non-industrial), big
17	Helen Reniers, Brigit van Daelen	HEMA (designer respectively buyer furniture & accessories)	Bamboo (industrial & non-industrial), big
18	Mariluz Fernandez, Ed van Engelen	Haans (product manager, designer)	Bamboo (industrial & non-industrial), big
19	Sander Vroone	Kwantum (purchasing agent furniture)	Non-bamboo, big
20	Jesse Kuiper	Kinnarps (managing director)	Non-bamboo, big
21	Hessel van Straten	NIBO NV (managing director)	Bamboo (industrial & non-industrial), SME
22	Arienne Henkemans	INBAR (project advisor)	Bamboo (industrial & non-industrial), inter-governmental organization
23	Charles de Roo	Galerie Ecce (designer / managing director)	Bamboo (industrial), designer
24	Dick Oskamp	Van Binnen (sales person)	Bamboo (industrial), MSE
25	Marco Groenen	De onderneming in architectuur (Designer / owner)	Bamboo (industrial), designer
26	Anthony Marschak	Adapt Design (Designer / owner)	Bamboo (industrial), designer
27	Jared Huke	Xeno Objects (Designer / owner)	Bamboo (industrial), designer
28	Robert Admiraal	Studio Admiraal (Designer / owner)	Bamboo (industrial), designer
29	Alexander Schmidmeier	High Touch (salesperson)	Bamboo (non-industrial), SME
30	Jan Bart Lucas	Architectural firm Lucas, Ellerman & van Vugt (Architect / owner)	Bamboo (industrial), architect
31	Alijd van Doorn	Doll architects (designer)	Bamboo (industrial), architect

Note: To identify the respondents, the same serial numbers as above are used in the tables that follow.

Categorization of companies according to product type

Type	Semi-finished products (mostly for building industry)		Finished products		
	Resource	Industrial	Flooring and interior finishing	Furniture	Accessories
MSE / SME company	7	1, 5, 7	1, 5, 7	2, 6, 7	9
Big company	4		16, 21, 24	3, 14, 15, 16, 17, 18, 19, 20, 29	15, 16, 17, 18
Total	2	3	6	12	5

Categorization according to organization type, bamboo products and level of industrialization

	Bamboo		Non Bamboo	Total
	Industrial	Culm / handicraft		
MSE / SME company	1, 2, 6, 7, 21, 24	7, 21	5	9
Big company	16, 17, 18,	16, 17, 18	3, 4, 14, 15, 19, 20	9
Other (designers, NGO, consultancy)	8, 22, 23, 25, 26, 27, 28, 30, 31	8, 9, 22	10, 11, 12, 13	13
Total	18	8	11	

Categorization of respondents in terms of region and production chain

	South	South / North	South / North	North	North
Production chain	Production / Processing	Transport	Product Development	Marketing & Sales	Use
MSE / SME companies	1, 2, 5, 7, 21	1, 2, 5, 7, 21	1, 2, 5, 7, 21, 24	1, 2, 5, 6, 7, 21, 24	1, 2, 5, 6, 7, 21, 24
Big companies	3, 4, 14, 15, 16, 18, 19, 20	3, 4, 14, 15, 16, 17, 18, 19, 20	3, 4, 14, 15, 16, 17, 18, 19, 20	3, 4, 14, 15, 16, 17, 18, 19, 20	3, 4, 14, 15, 16, 17, 18, 19, 20
Other (designers, NGO)	9, 13, 22, 27	9, 22, 27	8, 9, 10, 11, 12, 13, 22, 23, 25, 26, 27, 28, 29	8, 9, 10, 11, 12, 13, 22, 23, 25, 26, 27, 28, 29	9, 22, 23, 25, 26, 27, 28, 30, 31
Total	17	17	28	29	25

Appendix 3

Topic list

Production / Processing	Product Development South	Transport	(Strategic) Product Development North	Marketing & Sales	Utilization	General Questions
Production capacity Production costs Processing technologies - Facilities - Machines - Innovation Quality - Constant - Finishing - Control - Resource * Preservation * Drying	Product groups Innovation Market knowledge Product Development - Market access - Information (consumer demands & needs) - Choice product groups (PMT) - Innovation - Technical support - Management capacity	Domestic transport - Costs - Distance - Infrastructure - Organization Sea Transport - Costs - Distance - Infrastructure - Organization Packing -Knocked down Special demands - climate /	Markets / market knowledge Choice product groups Innovation Product design Involvement Western - Designers - Copying behaviour Outlets - Big * Whole sale * Department stores	Marketing / launch - presentation - positioning - commercials - advertising - Sales (story around product) - Outreach - Symposia - Lobby - Information centre - Product champion * Company (IKEA) * Designer * Celebrity Substitute products	Maintenance / Life Span - Effort - Lacquering - Preservation - Guarantee - Fire safety - Insects - Durability - Reliability - Technical support - Customer service - Safety - Stability in climate * indoor * outdoor - Disposal	What are de most important factors / aspects in a phase (e.g. production phase) that influence the market share of bamboo products? What are the problems / weaknesses / constraints that cause the low market share of bamboo products? How can this be solved? Which factors play a positive role in the commercialization process of bamboo products in the EU? Are there important

Time: Delivery - Speed to market Organization production chain - fine tuning actors - serial / modular - (inter)national support to sector - Technical support - Access to information and exchange of experiences - Financing Amount of middle men / intermediaries Project Partners - Relation / communication - Collaboration	Product design Involvement Western - Designers - Copying behaviour Certification - FSC - ISO - Corporate Social Responsibility * social circumstances * environmental impact * additives (e.g. glue)	temperature Import - Agro restrictions - Tax Law - Tests - Norms - Patents - Trade barriers	- Small Knowledge / Research Distributors - Unfamiliarity - Conservative Consumer - Unfamiliarity - Demonstrations / proof - Product info - Image - Aesthetical / visual - Sensorial / tactile - Associations - Combinations with other materials - Adoption time customer Product quality 'hard'	Management capacity Branding Logo Name Trends Competition		external developments that play a positive or negative role? Per sub-topic: Does sub-topics like "certification" play a role? Can you elaborate on that?

- NGOs - consultancy - Universities - Long term vision Lack of bamboo specific legislation / policy			- price / costs - mechanical properties - environmental - weight - maintenance - value for money - innovative / new - Performance compared to products from other renewable materials (e.g. wood) Product quality 'soft' - Texture - Image - Colour - Performance compared to products from other renewable materials (e.g. wood)			

Appendix 4

SWOT tables from literature review

Production and Transport

GENERAL					
Strengths	Remarks	Source	Weaknesses	Remarks	Source
			Products from big bamboo poles always need to be imported from (sub)tropical countries leading to extra time and money investments for shipping, customs, etc.		van der Lugt et al. 2006
			Lack of production capacity and quality management of producers in bamboo producing countries		Larasati 1999
Opportunities	Remarks	Source	Threats	Remarks	Source

INDUSTRIAL					
Strengths	Remarks	Source	Weaknesses	Remarks	Source
			In China only a couple of companies can meet the high EU demands for bamboo flooring. Main problems, in general, with companies: - bad machines - inadequate labour conditions	- It should be acknowledged that there are many crucial demanding processing steps to take during the production process that require a lot of skill and experience (complicated	CORPEI 2005; von Reitzenstein 2004

			- unreliable - inability to deliver in time - inability to deliver high quantities - inability to deliver consistent high quality - relatively high prices	drying process, selection of right strips: inside, outside, density, etc.) - Constant supervision and interaction by the European partner can help in establishing a better product - Once a business relationship with a European parquet company is maintained for a longer time, the Chinese partners become more reliable. Many EU parquet companies have invested a lot in time and money in their partners, sometimes turning earlier weaknesses in production quality into strengths. The price-performance ratio in China is superior compared with other bamboo producing countries at the moment and still improving. However, prices in China are also rising, so this situation might change in the future.	
			The industrial bamboo products from Latin	To catch up with China, many years of	CORPEI 2005; von Reitzenstein

			America have a quality that is far inferior to the Chinese products and in some cases the prices are even higher. Besides, there is a lack of experience in industrial bamboo processing in Latin America, compared with the Chinese bamboo sector. This is also due to the more difficult industrial processing of the endemic species *Guadua* (more and harder fibres), a lack of commercial plantations, a lack of required infrastructure, the investments already made in China by many European companies, and additional cultural factors (political instability, language barrier, business mentality)	experience need to be overcome and huge investments in skill, machinery and equipment need to be made. Also a company/ contact person with a more Western business attitude is a requirement.	2004
Opportunities	Remarks	Source	Threats	Remarks	Source

NON-INDUSTRIAL					
Strengths	Remarks	Source	Weaknesses	Remarks	Source
			Lack of quality (straightness, dryness, no preservation) of culms offered by providers	Intensive quality control and supervision required by buyer	van der Lugt et al. 2006

Opportunities	Remarks	Source	Threats	Remarks	Source

Product Development

GENERAL					
Strengths	Remarks	Source	Weaknesses	Remarks	Source
			Lack of information about bamboo	- Information system should be developed - Applies to all bamboo products	Garzon and Held 2003; Held 2002; Larasati, 1999
			Lack of research on bamboo (e.g. on exterior use, coatings, glues, etc.)		von Reitzenstein 2004
			Lack of market knowledge at producers side in the South		Larasati 1999
			Lack of product design skills at producers side in the South	Professional designers in the producing countries tend to focus on materials used in Western markets in which bamboo is usually not included. This is a pity since designers can act as a bridge between rural bamboo producers and the demands of urban and/or Western consumers.	Larasati 1999
			Lack of Western		Larasati

			designers working with bamboo		1999
Opportunities	Remarks	Source	Threats	Remarks	Source
Open new market segments by product innovation based on new processing technologies	Utilization typical advantages of bamboo	Held 2002; Larasati 1999			
For Latin America, it would be wise to differentiate from China (mass producing many standardized industrial products) and develop new products that can meet specific demands of customers in smaller batches (specific orders) and/or utilize *Guadua*'s specific qualities in new products to be able to compete with Chinese bamboo products (especially in North America), like, for example, through *Guadua*- based bamboo strand board.		CORPEI 2005; von Reitzenstein 2004			

For Latin America linking to the FSC scheme for bamboo might be worthwhile because of the wider experience with FSC schemes than in Asia.		von Reitzenstein 2004			

INDUSTRIAL					
Strengths	Remarks	Source	Weaknesses	Remarks	Source
			Lack of familiarity of Western European consumers with industrial bamboo products which has various causes: - The distribution network of these products is still too limited. - The industry is still too small to unite as an organisation that could start an advertisement/ promotion campaign.	- Publicity and dissemination of information about the advantageous properties of industrial bamboo products needs to be improved. - The enthusiasm, belief and knowledge of the first European importers to convey the potential of bamboo to possible distributors plays a crucial role in the commercialization of new industrial bamboo products in any European country.	Larasati 1999; von Reitzenstein 2004
			The very distinct look (many lines, vary structured) of bamboo veneer and panels might not appeal to everyone (aesthetics)	This applies even more to panels made from *Guadua*, which has a rougher fibre structure, resulting in a coarser product.	CORPEI 2005; von Reitzenstein 2004
Opportunities	Remarks	Source	Threats	Remarks	Source

NON INDUSTRIAL					
Strengths	Remarks	Source	Weaknesses	Remarks	Source
			Bamboo culm-based products in general have a poor image and are perceived by Western European consumers as low in quality and not durable.		CORPEI 2005; Held 2004; Larasati 1999
			Because of the physical form of bamboo culms (nodes, hollow, round, tapering) there is limited form variety when designing with them.		Larasati 1999
Opportunities	Remarks	Source	Threats	Remarks	Source

Marketing & Sales

GENERAL					
Strengths	Remarks	Source	Weaknesses	Remarks	Source
Bamboo as a resource is a cheap commodity		van der Lugt et al. 2006			
Opportunities	Remarks	Source	Threats	Remarks	Source
Sustainability requirements including ecological criteria are getting more important in society, which might serve		CORPEI 2005; Larasati 1999			

bamboo, as a renewable fast growing material					

INDUSTRIAL					
Strengths	Remarks	Source	Weaknesses	Remarks	Source
Bamboo has emotional (aesthetics), societal (sustainability) and technical (hardness, resistance, stability) properties that in many cases are superior to competing wood products (flooring sector).	- Use these properties in marketing - Differences with wood are not that big and even less in the case of flooring with some hard wood species. However, *Guadua* is seen as a very strong bamboo species - The aesthetic properties can also be a weakness because of the distinct look of industrial bamboo products. - Because the sustainability criterion is becoming more important (corporate social responsibility), institutional and commercial parties are more open to utilizing industrial bamboo products, perceived as	(CORPEI, 2005; Garzon and Held, 2003; von Reitzenstein, 2004)	Prices of good quality bamboo parquet are relatively high and launched at a similar price as hardwood flooring like oak.	High prices especially apply to solid bamboo; engineered bamboo flooring (top layer of bamboo on a wooden carrier) might be a more economic alternative.	CORPEI 2005; von Reitzenstein 2004

	being sustainable.				
			Most bamboo flooring is sold via resale trade resulting in a long chain.		von Reitzenstein 2004
Opportunities	Remarks	Source	Threats	Remarks	Source
A good way to promote high-quality bamboo board is through pushing the material among architects and designers who might use it in their projects, resulting in a lot of positive exposure. Mainly because there is a strong and important impulse from designers and architects to use bamboo as a sustainable, innovative, industrial material in their projects.		CORPEI 2005; von Reitzenstein 2004	There are many low-quality bamboo parquet producers in China who try to push their products in the EU market directly, without the intervention of EU importers, damaging the reputation of bamboo flooring because of the mediocre quality of their products. Also, more low-quality bamboo parquet importers in the EU try to make quick gains by importing and selling mediocre bamboo flooring, affecting the overall reputation of the product.		von Reitzenstein 2004
The market for industrial bamboo products is not saturated and has still a lot of potential for		von Reitzenstein 2004)	Lobby of the wood industry against bamboo, painting it as an inferior substitute to		von Reitzenstein 2004)

growth			wood products.		
In general, the USA market is less demanding than the EU market with respect to product quality (flooring).	- This might yield opportunities especially for the Latin American countries because of their nearness to this target market. - In the USA market there is also a huge demand for board material like OSB. If the *Guadua* fibres/particles could be used as a component instead of wooden fibres this also might be an interesting opportunity.	CORPEI 2005; von Reitzenstein 2004	Bamboo parquet is just a fashion trend and the interest in the product might diminish in the future.		von Reitzenstein 2004

NON INDUSTRIAL					
Strengths	Remarks	Source	Weaknesses	Remarks	Source
Bamboo culm-based products, in general, are cheap		Held 2004			
Opportunities	Remarks	Source	Threats	Remarks	Source

Utilization

GENERAL					
Strengths	Remarks	Source	Weaknesses	Remarks	Source
			Guadua seems more susceptible		von Reitzenstein

			to mould than *Phyllostachys pubescens* (moso)		2004
Opportunities	Remarks	Source	Threats	Remarks	Source

INDUSTRIAL					
Strengths	Remarks	Source	Weaknesses	Remarks	Source
			Unfamiliarity of sub-contractors with bamboo flooring resulting in problems in installation.		Garzon and Held 2003
Opportunities	Remarks	Source	Threats	Remarks	Source

NON-INDUSTRIAL					
Strengths	Remarks	Source	Weaknesses	Remarks	Source
In general, it is easy to erect and dismantle a bamboo culm-based structure because of the lightness of the culms.		van der Lugt et al. 2006	Bamboo culm-based products tend to crack because of tensions developing in the culm due to climatic differences between the bamboo producing countries and the European countries. Culm-based products have a low durability especially when used outside.	Special treatments might ensure that culm-based products do not split and crack.	van der Lugt et al. 2006 Larasati 1999
			Because of the shape (round, hollow and tapering) and because of the irregularity of	Some solutions for the joinery problem are presented in van der Lugt et al. (2006), which in	(van der Lugt, et al., 2006)

			bamboo, it is very difficult to make stable joints with bamboo culm. High costs and hassles because of the need to deploy skilled workers from abroad with experience in making bamboo culm joints (e.g. labour team of the Colombian architect Simon Velez).	summary, suggest: - using moulds over the bamboo culm during the growth stage - innovations in jointing techniques (prefabrication of culms with integrated joints, manipulation of the culms, adjustable joints) - industrial processing of bamboo into rectangular forms (e.g. through laminating techniques) instead of using culms - heat treatment and good plantation management	
			Lack of building legislation for bamboo culms in national building codes. As a direct result, costly, intensive and elaborate testing needs to be executed on bamboo culms with respect to various properties (strength, fire resistance, etc.)	Since 2004, ISO norms for bamboo developed by an international committee under chairmanship of Dr. Jules Janssen have become operative and will hopefully reduce testing requirements by local governments in order to issue building permits for bamboo constructions.	van der Lugt et al. 2006)

			Lack of classification systems for bamboo culms	Classification systems that are already available for timber still need to be developed for bamboo, for both the raw material (quality and strength classifications) and complete joints.	van der Lugt et al. 2006
Opportunities	Remarks	Source	Threats	Remarks	Source

Appendix 5

Categorization of responses received during interviews

The numbers in the table refer to respondents in Appendix 2. S, W, O and T refer, respectively, to Strength, Weakness, Opportunity and Threat.

Issue	Products General	Bamboo Products General	Culm / Handicraft Bamboo Products	Coiled Bamboo Products	Industrial Bamboo Products General	Plybamboo	Strand Woven Bamboo	Bamboo Mats	Total
Production: Organization, Capacity & Quality	S W 9, 11, 13, 22 O T	S 16 W 16, 21 O T		S W 9, 16, 17 O T	S W 1, 2, 3, 6,7, 10, 14, 15, 16, 18, 21, 25, 26, 30 O T 1, 2, 7, 8, 20, 21	S W 16, 17 O T	S 1, 2, 8 W 1, 2, 8 O T	S W 1 O T	30 Not duplicate: (ND) 19
Production: Plantation		S 5,16 W 25 O T							3
Production: Processing, Drying & preservation		S W 5, 14, 15, 16,							5

		18 O T							
Total Production Chain									ND: 20
Market knowledge South		S W 3, 6, 9, 11, 13, 18, 22 O T							7
Transport		S W 2, 7, 14, 16, 17, 20, 21 O T	S W 15, 18 O T						9
Product Design / Innovation: Culm			S W 20, 29 O T						2
Product					S	S	S		9

Development					W 1, 4, 5, 7, 10, 25, 27 O T	W O 1 T	W O 1 T		ND: 8
Product Development: Inclusion Designers					S 25 W 1, 2, 3, 5, 7, 8, 10, 11, 13, 14, 15, 17, 19, 20, 21, 22, 25, 26, 27, 28 O T				20
Total Product Development									ND: 22
Image		S 2, 3, 22, 25, 26, 27, 28, 31 W 2, 3,5, 6, 8, 9, 10,	S W 1, 2, 4, 7, 14, 15, 17, 18, 19, 22, 29 O			S 1, 2, 5, 6, 7, 8, 17, 18, 23, 24, 27, 28, 31 W 6, 7, 8			42 ND: 28

		11, 12, 13, 19, 22, 25, 27 O T	T			O T			
FSC lobby		S 5, 10 W O 1, 2, 3, 4, 6, 7, 8, 9, 10, 11, 12, 13, 14, 16, 17, 18, 19, 20, 21, 22 T 1, 4, 7, 8, 12							21
Lack of Distribution Channels and Knowledge		S W 5, 7, 8, 22, 25 O T			S W 1, 4, 5, 6, 7, 8, 10, 11, 12, 13, 14, 17, 18, 19, 20, 21,		S W 1, 2, 8, 14, 18, 21 O T		32 ND: 21

					22, 23, 24,25, 30 O T				
(Choice of) Market		S W O 7, 8, 11, 13, 16, 22 T 1	S W O 1, 7, 8, 11, 14, 15, 16, 29 T		S 19 W O 1, 2, 3, 4, 5, 10, 14, 18, 20, 22, 25 T 20		S W O 1, 2, 8, 14, 18, 21 T	S W O 1 T	34 ND: 20
Promotion / Branding		S W O 4, 6, 11, 20 T			S W 5, 6, 7. 10, 11 O 2, 3, 4, 5, 7, 10, 11,12, 16, 17, 19, 20, 21 T	S 5, 6 W 19, 22 O T	S 1, 2, 7, 12 W 1, 2, 21 O 2. 7. 14 T	S 1 W O T	33 ND: 18
Promotion / Branding: Bamboo as Emotional		S W O 4, 6,							9

Product		8, 9, 11, 13, 18, 20, 22 T							
Promotion / Branding: Product Champion					S W O 1, 2, 3, 5, 7, 8, 10, 11, 13, 14, 15, 17, 19, 20, 21, 22, 25, 26, 27 T				19
Promotion / Branding: Building Industry					1, 3, 4, 5, 6, 7, 10, 18, 22, 26, 30 S W O 1, 3, 4, 5, 6, 7, 10, 18,				11

					22, 26, 30 T 4, 5				
Promotion / Branding: Reputation after Launch	S W O T 2, 4, 5, 9, 10, 11, 20, 21								8
Total Promotion									ND 27
Trends General	S W O 3, 10, 11, 13, 17, 18, 19 T 3, 10, 11, 13, 17, 18, 19			S W 9, 16, 17 O T					10 ND 9
Trends: Imitation of Natural Materials	S W O								5

	T 6, 14, 15, 18, 19								
Trends: Interior Furnishing		S W O 3, 5, 6, 18, 20, 21, 23 T	S 18 W 2, 5, 6, 18, 19, 20 O T						13 ND 9
Trend total									ND 17
Utilization: Outside Splitting, etc			S 2, 16 W 7, 8, 9, 14, 25 O T						7
Utilization				S W 17, 9 16 O T		S 6 W 1, 2, 17 O T			7 ND 6
Utilization total									ND 9