ACHIEVING SUSTAINABILITY IN FOREST-BASED INDUSTRY

ZAGREB 2024

KAPUTA - MAŤOVÁ - RÁCZ - WANAT - LOUČANOVÁ - NOSÁĽOVÁ - OLŠIAKOVÁ - NOVÁKOVÁ - SKÝPALOVÁ - PAULIKOVÁ - MÁLEK - SLAVOVA - MILOSHEVSKA JANAKIESKA - STASIAK BETLEJEWSKA - ŠATANOVÁ

ACHIEVING SUSTAINABILITY IN FOREST-BASED INDUSTRY

Scientific book

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Editor-in-chief: **Prof. Denis JELAČIĆ, PhD. – Croatia**

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PREFACE

WoodEMA, i.a. is an international association for economics and management in wood processing and furniture manufacturing establihsed in the year 2007, with members from 19 countries on 3 continents. Since one of the main goals of the association is to promote science and results of scientific and professional work of its members, Association decided to start issuing scientific books. Each scientific book will be dedicated to a different topic and it will be related to a different field of expertize of the Association and its members.

This year we agreed that the topic for this issue should be dedicated to ACHIEVING SUSTAINABILITY IN FOREST-BASED INDUSTRY. Some of our members, but some non-members as well, who have research activites in fields of expertize related to the main topic are involved in creating of this scientific book. In this issue we have 8 chapters with 15 authors from 5 European countries who presented their research results in the area of sustainability, recycling, reusing and green innovations, related specifically to forestry, wood processing and furniture manufacturing.

Main goal of this scientific book is to stress the problems that forestry, wood processing and furniture manufacturing companies meet in their every day praxis, the way to solve those problems and to improve activities of that industrial branche using scientific methods and models.

This is the sixth scientific book issued by WoodEMA, i.a. to help collecting some knowledge and transfering that know-how further on. We hope to publish many other books this way providing scientific and professional help to our industrial branch in different managerial areas of expertize.

Editor-in-chief
Denis Jelačić

Authors of the chapters:

Chapter 1 – Vladislav KAPUTA, Hana MAŤOVÁ, Attila RÁCZ, Leszek WANAT, Technical Univeristy in Zvolen, Faculty for Wood Sciences and Technologies, Zvolen, Slovakia and Collegium Da Vinci, Faculty of Computer Science and Visual Communication, Poznań, Poland (**1,53 Authors Sheets**)

Chapter 2 – Erika LOUČANOVÁ, Martina NOSÁĽOVÁ, **Miriam OLŠIAKOVÁ,** Technical Univeristy in Zvolen, Faculty for Wood Sciences and Technologies, Zvolen, Slovakia (**1,05 Authors Sheets**)

Chapter 3 – Renata NOVÁKOVÁ, Renata SKÝPALOVÁ, Alena PAULIKOVÁ, Zdeněk MÁLEK, Ambis, a.s. Praha, Czech Republic and Slovak Association for Quality, Trnava, Slovakia (**1,07 Authors Sheets**)

Chapter 4 – Gergana SLAVOVA, University of Economics, Faculty of economics, Varna Bulgaria (**0,63 Authors Sheets**)

Chapter 5 – Leszek WANAT, Collegium Da Vinci, Faculty of Computer Science and Visual Communication, Poznań, Poland (**1,01 Authors Sheets**))

Chapter 6 – Marija MILOSHEVSKA JANAKIESKA, International Balcan University, Faculty of Engoineering, Skopje, North Macedonia (**0,92 Authors Sheets**)

Chapter 7 – Renata STASIAK BETLEJEWSKA, Czestochowa University of Technology, Czestochowa, Poland (**1,25 Authors Sheets**)

Chapter 8 – Anna ŠATANOVÁ, High School of International Management ISM Slovakia, Prešov, Slovakia (**0,79 Authors Sheets**)

CONTENTS

1. ACHIEVING SUSTAINABILITY – WITH THE CONSUMER OR THE CITIZEN?

Vladislav Kaputa, Hana Maťová, Attila Rácz, Leszek Wanat

1. INTRODUCTION

In this chapter we focus on the relationship between humans and their environment, specifically their pro-environmental decision-making. We present a synthesis of research findings on environmentally responsible man decision-making in psychological and social contexts. We consider this to be an important step in a deeper understanding of how, if at all, an individual 3can contribute to achieving sustainability. In particular, we are looking at the role of the individual – the man as citizen and the man as consumer – the value settings, attitudes and preferences that they more or less exercise in their purchasing decisions or manifest in their civic life. We present the results of research that analyses environmental citizenship in reflection with consumer decision-making and shows the link between mindful consumption and preferences for renewable materials.

As authors, we characterize the term sustainability as a concept of human endeavour leading society towards a paradigm based on prosperity of humankind that thrives socially and environmentally. Achieving sustainability is clearly an issue that the forest-based sector not only touches on, but is holistically involved in. With the assumption that the reader knows why this is so, we will only mention the main pillars: i) social (issues of decent work in the sector and employment in the regions), ii) environmental (arising from the nature of the resource - its renewability - the production of products and the provision of all the associated services, especially ecosystem services) and iii) economic (increase in welfare, rural development, innovation in processes and products, preferences for materials from renewable sources).

The home domain of the forest-based industry is the bioeconomy – and according to Moravčík et al. (2024) this is essential to achieving a balance between society, the environment, and economic development processes. The bioeconomy comprises those parts of the economy that use renewable biological resources from land and sea, suggests crops, forests, fish, animals and microorganism to produce food, materials and energy (EC, 2024).

In the effort to publish relevantly on the bioeconomy and the specificities of its markets, an interdisciplinary approach to our (academic) work cannot be circumvented. When studying consumers (and their choices) of products made from renewable materials, i.e. bioeconomy markets, we necessarily need to know their motives towards pro-environmental decision-making and behaviour. In this paper we therefore also draw on insights from psychology and sociology. This makes it possible not to relegate demand-creating individuals to the role of consumers only, but to examine the human

being and its (un)awareness in relation to the environment in a more holistic way. This approach allows us to understand consumer decision-making more comprehensively and also the (non)participation of individuals in social events.

When a person is actively involved in moving towards sustainability, we call this environmental citizenship. Dobson (2010) characterises it as 'pro-environmental behaviour' in public and private, driven by a belief in fairness of the distribution of environmental goods, participation and co-creation of sustainability policy.

2. THE PSYCHOLOGICAL CONTEXT OF PRO-ENVIRONMENTAL DECISION-MAKING

Research on environmentally responsible human decision-making often assumes that consumer decisions are motivated by individual values, but these are always situated in the context of given social dynamics. Because consumer decision-making is inherently complex and determined by many factors, in this text we specifically identify only those psychological processes that influence more environmentally responsible consumption.

None of us make decisions in a vacuum, because we all carry a rich variety of different value biases, ideologies and worldviews, and these tendencies of thought influence our decisions. This psychological context equally influences how we perceive environmental problems, as well as the extent to which we are willing to make pro-environmental decisions and cooperate in collective efforts to solve environmental problems.

Many environmental issues are very emotive for us because they are potentially life-threatening. For example, in the case of nuclear power or climate change, and this fact only further increases the importance of personal involvement. Moreover, the decision to act pro-environment can often involve some sacrifice of our life comfort: for example, increasing the cost of living by buying local organic food, or giving up daily use of the car – and such forms of behaviour are underpinned by our awareness that we are acting for the long-term collective good.

Rational choice theory and linear progression models explain pro-environmental behaviour and changes in it in the sequence: environmental knowledge → environmental attitude → environmental behaviour. By examining endogenous and exogenous factors, new models such as the theory of planned behaviour have emerged, working with the role of behavioural intentions as a mechanism linking beliefs and behaviour (Ajzen & Fishbein, 1980).

2.1. Environmental values

Scientific research on the relationship between values and environmental behaviour has a long tradition (Steg & Vleg, 2009). A value can be defined as "a desirable transsituational goal of varying importance that serves as a guiding principle

in the life of a person or other social entity" (Schwartz, 1992, p. 21). Our particular behaviour in environmental issues is predetermined by what we value. In this sense, research (Stern, 2000) has distinguished the importance of three basic types of values: egoistic (emphasis is placed on self), altruistic (emphasis is placed on the well-being of others), and biospheric (emphasis is placed on the good of the environment).

Several studies suggest that egoistic values tend to be negatively related to pro-environmental attitudes, intentions and behaviours, whereas altruistic and especially biospheric values are strongly positively associated with them (De Groot & Steg 2008; Steg & Vlek, 2009). A concrete example is provided by De Groot & Steg (2010) in their study in which participants were asked to express their intention to buy an environmentally friendly car and then donate it to environmental charities. Participants' environmental values were assessed along with their level of motivation. These were an indicator of the extent to which a person felt that they initiated and had control over their actions. Self-determined motivational types are more likely to perform pro-environmental acts and engage in activities that are perceived as more challenging (Villacorta et al., 2003). De Groot & Steg also found that participants who strongly endorsed statements such as "I like to contribute to the environment" - an example of intrinsic motivation - also scored high on measures of altruistic and especially biospheric value orientations (such as preventing pollution of the Earth). These findings led De Groot & Steg to recommend that practitioners try to promote pro-environmental choices by reinforcing people's biospheric values and intrinsic motivations, although the extent to which this is practical through large-scale interventions is questionable.

Based on the above research, we can observe that if we know which value is most important to a person, we can encourage them to behave according to that value. For example, if we want to encourage someone to buy a fuel-efficient car, we can argue that it is cheaper (egoistic type), or that lower pollutant emissions have a positive impact on people's health (altruistic type), or we can even argue that they have less negative impact on the whole environment (biospheric type).

2.2. Environmental values, personal experience and perceptual frameworks

It is not surprising that our environmental values are also shaped by personal experiences. For example, the experience of extreme weather events influences our attitudes towards environmental problems (Spence et al., 2011). Of course, extreme weather can be habituated to, so that exceptional extreme fluctuations have the greatest impact on changes in our values and life priorities, but subtle gradual but systematic changes, less so. Increased rainfall in a given area is only "noticeable" to the average person if, for example, the average quarterly rainfall is "condensed" into 3 days. But if, for example, we experience more rainy days in a given time period than before, we tend to overlook this change – which is also why it is difficult for us to notice environmental problems, because they often develop relatively slowly over longer time scales.

Another important factor to consider is (although it should not be) that the way information is presented to us also has a significant impact on our decision making (Sterman & Sweeney, 2007). Every attempt to solve an environmental problem begins with a question, but that question itself inevitably narrows and therefore frames the problem in some way. In general, people tend to accept pre-existing frames of perception of a given problem and seek to maintain the status quo that serves as a reference point for its interpretation (Goldstein et al., 2008). For example, encouraging people to use energy more efficiently is a better solution than framing the problem along the lines of limiting energy consumption, as the latter emphasizes loss, which potentially provokes resistance. Hardisty et al. (2010) in a study report that people are more willing to pay an extra fee when buying an air ticket if the fee is charged to them as a 'carbon offset' rather than a 'carbon tax'.

Previous personal experiences greatly influence our subsequent decisions. This phenomenon can also be viewed as a kind of spatial proximity and distance factor (Hardisty & Weber, 2009). Specifically, the less we perceive the negative effects of an environmental change, the more likely we are to think in the short term - and thus, factors such as price and convenience will be more important in our consumption decisions, compared to distant climate change or the threat of soil erosion sometime in the future. As if it doesn't matter how concrete or abstract a given environmental problem is - it's the remoteness in time that matters. The latter also greatly reduces our sense of anxiety and therefore we tend to make decisions based more on immediate benefits.

However, research by White et al. (2011) shows that we can also find solutions to more distant and abstract environmental problems (e.g. the vision of a sustainable society) – and this is in the spirit of the 'think globally, act locally' principle. We can achieve abstract 'global' goals through concrete 'local' actions, such as installing solar panels on our homes or sorting our waste. Thus, even abstract thinking can be positively oriented in our environmental decisions.

However, the extent to which people feel motivated towards environmentally friendly choices remains an important question. Experience shows that one of the best 'motivators' is unfortunately bad personal experiences - for example, with climate change such as floods or hurricanes. These act as an intense 'incentive' for individuals to show a willingness to participate in the implementation of environmental protection measures. Research by Howe et al. (2013) shows that people are sensitive to climate change and are concerned about the outcome of climate change. Green policies can find a receptive environment in a certain segment of the population, which then makes it easier to implement pro-environmental decisions.

3. THE SOCIAL CONTEXT OF PRO-ENVIRONMENTAL DECISION-MAKING

The existence of social rules is as old as humankind itself. A series of social psychological research supports the fact that implicit and explicit social norms (Sherif, 1965) about rules of conduct strongly influence people in what environmental choices

they make and how they act (Cordano et al., 2011). Both normative (prescriptive) rules (what people approve of or think should be done) and descriptive (descriptive) rules (what people actually do) strongly influence the extent to which people can be persuaded to participate in environmentally important actions, such as energy conservation or recycling projects - and also in overall pro-social behaviour (Krupka & Weber, 2009). Pro-social behaviour is voluntary behaviour that is helpful, sharing, and cooperative, with the benefits accruing to others or to society as a whole in terms of the end result (e.g., blood donation or volunteering). Of course, there may be other individual motivations behind a prosocial act, but in terms of the end result, a person's participation in an activity is positive for the community.

In many cultures, research has shown that social norms are closely related to pro-environmental behaviour, so that we can infer from social norms what pro-environmental behaviour we can expect for a given community (Smith et al., 2012). On the other hand, if different social groups to which an individual belongs - family, friends, school, workplace - have different views on environmental issues, this can cause internal conflict. In such cases, an environmentally friendly lifestyle does not seem nearly as attractive to the individual, and in a given reality, the intention to make a pro-environmental decision often declines sharply.

In addition to the social impact, environmental decisions can also influence stated social goals - especially if we make them an issue of social prestige. Research has shown that social status can also motivate people to behave pro-environmentally, especially if their 'green' decision is widely publicised (Griskevicius et al., 2010). In the same way, the high descriptive environmental standards of workplace managers, for example, can have a significant influence on the pro-environmental mindset and actions of their subordinates (Robertson & Barling, 2012).

3.1. Pro-environmental decision-making and worldview

The environmental worldview captures a person's general beliefs about the relationship between humans and the environment (Price et al., 2014). The New Ecological Paradigm (NEP) is now a commonly used tool for assessing environmental worldview. For example, test results of the NEP measurement scale revealed that altruistic values are positively related and egoistic values are negatively related to environmentally conscious beliefs (Dunlap, 2008).

Another research model used in this context is the Cultural Cognition Theory (CCT), which is based on the hypothesis that more scientifically literate individuals are more interested in environmental issues (Kahan et al., 2011). Classifying people's worldviews according to this dimensional structure is related to their level of acceptance of current scientific consensus views (e.g., on climate change and nuclear waste disposal), but it is also related to broader cultural and non-environmental issues. Research has not yet confirmed the validity of this hypothesis; on the contrary, other research later conducted by Kahan et al. (2012) found that differences in perceptions of climate risks are much better explained by culturally contingent differing worldviews

rather than scientific literacy. In any case, however, the research teams in question agreed that alongside basic scientific literacy, communication by the scientific community is equally important to provide information to the general lay public so that people can make more relevant decisions on environmental issues.

Extreme differences in worldview predispositions can therefore lead people to take even extremely contradictory views on environmental issues. For example, in the context of scepticism about the consensus scientific view that humans are causing global climate change, much research has documented that the individual psychological causes and motivations of its authors are the underlying basis for this rejection (Dunlap, 2013). Research examining this phenomenon has come to the interesting conclusion that even "deniers" on environmental issues can be pro-environmentally motivated as long as the results of climate change mitigation efforts are described in ways that they find appealing (Bain et al., 2012). Specifically, in this case, it may be a positive incentive if the reasoning emphasizes the fact that the overall sense of well-being and satisfaction among individuals in a given society will increase as a result of emission reductions.

In summary, several socio-psychological research studies support the fact that it is possible to present environmental issues in ways that encourage pro-environmental decisions among different groups. This is despite their worldviews and ideological differences - it is just a matter of finding the right arguments and incentives.

3.2. Individual and collective interests

Many environmental problems can be analysed as examples of mixed-motive decisions, where individual interests and collective interests are often in conflict with each other, which can create a number of social dilemmas. The degree to which an individual chooses to sacrifice his or her interests for the common good is influenced by many factors, including communication with group members, sanctioning (in the form of rewards or punishments), or the system of norms of a given community (Balliet et al., 2011).

Community members are best able to work together effectively if the expected positive consequences of their efforts can be well quantified. However, the greater the uncertainty factor of outcomes, the more the cohesion and motivation of a given community is eroded (Brucks & Van Lange, 2008). It is just that in the case of global environmental problems, there is typically a high degree of outcome uncertainty (consequences that do not manifest immediately), which is not conducive to people tending to act together when managing global problems.

One important factor in individuals' decisions to work together towards a common goal is their knowledge (or expectations) of what other members of the community are doing. Weber & Murnighan (2008) reached interesting results when examining the extent to which an individual's behaviour can influence a group. In their experiments, they showed that if that person exhibited consistent cooperative behaviour regardless

of the outcomes and decisions of other members of that group, then that individual's positive example served as a sort of "catalyst" for that entire group.

The social context plays an important role in environmental decision-making. This is because a given social context fundamentally influences the way we understand appropriate behaviour in response to environmental threats, as well as our willingness to engage in individual environmental activities while being able to make collective cooperative decisions. Although research suggests the severity of social influence on our pro-environmental decisions, research will continue to be needed to identify ways to overcome these barriers - especially in the context of environmental risk outbreaks.

4. THE ECONOMIC PRISM OF THE MAN-CITIZEN AND MAN-CONSUMER VIEW

Economics studies how and why people (as consumers, corporations, NGOs, the public sector or government agencies) make decisions about the use of valuable resources. Preferences are a normative criterion in studies dealing with individual choice among alternatives, and the decision is determined by individual preferences. The ethics of economics draws on utilitarianism. This is a principle of value assessment where utility refers to the balance of pleasure and suffering of an individual (Kaputa et al., 2020.). Normative economics only considers utility for people (anthropocentric approach), which has earned criticism from people with an eco or bio-centric approach to the environment. E. g. interesting approach towards the value of nature which could be called (for now) neo-anthropocentrism worked out Aldo Leopold - an American scientist and forester. Here, nature not only has value for man but also for its own value (Androvičová and Rácz, 2017).

The widely applied principles of mainstream economics face criticism from various platforms. The arguments of mainstream economics are at odds with interdisciplinary economic approaches to environmental problems. Norton (1994) argues that the model of economists (read neoclassical - mainstream economics) is not unhelpful, as information about preferences can inform information about environmental values. However, he argues that preference models provide only one approach to the valuation problem and that the usefulness of preference studies is enhanced when supplemented by a broader, more comprehensive treatment of other aspects of environmental values. Norton finds interdisciplinarity useful and notes the importance of an intergenerational approach. At the heart of the search for a sustainable society, should be dynamic, intergenerational issues that involve the protection and development of a relationship with the land.

The interdisciplinarity that many academics seek in their research has not yet managed to overcome political and social barriers and therefore we do not see it in practice.

4.1. Private and public interest

Man, as a consumer, is concerned with his private interests and thus with the pursuit of preference satisfaction. As a citizen, however, one is concerned with the 'public interest', where one enters into a debate about matters that are meaningfully related to the values of what is moral, right and best for the whole of the society with which one identifies (Ariely, 2009; Sagoff, 1988; Keat, 1994; Bodenhausen, 2012).

This "dual setting" of man has been investigated in various studies. For example, respondents in Ariely's study (2009) worked harder under the influence of non-monetary social norms than in paid work. There are many examples that show that people are more willing to work for a good cause than for money. Companies have used this insight and, in addition to applying it to customers, they also try to apply social norms to their employees (the way they communicate with the employee, the choice of incentives). They thus benefit from the blurring of the boundary between work and leisure (not as a case of 'exploitation'). However, there are professions where it is necessary to put one's health and life on the line (firefighters, armed forces, paramedics, mountain rescuers), or professions that bring social benefits (management of natural resources). They are motivated to do so not by market norms (private interest, preferences) but by societal norms (public interest).

4.2. Consumer

Conscious consumer purchasing decisions can start with the question: "Is this product good for the people or the environment in which it was made or in which I live?" or "Will I buy it at all?". Mindful consumption means that when making a purchase, individuals think not only about price and quality, but also about factors such as the impact on labour in the region/country where the product was produced; the impact on their own health and the health of others; the working conditions under which it was produced; the impact on the environment (in production, in use, at the end of its life); or consideration of the quantity they are buying.

To effectively deal with the problem of overconsumption, both behaviour and mindset need to change. *Mindful consumption* is premised on consciousness in thought and behaviour about consequences of consumption (Sheth et al., 2011). Jackson (2005) sees mindful consumer behaviour as a preference for sustainable, environmentally friendly products and services, supporting local producers, reducing waste and sorting waste. Stern (2000) points to the direct environmental impact of environmentally relevant private behaviour. This includes consumer choices (referred to as sustainable consumption, conscious consumption) in terms of purchasing environmentally friendly products, avoiding purchases from environmentally damaging companies, as well as activities such as energy conservation in the home, responsible waste management (non-pollution, recycling) but also transport (travel behaviour) and maintenance of household appliances.

How deep/shallow is the pro-environmental attitude of consumers in Slovakia helps to find out the study of Matova et al. (2024), in which consumers are segmented Slovakia into unique "green" groups based on their affinity for "green" purchasing decisions.

4.3. Citizenship

The problem is if companies respond to the need to stop overconsumption (due to economic rationality) only by implementing "sustainable policies", thus reducing Environmental Citizenship to the act of sustainable consumption. As Cao (2017) argues, this transforms green citizenship into green consumerism. The extent to which market rules are embedded in social and political relations leads some authors (Sandel, 2012) to argue that we are transforming from societies with market economy to market societies.

Cao (2008, p. 14) understands environmental citizenship to include not only group membership, but also rights (to clean air and water), duties (not to pollute), and means of education (education and awareness campaigns). Individuals can effectively exercise environmental citizenship in local community activities. In the encyclical 'Laudato si' there is an example of the formation of local cooperatives for the use of renewable energy sources, which ensure local self-sufficiency and even the sale of surplus energy. The encyclical explains that if the existing world order proves powerless to assume its responsibilities, local individuals and groups can bring about real change. Corruption causes a lack of law enforcement and therefore public pressure is needed to bring about decisive political action. Unless citizens control political power - national, regional and local - it will be impossible to control environmental damage (Francis 2015, p. 131). The difference in approach, depending on whether individual or societal benefit is at stake, is described by Cooper and Hart (1992, p. 22) when they argue that people as consumers seek to maximise their own materialistic needs, whereas as citizens they are concerned with what constitutes a 'good society'.

5. METHODS

The inquiry was thematically focused on mindful consumption and its relation to environmental citizenship. We prioritized decision-making factors in relation to preferences for products from renewable sources, especially wood products.

Prior to the survey, the questionnaire was piloted on a sample of 25 respondents. The survey itself was conducted electronically using a questionnaire (Google Forms) that included demographic and factual questions. It was disseminated via social media between March-April 2024 in the Slovak Republic. A non-probability sampling method – the snowball sampling technique – was used. After cleaning from incomplete questionnaires, univariate and bivariate analysis was performed on data from 136 correctly completed questionnaires. In the bivariate analysis of the collected data, we

looked for associations between the demographic characteristics of the respondents and their responses to the selected questions and between the selected substantive questions from the questionnaire. Pearson chi-square test of independence was used to examine the relationship between variables and Cramer's V and Pearson's contingency coefficient were used to examine the strength of associations between variables. When analysing the data in contingency tables, we respect the following condition: all expected frequencies in the contingency table must be Eij>1 and at least 80% of Eij>5 at the same time (due to the small sample size). Statistical dependence was observed at a significance level of $p<0.05$.

The research preparation, questionnaire design, description of the collected data and interpretation of the results were carried out considering the meaning of the terms defined in the Section 4.

Environmental Citizenship is defined as the responsible pro-environmental behaviour of citizens who act and participate in society as agents of change in the private and public sphere, on a local, national and global scale, through individual and collective actions, in the direction of solving contemporary environmental problems, preventing the creation of new environmental problems, achieving sustainability as well as developing a healthy relationship with nature. Environmental Citizenship includes the exercise of environmental rights and duties, as well as the identification of the underlying structural causes of environmental degradation and environmental problems, the development of the willingness and the competences for critical and active engagement and civic participation to address those structural causes, acting individually and collectively within democratic means, and taking into account inter- and intra-generational justice (ENEC, 2018).

6. RESULTS

Analysing the data, we found six statistically significant relationships between the responses to the questions (Tab. 1).

As many as 96.3% of respondents used the voluntary option to indicate their closeness of opinion within the political spectrum. The largest group is centre-oriented (44%), right-oriented is 30% and left-oriented is 26% of respondents. The results show a relationship between respondents' involvement in civic activities and their sympathies with a particular political spectrum (Tab. 2).

The association between the responses to these two questions, although weak according to Cramer's V, is statistically significant at the $p<0.05$ level of significance (Tab. 1). Overall, almost 30% of all respondents say they are engaged in civic activities and almost 50% of all respondents say they are not engaged. It can be noted that almost 52% of the right-oriented respondents in the sample claim to have been actively involved in civic activities (e.g. at the local community level), compared to only about 12% of the left-oriented respondents. Of the centre-oriented respondents, it was about 24%. The lowest percentage of neutral responses is recorded among right-oriented respondents – 13% of all right-oriented respondents and (at the same time) the lowest

percentage of the whole sample of respondents (3.8%). Up to about 68% of politically left-oriented respondents were not involved in civic activities, which is an interesting Slovak (or even Central-European) specificity. We do not comment further on this finding; it deserves a deeper analysis in a separate study.

Table 1 Statistically significant differences in responses

Questions' content		Pearson chi-square			Pearson contingency	Cramér's V
		Chi-square	df	p		Effect size
1.	Respondent's political preference vs. Have you been involved in any citizenship activities?	16.74967	df=4	p=0.00216	0.3366975	0.2528439 small
2.	Gender vs. Do you agree with the statement that the consumption of goods in developed countries, including Slovakia, causes a large ecological footprint (burden) in countries where goods are produced?	7.819653	df=2	p=0.02004	0.2339913	0.2406727 small
3.	Do you make mindful buying decisions often? Vs. Is the eco-label (about environmental impact) critical for you when buying certain products?	22.11889	df=4	p=0.00019	0.3740157	0.2851657 small
4.	Do you make mindful buying decisions often? Vs. Is a Fair trade label (e.g. Fair Trade) a decisive factor for you when buying certain products?	34.97802	df=4	p=0.00000	0.4523009	0.3586024 moderate
5.	Do you make mindful buying decisions often? Vs. Is the country of origin decisive for you when buying certain products?	11.51944	df=4	p=0.02131	0.2794416	0.2057933 small
6.	Do you make mindful buying decisions often? Vs. When you are shopping and have a choice between products, do you consider the fact that they are made from renewable materials?	17.94124	df=4	p=0.00127	0.3413884	0.2568277 small

Table 2. Exploring civic engagement within a political orientation

Respondent's political preference	Have you been involved in civic activities? That is, at the local community level (social, environmental, health, arts, etc.)			
	YES	NEUTRAL	NO	Total
Right-oriented	20	5	14	39
Column %	52.63%	17.86%	21.54%	
Row %	**51.28%**	**12.82%**	**35.90%**	
Center-oriented	14	16	28	58
Column %	36.84%	57.14%	43.08%	
Row %	**24.14%**	**27.59%**	**48.28%**	
Left-oriented	4	7	23	34
Column %	10.53%	25.00%	35.38%	
Row %	**11.76%**	**20.59%**	**67.65%**	
Total	38	28	65	131
Grand Total	**29.01%**	**21.37%**	**49.62%**	100%

A statistically significant association (at a significance level of $p<0.05$) was proven between the gender of the respondent and the attitude towards the statement: "The large environmental footprint in countries where goods are produced is due to the consumption of these goods in developed countries, including Slovakia" (Tab. 1). Approximately 65% of all respondents agreed – with up to 75% of women and only 25% of men (Tab. 3). On the contrary, 10% disagreed and 25% of the sample of

respondents took a neutral position. These findings suggest that the women in our sample are seeking (are aware of) deeper relationships between their local purchasing decisions and their global impact.

Table 3 Exploring environmental footprint awareness among men and women

Gender	Do you agree with the statement that a large environmental footprint (burden) in countries where goods are produced is caused by the consumption of these goods in developed countries, including Slovakia?			
	YES	NEUTRAL	NO	TOTAL
Woman	66	21	5	92
Column %	75.00%	61.76%	38.46%	
Row %	71.74%	22.83%	5.43%	
Man	22	13	8	43
Column %	25.00%	38.24%	61.54%	
Row %	51.16%	30.23%	18.60%	
Total	88	34	13	135
Grand Total	65.19%	25.19%	9.63%	100%

A statistically significant relationship was also found for the question: "Do you make conscious purchasing decisions often?" and "Is the environmental label a deciding factor for you when buying certain products?" (Tab. 1). Just under 52% of all respondents say that they make conscious purchasing decisions (we will refer to them as "mindful") and over 15% of respondents say that they do not make mindful purchasing decisions often (we will refer to them as "not mindful"). Almost 48% of the "mindful " respondents say that the environmental label is crucial for them when buying products, in contrast to the "not mindful" respondents, where only 9.5% of them say so. Conversely, almost 62% of " not mindful" respondents say that the environmental label of a product is not critical to them. The question on product environmental labelling was followed by an open-ended question (For which products do you mostly do so?) designed for respondents (36%, 49/136) who consider it crucial when buying products whether the product carries an environmental label. The most frequent answers to the open question were as follows: food, drugstore goods, clothing.

Another statistically significant relationship is for the questions, "Do you make conscious purchasing decisions often?" and "Is a righteous trade label (e.g. Fair Trade) a deciding factor for you when buying certain products?" (Tab. 1). Of the "mindful" respondents (52% of the whole sample), almost 40% say that the righteous trade label is decisive for them, but up to almost 47% have a neutral attitude. For almost 72% of "not mindful" respondents the righteous trade label is not crucial. Also important is the fact that almost 55% of the respondents who answered neutral to the question on conscious purchasing decisions also expressed a neutral attitude towards the question on righteous trade.

A dependence (at the $p<0.05$ level of statistical significance) was found between responses to the question: "Do you make mindful purchasing decisions often?" and "Is the country of origin decisive for you when buying certain products?" (Tab. 1). Of the

"mindful" respondents, 77.5% say that the country of origin of the product is decisive for them when making a purchase. Another 20% of them expressed a neutral attitude here. Interestingly, 52% of the "not mindful" respondents claim that the country of origin of the product is a deciding factor for them when making a purchase. Another 24% of the "not mindful" respondents here expressed a neutral attitude and 24% of them also expressed disagreement. Interestingly, 59% of the respondents with a neutral attitude towards mindful decision making when buying products say that the country of origin is a deciding factor for them. Thus, a total of 68% of all respondents in the sample say that the country of origin of a product is important to them when making a purchase.

Following this, we asked respondents in an open-ended question whether there are “regions/countries from which they do not prefer goods”. Only 9% of the sample of respondents do not have such countries, but up to 59% gave some reason. In general, the answers were: countries from where logistics are difficult and/or lengthy; countries with polluting environments and/or unsuitable working conditions. Of those Slovaks who listed a reason or country, 34% did not prefer goods from Asian countries and 24% listed Poland (in this case they specifically mentioned avoiding Polish food).

On the topic of renewability, a statistically significant relationship was found for the questions: "Do you make conscious purchasing decisions often?" and the question: "When you are shopping and have a choice between products, do you consider the fact that they are made from renewable materials?" (Tab. 1). Of the "mindful" respondents, 62% agreed with the second question, 7% disagreed and 31% were neutral on this question. Of the "not mindful" respondents, 43% do not consider the factor of renewability, 29% took a neutral position, and the same 29% of the "not mindful" respondents say that they consider whether products come from renewable materials when choosing products. The bizarreness of this statement suggests that renewability plays a role in purchasing decisions even for a proportion of those respondents who reported that they do not make mindful decisions often. Additionally, it can be noted that the factor of renewability of materials is also taken into account in purchasing by 43% of respondents with a neutral attitude towards whether they make mindful purchasing decisions.

Table 4 Proportion of responses to questions (N=136)

Questions	YES (%)	NO (%)	NEUTRAL (%)
Is the eco-label (about environmental impact) critical for you when buying certain products?	36.03	25.74	38.24
Is a Fair trade label (e.g. Fair Trade) a decisive factor for you when buying certain products?	25.00	30.15	44.85
Is the country of origin decisive for you when buying certain products?	67.65	10.29	22.06
When you are shopping and have a choice between products, do you consider the fact that they are made from renewable materials?	50.74	16.18	33.09

Tab. 4 shows the percentage of responses of all respondents to the questions of the four dependencies (statistically significant) found mentioned above (the others are

shown in the previous tables). The importance of a broader range of purchasing factors for different wood products has been addressed (in the context of several European countries) in previous works (Paluš et al., 2012; Kaputa et l., 2018; Jošt et al., 2020; Barčić et al., 2020) – published by WoodEMA members.

It is clear from the data in Tab. 4 (as well as from the previous works mentioned above) that the country of origin and the renewability of the materials from which the product is made are important purchasing factors. The statistically significant dependence described above between the answers to the question on mindful consumption and the consideration of the fact that the product comes from renewable materials points to the importance of wood-based products. This is because the question 'on renewable materials' used an illustrative figure showing preferably wood/paper and plant-based products (including bamboo). Moreover, the above analysis shows that this is not only true exclusively for the part of consumers who consider their purchasing decisions to be mindful.

Also interesting from the results is the higher proportion of respondents with a neutral attitude towards the importance of the eco-label on the products they buy. Taking into account also the above described in the analysis proportions of respondents with neutral attitudes towards products labelled with the “Fair Trade” label, we would like to conclude that consumers with neutral attitudes are certainly the most interesting group for targeting pro-environmental education (including also the social factor) or education towards mindful/conscious consumption. On the contrary, a person actively acting on a civic platform (also in line with the definition of the Environmental Citizen) is himself raising the awareness of others – he/she is thus not only the target of such education, but also the bearer and disseminator of information on environmental issues and challenges (agent of change).

7. CONCLUSIONS

The word sustainability is becoming a socially and commercially vague term due to time and overuse. This is probably also the case in the scientific community, but the urgency of environmental challenges has not changed. More radical solutions (urgently in both social and environmental goals) are needed today in the pursuit of sustainability. These may impose costs on parts of the population that they consider unfair (the social factor). In the text, we present pro-environmental education aimed at mindful consumption (as opposed to consumerism) and openness to discourse and action as a way of seeking consensus in public affairs (as opposed to unilateral political decisions). In this context, Bedsted (2019) points to signs of 'resistance to sustainability' in the context of the election of Trump and the yellow vests movement in France. He argues that democracy is a prerequisite for sustainable development and that educators and scientists should see themselves as facilitators of social dialogue rather than environmentalists and activists.

Decision-making of citizen takes place in public discourse. It explains and defends the values it believes in and takes positions on how to solve environmental problems.

When we talk about environmental challenges, they refer to the interaction of humans with their environment. Decisions are made (and sought) in exertion – the ability to persuade, to seek appropriate arguments and tools to achieve them. Solutions are in the nature of a compromise that emerges from the agreement of the groups involved.

The contemporary consumer has it easier in some respects. Decisions are largely made not by consensus, but on the basis of individual preferences. Parallel to the political vocabulary, we can say that he votes by his purchasing decision. In line with the marketing concept, businesses compete in revealing his needs but also his wants. It thus indicates the direction in which the production of goods and the supply of services is heading. It can be noted that such competitive efforts of enterprises are positively reflected in their motivation (and in certain sectors necessity) to be included in the innovation flow.

Turning attention back to the bioeconomy, we can see that although it does not automatically lead to more sustainable production and consumption processes, it has the potential to contribute to the sustainability goals. In a study of research on the economics of innovation and consumer responsibility (Wilke et al., 2021), there are arguments pointing to consumers as potentially active agents who share responsibility with other actors in the system of transition to a sustainable bioeconomy. Wilke et al. (2021) find that the consumer is considered a largely passive actor within the bioeconomy literature, which the authors argue is questionable to say the least and requires further research, particularly in light of the increasingly blurred boundaries between consumers, producers and citizens.

The results of our research show a still large proportion of consumers with neutral attitudes towards environmental issues – in the language of the young: "I don't deal with it". It is questionable whether the respondents who labelled their purchasing decisions as “mindful” are acting in this way. In fact, this self-determination means that they take into account a number of factors, or that their choices have certain frameworks (patterns) which - and only some of them (!) – apply when choosing products. This includes country-of-origin preferences, and labelling – whether environmental or fair trade. However, attitudes towards the renewability of the materials from which goods are made are interesting, as this factor is also considered by a proportion of respondents who did not identify themselves as mindful. It is worth highlighting that a significantly larger proportion of women in the sample showed a deeper awareness of the (social and environmental) impacts of their local purchasing decisions on a global scale – production in offshore locations and consumption of these goods in developed markets. Based on the results, we still see a wide scope for education here – and this should have spillovers to individuals' private (consumer) preferences as well as their public (civic) engagement.

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2. GREEN INNOVATIONS AND GREEN CONSUMERS ORIENTED TOWARD A LIFESTYLE CONNECTED WITH NATURE

Erika Loučanová, Martina Nosáľová, Miriam Olšiaková

1. INTRODUCTION

The relationship between humans and nature has been discussed throughout human history. In recent years, the idea of being connected to nature has become an increasingly important transdisciplinary research topic (Beery et al., 2023). Nature connectedness is understood as the degree to which a person possesses the quality of feeling a connection to the natural environment as a possible way to foster emotional connections (Dong et al., 2019; Kautish et al., 2024). The expressions "love for nature" and "nature connectedness" basically refer to people's intense passion for the natural world and its surroundings. People's emotions, convictions, and inclinations toward the natural environment are typical characteristics of these relationships (Kautish et al., 2024).

The degree to which a person feels a connection to the nature can be a good indicator of their love of the nature leading to behavior that is helpful to the environment, such as buying green products (Kautish et al., 2024). Consumer interest for natural products has increased in the last several years. The authors describe this kind of drive as biophilia, or the love of nature. Declaring a product's natural state is in line with current consumer tendencies toward sustainable and healthful consumption (Velasco et al., 2023).

People are much more concerned about the environment now that environmental issues are more widely known. These issues have a variety of effects on consumer behavior, including choices and purchase patterns (Ogiemwonyi et al., 2023). The environment is the primary factor influencing the diverse range of product choosing behaviors among consumers, aside from their own behaviors. In a comparable way, one's decision-making regarding goods purchases may be impacted also themselves (their family) or the environment. In addition, each individual consumer may have different variables influencing their decision on purchase, such as disparities in their gender, age, education, job as well as monthly spending on food and beverage goods (Rahmah and Satyaninggrat, 2023).

Based on the aforementioned, an upcoming term in the field of interest—lifestyle—has a big impact on what customers decide to buy. Lifestyle is a newer concept as the pattern in which people live and use or spend money and time (United Nations, 2018). Due to the changes in people lifestyles, the access to environment, wildlife, and green places around us has been restricted. According to the data of United Nations (2018) currently, 55% of people on Earth reside in cities; by 2050, that number is expected to rise to 68%. Actual changes in lifestyle manifested in the form of the apartment culture of housing, smaller and dense communities, as well as increased use of television, internet and mobile phones worsened the situation (Mahato and Ekka, 2023).

Public health and environmental sustainability present two of the most significant global challenges of the 21st century (WHO, 1997), while, for example, Martin et al. (2020) points out on an increasing recognition that these two challenges are inter-

connected. Numerous health and sustainability-related outcomes are linked to both psychological connectivity and physical contact with nature. There is now growing evidence that daily exposure to nature and fresh air is essential for optimising overall physical and mental health (Sundermann, 2023). It was discovered that particular forms of engagement with nature, together with individual variations in nature connectivity, had distinct associations with elements of health, happiness, and pro-environmental actions (WHO, 1997). This is also confirmed by several studies. For example Abookire et al. (2024) demonstrated that spending time in nature improves mental health in addition to its physical health benefits, or even King and Church (2013) who points out that interactions with the countryside are beneficial to the physical and psychological health of young people, as well as for their social, cognitive and educational development. Even with proof of nature's advantages, people are spending less time in the nature (Mahato and Ekka, 2023).

Thus, in recent years, green innovations emphasizing not only economic but also environmental and social elements have started to receive greater attention. In combining these three aspects towards sustainability, in terms of reducing overall emissions or existing environmental burdens and health risks, the overall ideas of healthy lifestyles and sustainable consumption have begun to be promoted (Loučanová and Nosáľová, 2020; Zuraidah et al., 2012). Purwono et al. (2023) point to an increased public's level of utilization of herbal products causing significant emerging of economic benefits. The key reason is that people are become more proactive about their health and looking for alternative forms of treatment to maintain it (Purwono et al., 2023). Also non-wood forest products are collected or harvested for commercial and medical purposes from forests. The most important factor affecting the purchasing preferences of consumers is freshness (Özkan and Deniz, 2023). Furthermore, new forms of natural therapies are becoming more and more popular. The scope of health benefits of forest bathing/forest therapy and of time in nature have been increasingly documented over four decades of research. One powerful advantage of Forest Therapy is that while it enhances the wellbeing of participants, it also expands our awareness of participating in a cooperative, reciprocal ecosystem, which we can emulate and advance in our healthcare delivery systems (Abookire et al., 2024).

Consumers' concern for the environment is growing as a result of the modern world. Their buying habits have started to reflect these worries, and environmental consciousness has given rise to a new market category known as "green consumers." Innovations in health maintenance and ecological practices focused on a lifestyle connected to nature can have a positive impact on people's lives. Since not every customer is equally environmentally conscious, consumer segmentation is required. In the following section, we focus on the possible link between environmental consumers' segmentation models and their interest in green innovation, spending leisure time, green behaviour and purchase, as well as different ways to appeal the consumer segment according to their characteristic and value orientation.

The NMI National Marketing Institute (2004) has developed the LOHAS - Lifestyle of Health and Sustainability segmentation model, which places consumers into one of five groups depending on their awareness and involvement in environmental issues as follows: LOHAS consumers, Naturalites, Drifters, Conventionals and Unconcerneds. Although we focused on the LOHAS model when we proposed the green consumers segmentation model, we also considered a number of segmentation studies as Ottman's segmentation (2024) as well as Ziaei-Bideh and Namakshenas-Jahromi model (2020). Our proposed model implements the categorization and characteristics

of these segments and provides its own perspective on segmentation model of environmental life style. There are the following market segments that can be named and described:

LOHAS CONSUMERS – are environmental stewards who use green products frequently, are socially conscious, and are motivated to preserve the environment. They take action and inspire others to follow suit in order to maintain the wellbeing of the earth and themselves.

- *Resource Conservers* – they hate waste. They prefer reusable packaging, sustainable clothing. They recycle and re-use, avoid over-packaged products. They are responsible users of energies and resources.
- *Animal Lovers* - they are concerned about animals, they treat them responsibly, their love for animals is reflected in their attitudes towards products, they are likely to be vegetarian or vegan.

These consumer groups present the features by which we can name and classify them by term of Ziaei-Bideh and Namakshenas-Jahromi model (2020) as *Intense greens.*

NATURALITES – they base the majority of their purchasing decisions on the advantages for their own health. They are not as involved in planetary health, despite their interest in environmental protection, which is mostly motivated by concerns for their own health.

- *Outdoor Enthusiasts* – they spend their free time in nature, camping, love for nature is manifested in their behavior, preferences, they seek to minimize the impact of their recreational activities. When shopping, they look for sustainable labels on their products, they are also likely to purchase products from recycled materials.
- *Health Fanatics* – they worry about the impact of products and behavior on their health, they prefer organic foods and natural cosmetics, they are well informed and educated about the impact on their health.

DRIFTERS – motivated by the latest trends, these consumers' commitment to any issue, including sustainability, is constantly shifting. General population in NMI defined consumer segments) youngest segment, DRIFTERS are more likely to view price as a barrier to green living.

CONVENTIONALS – they are not very concerned about the environment because they are more motivated by frugal living and pragmatism than by pure environmental benefits. On the other hand, they do participate in certain environment related activities, like energy conservation and recycling.

These consumer groups present the features by which we can name and classify them by term of Ziaei-Bideh and Namakshenas-Jahromi model (2020)] as *Potential greens.*

UNCONCERNEDS – represents the portion of the population that exhibits no sense of environmental responsibility.

These consumer groups present the features by which we can name and classify them by term of Ziaei-Bideh and Namakshenas-Jahromi model (2020) as *Browns.*

Subsequently, the Table 1 provides an overview of our proposed segmentation model of environmental life style of consumers, where their characteristics according to green behavior, as well as possible ways of marketing appeal of the consumer segment are present.

Table 1. Lifestyle Segmentation Models of Consumers (Source: Developed by the authors based on the literature sources NMI – National Marketing Institute (2004), Ziaei-Bideh and Namakshenas-Jahromi (2020) and Ottman (2024)).

Authors' models to lifestyle	LOHAS	Ziaei-Bideh and Namakshenas-Jahromi	Ottman	Characteristics	Ways to appeal the consumer segment
Types	LOHAS consumers	Intense greens	Resource Conservers Animal Lovers	- values-driven (by personal and planetary health) - passionate recyclers, energy and water savers - they use gentle technologies - animals and nature lovers - green, healthy, and social-conscious products buyers - they seek out companies who practice corporate social responsibility	- highlight the economical, long-lasting and reusability benefits of products - offer services that enable them to recycle, compost and save energy - conduct targeted marketing campaigns (for example, helping animals, advertising in magazines focused on the environment, animals, etc.) - CSR development
	NATURALITES		Outdoor Enthusiasts Health Fanatics	- spending leisure time in nature and practise sports in nature - driven by personal health and wellness and adhere to a healthy lifestyle - they are looking for natural and organic foods, natural cosmetics - they are loyal to those companies/brands who practice credible CSR	- focus on organic aspects, health benefits, trust, transparency and natural ingredients - cross-promote with organic foods companies or a non-toxic cleaning product - conduct a joint promotion with national parks or manufacturers of boots, reusable bottles, and trail mix snacks - CSR development
Types	LOHAS	Ziaei-Bideh and Namakshenas-Jahromi	Ottman	Characteristics	Ways to appeal the consumer segment

DRIFTERS			- they are driven by trends - they are engaged in sustainability although their behaviours are not deeply rooted - they are price sensitive	- focus on trends in sustainability - emphasize the benefits of sustainability and the economic, long-term and reusable benefits of the products - offer services that are in line with current sustainability trends; targeted marketing campaigns focused mainly on price
CONVENTIONALS	Potential greens		- this is practical segment - does not have green attitudes but does have some “municipal” environmental behaviors such as recycling, energy conservation, and other similar behaviors - this segment’s behavior is driven more by cost savings or a desire to waste less than by environmental consciousness	- emphasize the benefits of sustainability and the economic, long-term and reusable benefits of the products - education - conduct targeted marketing campaigns (for example, environmental education activities, subsidy schemes for introducing ecological solutions, etc.)
UNCONCERNEDS	Browns		- not environmentally conscientious at all; tendencies to have negative attitudes about the environment - nongreen behaviors - altruistic, biospheric, and religious values are very low, and they are egoistic consumers - low knowledge or no interest in the environment and social issues mainly because they do not have time or resources	- education - conduct targeted marketing campaigns (for example, environmental education activities, subsidy schemes for introducing ecological solutions, etc.)

As it is evident from the table 1, consumers' concern for the environment is related to their daily behavior, buying habits as well as attitudes and preferences to specific product and services group as well as green behaviour and green innovation. In our study we focus on the possible link between environmental consumers' segmentation models and their interest in green behaviour and green innovation. The aim of the paper is to find out Slovakian society's perceptions on green innovation and various forms of behaviour that represent a lifestyle connected to nature. Using the KANO model we want to find out the level of attractiveness, mandatory occurrence or indifference in relation to various different types of lifestyle connected to nature.

2. METHODOLOGY

According to Loučanová and Nosáľová (2020), the Kano model technique is used to distinguish different attitudes to various types of lifestyle connected to nature from the perspective of social perception. This allows us to identify all the relevant requirements of individuals. Using the Kano model, we are able to examine how an individual's unique needs are dependent on green innovations reflected in individuals' lifestyles in relation to nature in a nonlinear and asymmetric dependence. This is based on the individual and cumulative satisfaction with the variables under observation.

The basic steps of the Kano model provide the foundation for a methodical approach to identifying the relevant individual requirements for green innovation and green behaviour.

We based our study on the work of Zuraidah et al. (2012), which we transformed into the Kano questionnaire. In order to construct the questionnaire, we need to formulate two types of statements. We formulate these statements to capture the respondent's reaction in case the requirement has been fulfilled as in the case of non-fulfilment of the requirement. The statements referred to green behaviour practises such as recycling, reusing, minimising consumption,and packaging, using organic food, riding a bicycle, etc. (see Table 3 – statements).

The questionnaire is designed to gather responses from consumers on a Likert scale, which ranges from strongly disagree to neutral, partially agree to strongly disagree.

The fundamental technique for determining each person's unique needs is questioning; in our study it is used as a multifaceted approach that aims to acquire and collect primary data regarding people's behaviors and attitudes toward different types of green behaviour and green innovation. Because of the relevance of the research it is necessary to count minimal sample of respondents (n) according to the formula:

$$n = \frac{z^2 * p * (1-p)) + e^2}{e^2 + z^2 * p * \frac{(1-p)}{N}} \qquad [1]$$

where:
N - Population size
e - Permissible margin of error
p - Variance in %
z - Confidence level

Based on Slovakia's total population of 5 431 235 people in 2022, the sample of respondents was set to the necessary 386 respondents, with a margin of error of 5% and a confidence level of 95%.

The process of questioning and obtaining the necessary attitudes of respondents is followed by the creation of KANO database. The Kano model cross rule is used to analyze form of individual statement to the positively and negatively asked questions separately. Based on this evaluation, the attitude specific to analysed type of green behaviour is founded. This approach classifies the observed types from the viewpoint of social perception into: must be (M), one-dimensional (O), attractive (A), reverse (R), indifferent (I) and questionable (Q) (Table 2) (Loučanová and Nosáľová, 2020).

Table 2. KANO model to assess the needs of respondents

		Negative conceived question				
		Strong agreement	Partial agreement	Neutral stance	Partial disagreement	Strong disagreement
Positive conceived question	Strong agreement	Q	A	A	A	O
	Partial agreement	R	I	I	I	M
	Neutral stance	R	I	I	I	M
	Partial disagreement	R	I	I	I	M
	Strong disagreement	R	R	R	R	Q

According to Chen and Cheng (2010), Chen, Liu, Hsu and Lin (2010) individual attitude categories affecting respondents' satisfaction can be described as follows:

Must be (M) requirements are seen as natural and are taken for granted by people. They can be categorized as primary or basic, and people only pay attention to them when they are not met. Their identification is crucial primarily because, while fulfilling these needs will affect people's satisfaction, people will notice deficits and non-fulfillment right away, leaving them unhappy, unsatisfied.

One-dimensional requirements (O) are those characteristics of the product that, when met, cause people to be content; conversely, when these requirements are not met, people become dissatisfied. In other words, the more often these criteria are met, the more satisfied people are. On the other hand, people do not always demand one-dimensional needs, unlike mandatory (must-be) requirements. Individual satisfaction and the fulfillment of these requirements are directly correlated linearly. Attractive requirements (A) are those, which have a clear effect on the satisfaction of individuals, because they do not expect them. In case that these requirements are not fulfilled, it will not result in dissatisfaction of individuals.

Reverse requirements (R), sometimes referred to as the exact opposite in some research (Sharif Ullah and Tamaki, 2011), are characteristics of a product that cause consumers to respond contradictorily.

Referred to as insignificant requirements, *indifferent requirements (I*) are those attributes that are not essential for customers and whose fulfillment or non-fulfillment

has no impact on the level of satisfaction or dissatisfaction expressed by the customers.

Questionable or unclear requirements (Q) express uncertain results, which are connected to either improperly formulated questions or consumers' misinterpretation of the questions.

The individual requirements are then categorized and expressed as a percentage, where the category with the highest percentage identifies the particular category of the observed parameter. The percentage of all observed requirements is represented by the maximum value requirement (%) of the recognized specific category.

Subsequently, the results from Kano's model by the requirements studied, these were categorized according to the segmentation model of innovative approaches to lifestyle (animal lovers, outdoor enthusiasts, resource conservers and health fanatics). The calculated values of the parameters present the value for the respondents in terms of their approach to the segment. According to the theoretical knowledge (Loučanová, 2016) Kano model of customer satisfaction states that:

- mandatory (must be) requirements must be fulfilled to the maximum extent, therefore they are given the highest weight of 3,
- one-dimensional requirements have a significant impact on customer satisfaction and therefore their weight is 2,
- attractive requirements are not expected by the customer but are satisfied if they satisfy their needs and therefore we give them a weight of 1
- indifferent requirements have no impact on customer satisfaction or dissatisfaction and therefore their weight is 0.
- reverse requirements demands are strongly reflected in customer dissatisfaction and their weight is then negative -1,
- questionable or unclear requirements representing customers' misunderstanding of an issue or ambiguous attitude towards a given demand, which we do not evaluate.

3. RESULTS

Nowadays, consumers' concern for the environment is growing and that environmental consciousness has given rise to a new market category known as "green consumers." These ecological practices and environmental worries are reflected in their buying habits, but also in their overall life style. In the research we focused on a lifestyle connected to nature and related behaviour. In our study, we focus on the possible link between environmental consumers' segmentation models and their interest in green innovation, spending leisure time, green behaviour and purchase, as well as different ways to appeal the consumer segment according to their characteristic and value orientation. In order to observe the diversity of attitudes on the scale of positive and negative perception, KANO model was used. The statements of KANO model referred to green behaviour practises such as recycling, reusing, minimising consumption and packaging, using organic food, riding a bicycle, etc.

As for the research itself, 386 respondents took part in the survey, of which the sample consisted of 216 women and 170 men. The highest educational attainment of the majority of respondents was recorded as secondary education with a high school diploma. Out of the total respondents, 247 of them live in urban areas and 139 respondents live in rural areas. The individual questions from the survey were evaluated using the Kano cross-rule model, see the following table.

Table 1. Results Kano model

Type of the Life Style	Question formulation	Requirements												Identified
		Mandatory		*One-dimensional*		*Attractive*		*Indifferent*		*Reverse*		*Questionable*		
		Absolute	*Relative*	*Absolute*	*Relative*	*Absolute*	*Relative*	*Absolute*	*Relative*	*Absolute*	*Relative*	*Absolute*	*Relative*	
Outdoor Enthusiasts	To save energy (emissions), I only drive when necessary	3	0.78	1	0.26	115	29.79	198	51.30	64	16.58	5	1.30	**I**
Outdoor Enthusiasts	I try to limit the use of those products that have been produced using limited resources	19	4.92	4	1.04	58	15.03	234	60.62	71	18.39	0	0	**I**
Resource Conservers	I don't buy products with unnecessary excessive packaging	4	1.04	18	4.66	101	26.17	211	54.66	52	13.47	0	0	**I**
Resource Conservers	I buy products in reusable packaging/containers whenever possible	23	5.96	24	6.22	103	26.68	201	52.07	35	9.07	0	0	**I**
Resource Conservers	When deciding between two identical products, I always buy the one that is less environmentally harmful.	21	5.44	14	3.63	77	19.95	221	57.25	53	13.73	0	0	**I**
Resource Conservers	I only buy a product if it is from an environmentally responsible company	7	1.81	23	5.96	43	11.14	232	60.10	81	20.98	0	0	**I**
Resource Conservers	I am trying to replace single-use plastics with greener alternatives	13	3.37	18	4.66	131	33.94	192	49.74	32	8.29	0	0	**I**
Type of the Life Style	Question formulation	Requirements												Identified
		Mandatory		*One-dimensional*		*Attractive*		*Indifferent*		*Reverse*		*Questionable*		

		Absolute	*Relative*	*Absolute*	*Relative*	*Absolute*	*Relative*	*Absolute*	*Relative*	*Absolute*	*Relative*	*Absolute*	*Relative*	
Resource Conservers	When using electricity and water. I try to minimize my consumption	24	6.22	9	2.33	223	57.77	124	32.12	6	1.55	0	0	**A**
Resource Conservers	I try to buy things "second hand" and thus I don't support „fast fashion“	15	3.89	15	3.89	101	26.17	198	51.30	56	14.51	1	0.26	**I**
Animal Lovers	I am vegetarian/vegan/I could leave meat out of my diet	7	1.81	11	2.85	63	16.32	142	36.79	163	42.23	0	0	**R**
Resource Conservers	I would be willing to contribute to support environmental associations	3	0.78	7	1.81	84	21.76	241	62.44	51	13.21	0	0	**I**
Animal Lovers	I would be willing to contribute to support animal charities	2	0.52	218	56.48	131	33.94	3	0.78	32	8.29	0	0	**O**
Outdoor Enthusiasts	I have no problem using a bicycle instead of a car	21	5.44	9	2.33	145	37.56	174	45.08	37	9.59	0	0	**I**
Health Fanatics	I am willing to pay more money for healthy products and organic food	12	3.11	8	2.07	72	18.65	256	66.32	38	9.84	0	0	**I**
Outdoor Enthusiasts	I try to minimize the time spent in shopping centres, etc.. I prefer to spend time in nature	7	1.81	13	3.37	138	35.75	198	51.30	30	7.77	0	0	**I**
Type of the Life Style	Question formulation	Requirements												Identified
		Mandatory		*One-dimensional*		*Attractive*		*Indifferent*		*Reverse*		*Questionable*		
		Absolute	*Relative*	*Absolute*	*Relative*	*Absolute*	*Relative*	*Absolute*	*Relative*	*Absolute*	*Relative*	*Absolute*	*Relative*	

Resource Conservers	When buying, I prefer products with the FSC label (from sustainable sources)	17	4.40	3	0.78	40	10.36	260	67.36	66	17.10	0	0	**I**
Animal Lovers	I am happy to contribute financially or materially for animals in shelters	7	1.81	14	3.63	133	34.46	198	51.30	34	8.81	0	0	**I**
Animal Lovers	If I found an injured animal, I would definitely call for help	15	3.89	20	5.18	168	43.52	169	43.78	14	3.63	0	0	**I**
Animal Lovers	I buy products that have not been tested on animals	9	2.33	6	1.55	92	23.83	234	60.62	45	11.66	0	0	**I**
Health Fanatics	I buy mostly food labelled as organic	9	2.33	9	2.33	57	14.77	265	68.65	46	11.92	0	0	**I**

The Kano model's overall survey results indicate that Slovak respondents are unaffected by the issue of green innovation and innovative approaches to lifestyle connected with nature.

The features of attractive requirements, on the other hand, ranking second most numerous in terms of study parameters. This indicates that participants have no expectations for these requirements, but they perceive them positively if they do occur. This indicates that, for instance, in the case of energy saving (emissions), up to 118 respondents view energy saving or emissions saving extremely positively (attractively), despite 199 respondents stating that the given data does not influence them.

As shown by a number of initiatives in Slovakia, respondents from Slovakia agree that supporting nature is a one-dimensional criterion when it comes to helping animals. As contradictory Slovak respondents view the subject of vegetarianism, for example they are unwilling to give up meat.

Slovak respondents perceive saving resources as attractive, especially in terms of their household costs. Respondents do not belong to any active group when it comes to regular help for animals, but they always take the opportunity to help when they can.

Based on the ecological consumer sub-segments in terms of innovative approaches to lifestyle, we divided the questions into four categories of outdoor enthusiasts, resource conserves, animal lovers and health fanatics. We then gave weights to each of the specified needs, as indicated in the figure below (Figure 1), in accordance with the methodology. This made it possible to categorise the segments outdoor enthusiasts, resource conserves, animal lovers and health fanatics according to their attitudes to green behaviour and innovation acceptance (attractive, one-dimensional, indifferent or reverse).

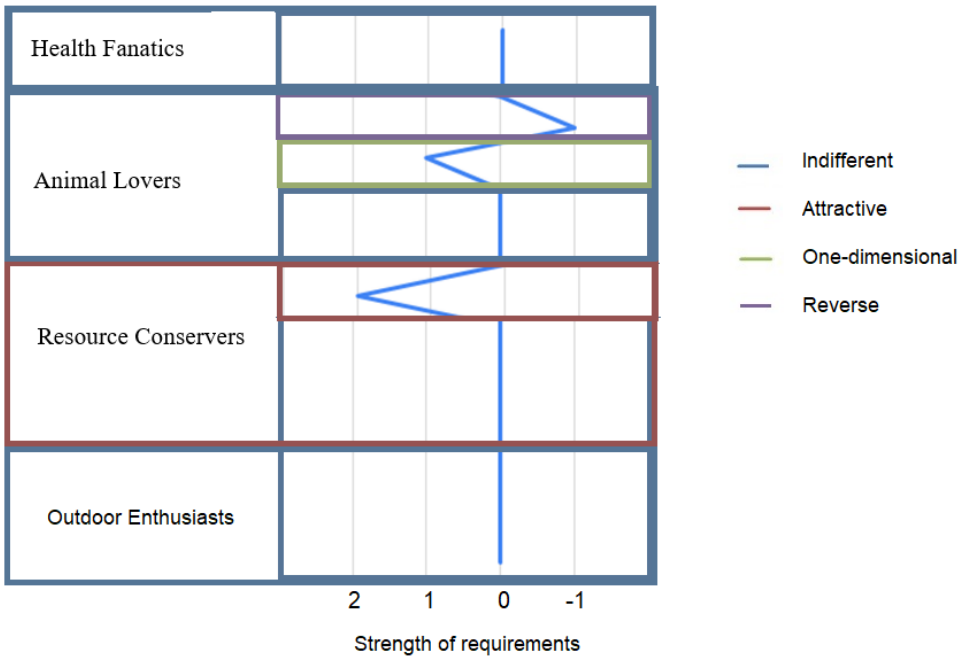

Figure 1. Attitudes towards the lifestyle of Slovaks from the point of view of accepting green innovations

We may conclude from the previous that Slovak respondents could be categorized as resource conservers and animal lovers. Based on Ziaei-Bideh and Namakshenas-Jahromi (2020), we can characterize them as intense green and belonging to LOHAS consumers. In terms of marketing activities, it is appropriate in Slovakia to apply marketing tools aimed at: highlight the economical, long-lasting and reusability benefits of products, offer services that enable them to recycle, compost and save energy, conduct targeted marketing campaigns (for example, helping animals, advertising in magazines focused on the environment, animals, etc.) and CSR development.

4. CONCLUSION

Slovak respondents could be classified as intense green innovators based on their opinion of green innovations that promote a lifestyle in harmony with nature. They are mainly oriented towards saving resources (resource conservative) and have a positive relationship with animals, although they are not willing to change their attitudes in many areas, or do not have a specified relationship with them. However, it should be emphasised that this classification, although prevalent, is determined on the basis of small differences from other types of lifestyle attitudes, and therefore there is a need for ongoing scientific research in this area. Currently, marketing strategies that highlight the advantages for Slovak consumers, recycling, resource conservation, etc. are required in order to encourage a more intensive green lifestyle among Slovaks and in other areas of the green transformation of the economy.

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3. RECYCLING OF WOOD PRODUCTS IN THE CONTEXT OF EMPLOYEE SKILLS AND EXPERTISE

Renata Nováková, Renata Skýpalová, Alena Pauliková, Zdeněk Málek

1. INTRODUCTION TO THE ISSUE

The chapter recycling products made of wood in the context of skills and professional training of employees is based on one of the sub-tasks of the IGA project, which is being processed at Ambis University, and therefore the results of the pilot survey regarding significant changes in the subject area within the Czech Republic. The main goal was to point out the area of recycling, which is very current, not only from the point of view of multinational institutions, but above all from the point of view of processors and producers in individual EU member countries. Recently, there has been a large influx of new regulations and legislative changes in the field of recycling, in the packaging economy and in the field of end-of-life products. The woodworking industry is key in this regard, and the obligation to change will not only concern the product itself, management, but also new demands on the professional skills of employees. Therefore, the authors first of all focused on defining the basic key elements that will be directly affected by the new legislative changes, they pointed out the demands regarding the professional skills of employees who are an important part of the entire recycling chain. At the end of the chapter, the so-called best practice with specific examples pointing to new possibilities and the use of recycled materials in practice.

1. RECYCLING AND LEGISLATION IN WASTE MANAGEMENT

In 2024, the Czech Republic adopted significant changes in waste management legislation that have an impact on businesses. These changes are aimed at tightening regulations and increasing the responsibility of businesses in the field of waste management, with the goal of aligning with the broader environmental goals of the European Union.

Key elements of the new legislation:

1. Extended Producer Responsibility (EPR): Businesses must now take more responsibility for the entire life cycle of their products, especially in the area of packaging and single-use plastic waste management. This includes financing the costs of waste collection, disposal and educating the public about proper waste management. (European Parliament, 2024).

2. New requirements for reporting and documentation: From 2025, companies must comply with stricter standards in the field of reporting, especially regarding documentation on waste generation and disposal. This includes more frequent reporting and tougher penalties for non-compliance. (European Commission, 2024).
3. Increased emphasis on recycling and the circular economy: The law encourages businesses to implement recycling practices and circular economy principles. Companies are motivated to reduce waste production through established recycling targets and promotion of material reuse. (European Commission, 2024).
4. Financial consequences: Non-compliance with the new regulations can lead to high fines, up to 10 million CZK (approximately EUR 407,000). This creates a strong financial incentive for businesses to comply with the new requirements. (Czech Ministry of Environment, 2024).

These changes are part of the Czech Republic's broader strategy to reduce waste and improve overall environmental sustainability. The new regulations aim to encourage businesses to behave more sustainably with an emphasis on reducing the negative impact on the environment.

Companies operating in the Czech Republic should ensure that their procedures are up-to-date in accordance with these regulations in order to avoid severe fines and at the same time contribute to the achievement of environmental goals. (Czech Ministry of Environment, 2024).

The new law on the processing of wood waste in the Czech Republic will apply to a wide range of companies that are engaged in the production, processing or distribution of wood products. Specifically, these are the following types of businesses (law No 541/2020 Waste law):

1. Manufacturers of furniture and wooden products: The law applies to manufacturers who produce wooden products such as furniture, wooden structures, floors, doors and windows. These businesses generate a significant amount of wood waste that must be properly treated or recycled.
2. Wood processors: Businesses engaged in the primary processing of wood, such as sawmills and other processors that convert wood into building materials, pallets, plywood or other wood products.
3. Paper and pulp manufacturers: Companies that use wood as a raw material for the production of paper, cardboard and pulp are also under strict supervision when it comes to the efficient use of wood waste.
4. Construction businesses: Companies that use wood materials to build buildings, bridges or other structures will need to ensure that waste wood from these projects is responsibly managed.
5. Manufacturers of packaging and pallets: Businesses that produce wooden packaging, pallets and similar products are also covered by the new regulations, as their production process often creates wood waste.
6. Biomass companies: Companies that use wood waste to produce biomass will have to ensure that their waste processing complies with the new environmental standards. (Czech Ministry of Environment, 2024).

These businesses will have to take measures to increase recycling, minimize waste and make the use of wood raw materials more efficient. In case of non-compliance with these regulations, they face significant financial penalties. The new law aims to reduce the environmental impact and promote the sustainable use of wood as a renewable resource.

Wood recycling is a key aspect of sustainable management of this natural resource. Its goal is to minimize waste and maximize the use of wood that has already fulfilled its original purpose. Recycled wood can be reused in a variety of industrial applications, reducing the need to harvest new wood and conserving natural resources. In the following sections, we will focus on some specific forms of wood product recycling.

1. Recycling of building wood

One of the main areas where wood recycling is applied is construction. After the demolition of buildings or renovations, a large amount of construction wood can be reused. This process involves sorting, cleaning and treating the wood so that it can be used in new construction projects. For example, wooden beams, floorboards or cladding materials can be renovated and re-integrated into new constructions. (https://dobryzaklad.sk/recyklacia-a-opatovne-vyuzitie-stavebneho-odpadu/)

2. Production of chipboards

One of the most widespread forms of wood recycling is its use for the production of chipboards. This process involves grinding waste wood into small particles, which are then mixed with glue and pressed into solid boards. Chipboards are widely used in the furniture industry and construction, thus providing an affordable and ecologically acceptable alternative to solid wood.

3. Production of MDF (Medium-Density Fiberboard)

MDF boards are another wood recycling product that is made from finely ground wood fibers mixed with glue and pressed at high temperatures. This material is denser and more durable than chipboard, which makes it suitable for the production of furniture, doors and interior cladding. The production of MDF boards helps to efficiently use wood waste that could otherwise end up in landfills.

4. Production of paper and cardboard

Recycling of wood waste for the production of paper and cardboard is another important form of recycling. Using old wood and wood waste, new cellulose fibers are produced, which are then processed into paper products. Recycled paper and cardboard reduce the burden on forests and represent an important step in the circular economy.

5. Production of wood chips and mulch

Wood chips are another wood recycling product that is used as fuel, but also in gardening and agriculture. The recycling process involves shredding wood waste into small pieces that can be used as mulch to protect the soil and retain moisture. Mulching with wood chips improves soil quality, reduces erosion and helps maintain a healthy ecosystem.

6. Bioenergy production

One of the important forms of wood recycling is its use for the production of bioenergy. Combustion of wood waste in power plants or in domestic boilers can produce heat and electricity. This process is considered a carbon-neutral solution, because burning releases only as much CO2 as was absorbed by the wood during its growth. The production of bioenergy from wood represents a sustainable alternative to fossil fuels and contributes to the reduction of greenhouse gas emissions.

7. Wood upcycling

Upcycling is a creative process where wood waste is turned into new products with higher value. This is, for example, the production of art objects, designer furniture pieces or architectural elements from recycled wood. Upcycling is environmentally friendly and contributes to reducing waste, while supporting the creative and innovative use of wood material

8. Wood composting

Some forms of wood waste, especially thin and fine wood chips or sawdust, can be composted. This process allows the wood to be turned into organic compost that is rich in nutrients and can be used to improve soil quality. Wood composting is an example of natural recycling that promotes the circulation of nutrients in the ecosystem.

2. IMPORTANCE OF THE HUMAN FACTOR IN RECYCLING AND RESPONSIBLE CONSUMER BEHAVIOR

Recycling of wood products is a process that not only includes technological and logistical aspects, but is also deeply connected with the human factor. People are key actors in every step of the recycling chain – from the collection and sorting of wood waste to its processing and reuse. The human factor in this context means the knowledge, skills, attitudes and behaviors that directly affect the success of recycling processes. This article focuses on various aspects of the importance of the human factor in the recycling of wood products. (https://www.enviroportal.sk/dokument/f/strategicky-plan-spolocnej polnohospodarskej-politiky-2023-2027.pdf)

1. Education and information

One of the most important aspects of the human factor in recycling is education and public awareness of the importance of wood recycling. Without sufficient understanding of why recycling is important and how to properly recycle wood products, the entire system would be less effective. Education campaigns and programs aimed at raising awareness about recycling, including proper sorting of waste, can make a significant contribution to increasing recycling rates.

2. Motivation and engagement

Individual motivation and commitment play a critical role in the success of recycling programs. If people are sufficiently motivated, either through economic incentives, social responsibility, or environmental awareness, they will be more actively involved in recycling. Programs that offer rewards for good recycling behavior or support

community activities aimed at reducing waste can significantly increase people's engagement.

3. Skills and professional training

The recycling of wood products requires specific technical skills and training, especially in the field of processing and re-use of wood material. Employees at recycling centers, construction workers, as well as product designers and manufacturers play an important role in ensuring that recycled material is used effectively and creatively. Professional training in the field of new technologies and recycling procedures is key to improving the efficiency of the entire process.

4. Cooperation and coordination

Effective wood recycling also depends on cooperation between different actors – from local governments, through businesses to non-profit organizations and individuals. Cooperation and coordination make it possible to create efficient logistics networks for the collection and processing of wood waste, as well as to support innovations in the field of recycling. Sharing of information, best practices and mutual support between all parties involved is important in this collaboration.

5. Creativity and innovation

Human creativity and innovative approach are of great importance in finding new ways to recycle wood products. Designers and engineers can come up with new ideas for using recycled wood in a variety of areas, from construction to arts and crafts. A creative approach can also lead to upcycling, where recycled material is turned into products with higher added value, maximizing its economic and environmental value.

6. Responsible consumer behavior

End consumers play a key role in the recycling process by making informed decisions when purchasing and disposing of wood products. Responsible consumer behavior includes choosing products that are made from recycled or certified wood and recycling them properly at the end of their useful life. Consumers who choose products with a lower ecological impact contribute to supporting sustainable markets and reducing the overall amount of waste.

Responsible consumer behavior is the key to a sustainable future. Consumers have the power with their decisions to influence market trends, support ethical and ecological businesses, and reduce their environmental impact. This approach is not only about protecting the environment, but also about creating a fairer and more sustainable society. Every purchase that is made with these principles in mind is a step towards a more responsible and sustainable world.

7. Politics and Regulation

The human factor in the form of political decisions and regulations also has a significant impact on the recycling of wood products. Laws and regulations can create a framework that promotes recycling and sustainable use of wood, for example by introducing recycling targets, promoting green technologies and ensuring sustainable forest management. Politicians and public officials thus directly influence how wood is handled throughout its entire life cycle.

(Plaksiuk,O., Nováková, R., Habiňáková, E.(2022): Investment in Human Capital as a guarantee of the country´s economic development in woodworking industry. In:

Proceedings from 15th International Scientific Conference WoodEMA 2022, s. 333 – 340, print KON-PRESS, Trnava, Slovakia,ISBN 978-953-846-00-9)

2.1. Innovations in the recycling process of wood products and financial savings

Innovations in wood recycling play a key role in improving efficiency, reducing costs and maximizing environmental benefits. These technological and process improvements not only promote sustainability, but can also bring significant financial savings to industries that use wood as a raw material. In the following sections, we will focus on some of the most significant innovations in the recycling process and how they contribute to financial savings.

1. Advanced sorting and separation of materials

One of the key innovations is the use of advanced technologies for sorting and separating wood waste. Modern sorting lines use optical sensors, infrared spectroscopy and X-ray technology to accurately distinguish different types of wood and impurities such as metal parts or plastics. These technologies enable more efficient recycling and reduce the amount of waste that must be disposed of. Financial savings arise from lower disposal costs and higher quality recycled material, which can be sold at a higher price.

2. Automation and robotization of recycling processes

Automation and robotization bring a significant improvement in efficiency in the wood recycling process. Robots can perform complex tasks such as dismantling wooden products, removing metal parts or other impurities, and sorting materials with high accuracy and speed. This approach not only reduces the need for manual work, but also minimizes errors and speeds up the entire process, resulting in lower operating costs.

3. Innovations in chemical recycling

Chemical wood recycling is an advanced method that enables the decomposition of wood waste into basic chemical components, which can then be used for the production of new materials. For example, the pyrolysis process turns wood into biochar, biooil and biogas, which can be used as raw materials for the chemical industry or as a source of energy. This innovation not only maximizes the use of wood waste, but also creates new market opportunities for recycled products, increasing their economic value. (Kačík, F.: Inovatívne metódy termickej a chemickej modifikácie pre efektívnejšie využitie dreva v interiéri aj v exteriéri, projekt VEGA č. 1/0521/15, Innovative methods of thermal and chemical modification for more efficient use of wood both indoors and outdoors, VEGA project No. 1/0521/15)

4. Production of biocomposites and alternative materials

One of the new areas in wood recycling is the production of biocomposites, which combine recycled wood fibers with other materials such as plastics or metal components. These composites can be used in construction, the automotive industry or in the production of furniture. The advantage is that biocomposites often offer better mechanical properties

and durability than traditional materials, while being environmentally friendly. Financial savings are reflected in lower costs for raw materials and in the creation of new, high-value products. (Kruhak,T., Barčic Pirc A., Klarič, K., Perič, I., Motik, D., Ostoič, I.(2022): Contribution of forest-based Industry in low carbon circular Bioeconomy: Life Cycle assessment of selected wood-based products using imapro software. In: Proceedings from 15th International Scientific Conference WoodEMA 2022, s.205 – 210, print KON-PRESS, Trnava, Slovakia,ISBN 978-953-846-00-9)

5. Efficient use of energy from wood recycling

The production of energy from wood waste through incineration or pyrolysis is becoming increasingly popular. New technologies enable more efficient burning of wood with lower emissions and higher energy output. The use of wood for the production of heat and electricity not only reduces energy costs in industrial processes, but also offers the possibility of selling excess energy, which increases the financial benef

6. 3D printing from recycled wood

3D printing from recycled wood is an innovative technology that enables the production of complex wooden objects with minimal waste. By combining wood dust or wood fibers with biodegradable polymers, it is possible to create new products with high precision and complex shapes. This technology reduces the need for new wood and minimizes waste, resulting in significant financial savings in material costs and logistics.

7. Digital platforms and recycling chain tracking

Modern digital technologies such as blockchain and IoT (Internet of Things) enable better tracking and management of the recycling chain of wood products. These systems can monitor the flow of material from collection to final recycling, ensuring transparency, reducing the risk of fraud and improving process efficiency. Improved inventory and material flow management leads to logistics optimization and cost reduction, resulting in significant financial savings.

Innovations in the process of recycling wood products bring not only environmental benefits, but also significant financial savings. Automation, advanced sorting, chemical recycling and new material technologies are improving the efficiency and quality of recycling processes, leading to lower operating costs and higher economic returns. For industries using wood as a raw material, these innovations are crucial for sustainable growth and competitiveness in the global market

2.1.1. 3D printing from recycled wood - examples from practice

3D printing technology from recycled wood is an innovative approach that enables the creation of complex and functional products with minimal waste. This technology combines wood fibers or wood dust with biodegradable polymers, creating a material suitable for additive manufacturing. The following are examples of how 3D printing from recycled wood is used in various fields of practice.

1. Production of furniture and interior elements

One of the best-known examples of the use of 3D printing from recycled wood is the production of furniture and interior elements. Companies like Furnituren specialize in the production of designer furniture from wood composites that are printed using 3D printers. This approach makes it possible to create unique, custom-made pieces of furniture that are not only ecologically sustainable, but also economically efficient. Thanks to 3D printing, complex geometric shapes are possible that would be difficult or expensive to produce using traditional methods.

Figure 1. Custom-made pieces of furniture (https://www.jurhan.com/p/477/zahradne-lehatko)

2. Architectural models and prototypes

Architectural offices and design studios use 3D printing from recycled wood to create building models and prototypes. Forust, part of the Desktop Metal group, has developed technology that enables 3D printing from recycled wood materials, creating architectural models with a realistic wood look and texture. This technology allows architects and designers to quickly create and modify models, improving the design process and reducing material and prototyping costs.

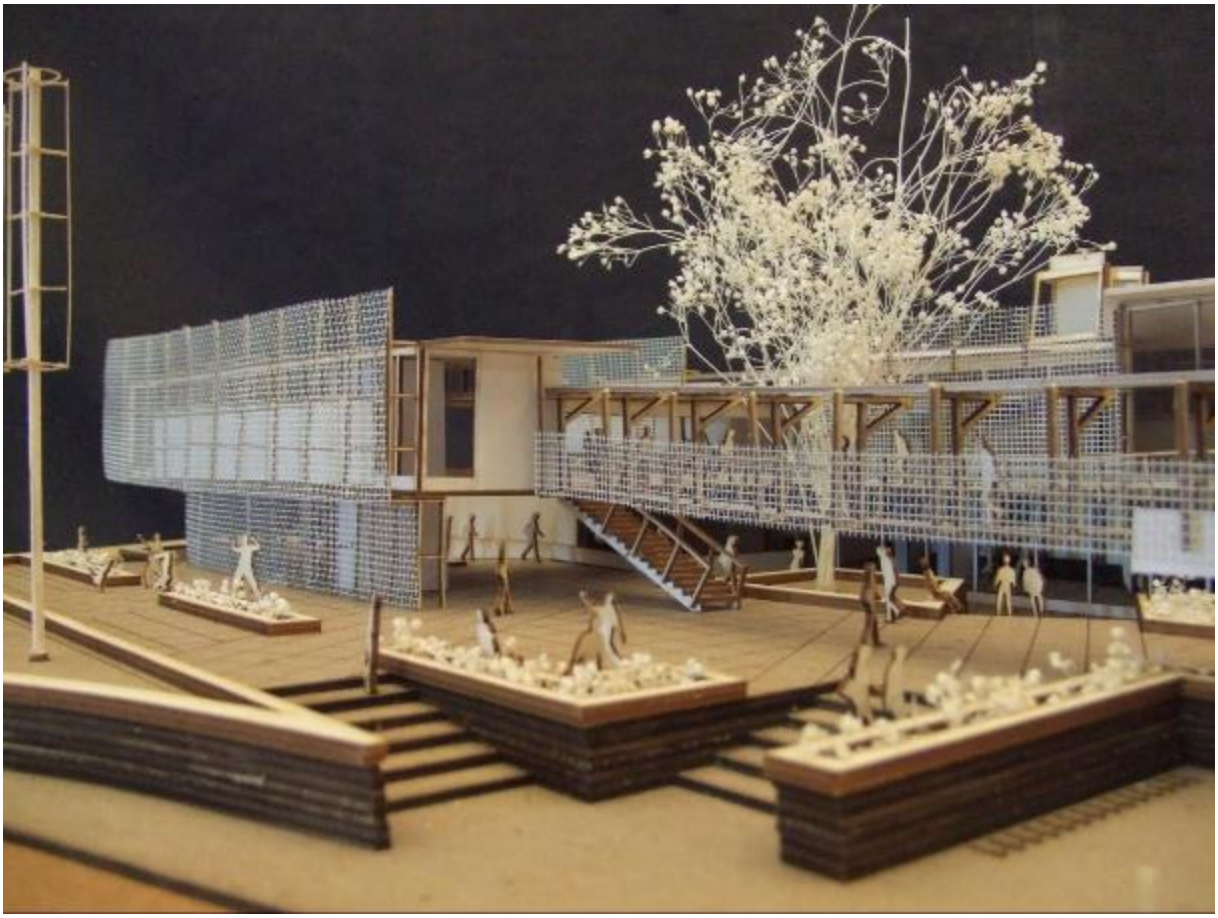

Figure 2. Architectural models with a realistic wood look and texture (https://www.forust.com/)

3. Production of fashion accessories

The fashion industry has also discovered the potential of 3D printing from recycled wood. Companies such as Opendesk and Simone Post use this technology to produce fashion accessories such as bracelets, earrings or belts. These accessories are made of wood composites, which gives them a unique look and an ecological dimension. 3D printing enables the rapid production of small series and personalized products, which is an increasingly important aspect in fashion.(https://www.jrmade.sk/drevene-modne-doplnky/)

Figure 3. Fashion accessories from recycled wood (https://woodwear.sk/produkt/pansky-dreveny-motylik-a-traky-horcicovy/)

4. Creation of artworks and decorations

Artists and designers are increasingly experimenting with 3D printing from recycled wood to create works of art and decorative elements. For example, artist Neri Oxman and her team at the MIT Media Lab have developed a series of art installations that combine recycled wood and other natural materials with 3D printing. This approach makes it possible to create complex and organic shapes that are difficult to achieve with traditional sculpting techniques.

Figure 4. Combination recycled wood and other natural materials with 3D printing from artist Neri Oxman (https://www.sfmoma.org/artist/Neri_Oxman/)

5. Use in the construction industry

In the construction industry, 3D printing from recycled wood is starting to be used in the creation of building elements and structures. Printed wood bricks or panels are an example of how recycled wood can be used to create modular building systems. These elements are light, durable and provide good insulating properties. 3D printing enables construction components to be manufactured on site, reducing transport costs and minimizing waste.

Figure 5. House made of wooden recycled material by 3D printing (https://constructive-voices.com/sk/7-kr%C3%A1snych-3D-tla%C4%8Den%C3%BDch-domov/)

3D printing from recycled wood is quickly becoming a popular technology, finding applications in a variety of industries, from furniture and fashion to art and construction. The use of this technology brings ecological and economic benefits, as it enables the efficient recovery of wood waste and reduces the need for new raw materials. Innovations in this area suggest that 3D printing from recycled wood will have an increasing impact on sustainable manufacturing and design in the future. (https://www.stavajsnami.sk/drevo-z-3d-tlaciarne-ci-pruzny-beton-stavebne-materialy-buducnosti/#google_vignette)

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4. METHODS OF SUSTAINABILITY IN THE FOREST INDUSTRY OF BULGARIA

Gergana Slavova

1. KEY WAYS FOR SUSTAINABLE FOREST MANAGEMENT

When we talk about sustainable management of the forest sector, we must bear in mind that it can be achieved on the basis of the basic methods of sustainability in the economy, combined with soil fertility conservation, proper treatment of forest flora and fauna and conscious training for sustainable forest management.The methodology we use is based on the methods for achieving sustainability in the forestry sector and on the principles of soil, air, plant, animal and water conservation in forest areas. It is vital to protect habitats in forestry to maintain the balance of life in forest areas. The main methods for achieving sustainability in the forest sector are associated with: reducing the harmful impact on natural factors existing in the forest area. Reducing air, soil and water pollution. Introduction of technologies to strengthen forest areas. Prohibition of unregulated logging in forests. Develop comprehensive training programmes for the maintenance and sustainable care of the forest sector. The concept of sustainable forest management are multifaceted and interpreted differently by different authors. These interpretations significantly influence the methodologies used, the perceived effectiveness and the criteria for successful management of the sector. This diversity reflects a comprehensive and multidimensional approach to sustainability and management, including environmental, economic, social and technological dimensions. Some economic studies, such as those by Munir et al. (2022), discuss sustainable management in larger systems such as regional water management and conservation systems. These studies often use methodologies such as systems analysis or simulation models to understand complex interactions and predict long-term consequences. Other specialized work (Zeweld et al. 2018) explores the socioeconomic and psychological dimensions of sustainable management. These typically use social science methodologies, including surveys and interviews, to understand how human factors influence forest sector acceptance and performance. Begho et al. (2022) conducted a systematic review of the factors influencing the adoption of sustainable practices in the agriculture and forestry sector, highlighting the importance of policy support and community engagement in facilitating sustainable transitions (Begho et al., 2022). The scope of the research commented on directly influences the way in which performance is measured and the understanding of successful management. Combining the forestry sector with the agricultural sector on the basis of permaculture is also an extremely good measure for sustainable management in the forestry sector (Slavova, 2024). The application of the circular economy model between the forestry and agricultural sectors contributes greatly to

sustainability in the agricultural sector (Slavova, Doneva, 2022). Sustainable management of the forest sector is also associated with new production prospects in the forestry sector (Kirechev, 2024) Wood and timber processing is an opportunity to use waste wood products for mulching in the agricultural sector and also for the production of furniture or pellets. There are different types of innovations in the field of wood processing and development (Lesníková, P., Kánová, 2023). They also create an opportunity for a more sustainable model of forestry in the country that implements them. Bulgaria has a tradition of producing paper and furniture from waste wood materials. The production of special boards from glued wood waste is not new for our country, but the production and processing technologies are new. Something that is applied in Europe, and recently also in Bulgaria, is the use of recycled wood materials, and from them the production of paper, as well as the production from recycled paper of a new modern design.(Zach , 2023) All this contributes to the sustainability not only of forestry, but also of the processing sector in the forest industry. Ecologically oriented research evaluates success in terms of biodiversity enhancement and soil health improvements, while economically oriented research may prioritize increasing yields or profits. Integrative studies consider a range of indicators of success, including environmental impact, economic viability, social equity, and resilience to climate change.One of the main methods of sustainability in the forestry sector, as well as in agriculture worldwide, is to preserve soil fertility. A large part of the fertile soils in our country are located in forest areas. Including black soils and their different varieties, such as carbonate, typical, leached and podzolic black soils. In fact, fertility is one of the most important qualities that soil possesses. It is the soil's ability to provide the necessary conditions for plant life and development, including forest vegetation cover. In reality, the soil provides the plants with the necessary amount of water, air, light and heat. Again, thanks to its composition, both in the agricultural and in the forestry sector, plants fight the appearance of various diseases and pests. Therefore, in order to create a sustainable forestry industry, the composition of forest soils and the absence of pollutants and other harmful substances in them that have a toxic effect on plants and micro-organisms in forest communities is very important. In addition, the fertile soil must have a deep and structural horizon, as well as favourable physical, chemical and biological properties that are conducive to the emergence of forest plant species. In fact, productivity is the main characteristic by which scientists determine soil quality. In our country, part of the forests are located on different types of black soils, and another part is logically located on forest soils, which in turn are: grey forest soils, brown forest soils and cinnamon soils. In order to improve the soil fertility of forest soils, and thus the sustainability of the forestry industry, the most important activities are proper management, monitoring and control of forest holdings in the country, as well as the periodic renewal of forest stands, strict penalties for illegal logging, and the establishment of forest protection belts in the country. Only in this way can we prevent soil erosion and also strengthen forest biocommunities and preserve fields from wind erosion. Only in this way can we preserve our forests, their flora and fauna and maintain the rich biodiversity of plants and animals in our country. In our view, sustainable forest management is linked to an ecological approach that encompasses:

preserving biodiversity in forests, it is also linked to the conservation of native species and ecosystems. Conservation Soil health: Focus on soil organic content, structure and microbial activity in forest areas Water resource management: Efficiency and sustainability of water use in forest areas and waste management and recycling. In addition, we believe that the role of specific practices aimed at training the younger generation in the care and conservation of forestry is important. Sustainability is a term that is primarily associated with the ability to preserve something for future generations. In the case where we are talking about sustainable management of the forest sector in Bulgaria, in our opinion, the most important role for this is the proper and systematic education of children from the earliest to the latest age so that they can then in turn be involved in the process of protecting forest communities. It is important for us that the children learn about the ecological aspects related to the conservation of forest areas, both the soil, trees, air, water and the rich forest flora and fauna in our country.

2. DEVELOPMENT OF FOREST SCIENCE EDUCATION AND THEIR APPLICATION FOR SUSTAINABLE FOREST INDUSTRY IN BULGARIA

Another extremely important method for the sustainability of the forest industry and its future development in Bulgaria is the conscious and targeted education of children and the formation in them of a consciousness to love and respect nature. To protect the trees in the forest, to be aware that wood is a raw material for many basic products in human life. For them to be aware of all this, their education should start as early as pre-school age with books and teaching aids well adapted to their age. Monitoring and control in the area of forest use is also crucial for the sustainability of the forest sector. Tackling large-scale and illegal logging, as well as illegal timber exports.

2.1. Pre-primary, primary and secondary education in forestry sciences

In our country there is a magnificent children's encyclopedia about the forest. It is not a Bulgarian edition, it is translated literature, but it is magnificently illustrated so that children will be attracted and want to learn more about the magic of the forest. In secondary education, forest topics appear in biology, ecology and geography textbooks, and in special secondary schools we have specialised classes for the forestry and forestry sector. There are exactly 28 secondary schools in Bulgaria that train forestry technicians. According to journalists, these schools are too many for our country, but not according to us. The formation of knowledge, respect and esteem for forest resources and the forestry sector is a very important prerequisite for a sustainable forestry sector and for the future of planet Earth. We must not forget that forests are the lungs of our planet and only afforestation, not deforestation, will enable us to have a sustainable forest sector and a future for our children. Fortunately, in Bulgaria we still have specialised schools at secondary level in the training of forestry and logging and forestry and hunting. Areas such as Velingrad, Blagoevgrad, Teteven,

Kotel, Elena, Bansko and other mountainous regions need graduates in this field. The successful children then go on to work in the forestry sector or go on to higher education in the same field. Secondary schools in Bulgaria, under the patronage of the Executive Forest Agency (EFA), celebrate Forest Week every year. In the last year 2024, five specialized high schools were awarded-National High School of Forestry "Hristo Botev" Velingrad, Professional Forestry School "N. Vaptsarov" - Bansko, National Vocational School of Forestry and Woodworking "Sava Mladenov" - Teteven, Vocational School of Woodworking "Ivan Vazov" - Velingrad and Vocational School of Agriculture "Buzema" - Sofia. At a special exhibition at the country's Ministry of Agriculture, the students presented their activities and works of art to the general public. Each of the awarded schools also received a 200 BGN cash prize from the Executive Forestry Agency. This is a further incentive to the children to be more inquisitive and willing to work in this sector, thus making it truly more sustainable and preferred in the years of application of high technology and artificial intelligence. To conduct theoretical training and practical classes, the specialized schools of forestry have specialized laboratories in wood cutting and cutting tools, training and demonstration center for hand power tools, automation and automation of production, and the Forestry University in Sofia, in addition to the training and production center in woodworking, training and production center for furniture production, has a laboratory of computer animations and virtual reality, training and demonstration All schools in the forestry sector and manufacturingindustry maintain close contacts with companies in the woodworking and furniture industries, where they conduct practical training of students and use as a base for the development and implementation of research projects. The first Bulgarian youth who studied abroad to get higher forestry education was Stefan Donchev from Klisura. Back in 1876 he graduated with excellent grades from the Royal Agricultural Academy in Proskau, Prussia. And before that he studied at the agricultural forestry school in Križevac, Croatia. The data are from the book "The tamed floods in Bulgaria" by Peko Panov, himself a graduate of the Faculty of Agronomy and Forestry in Sofia. The book also notes that the progenitors of forestry science in Bulgaria received their higher education after the Liberation of Bulgaria in the most renowned forestry academies, royal institutes and universities and other schools in Germany, France, Austria, the Czech Republic, Russia and Croatia. After returning to their homeland, they immediately started working hard for the Bulgarian forest. The foundations of forestry education and science in Bulgaria were laid at the end of the nineteenth century.

2.2. Universities and their departments educating bachelor, master and doctoral students in forestry sciences

First schools for forest guards were opened - in Chamkoria (Borovets) and Velingrad, and in the early twentieth century - the academic forestry education. The Department of Private Forestry was opened at the Faculty of Agronomy of the University of Sofia. In 2024, Bulgaria celebrates exactly 140 years of the Central Forest

Service, 120 years of the Forest Seal and 110 years of the Union of Foresters in Bulgaria. On the occasion of these events, reforestation campaigns are being held throughout the country, as well as initiatives to involve children in nature and the forest. This really makes our country's forest sector more sustainable. But in fact, the forest industry in Bulgaria has been talked about for a long time, but the Forestry Department, at the Academy of Agriculture - Sofia was founded in 1949. And since 1953 , 71 years ago in our country appeared an independent Higher Institute of Forestry with 5 specialties, one of which is Mechanical Technology of Wood. Today (2024) the Forestry University in Bulgaria has an independent department focused on sustainable forest resources management, as well as specialized journals in this field. Forestry University owns besides educational and recreational base in Yundola among the most beautiful forest massifs in our country. This base has magnificent collections of tree species and forest dwellers. The Faculty of Forest Industry was established as an independent educational and scientific structure at the University, which started its activities exactly fifty years ago in 1974 on the basis of the specialisation Mechanical Wood Technology. The first Dean of the Faculty was elected prof. Nino Statkov, and then successively deans were prof. Andrey Kavalov, prof. Hristo Shehtov, prof. Georgi Filippov, prof. Hristofor Videlov, prof. Nikolay Yosifov, prof. Bozhidar Dinkov, Assoc. Hristofor Rusanov, Assoc. Neno Trichkov, Prof. Dr. Zhivko Gotchev. From 2024. Prof. Dimitar Angelski, PhD. Forestry University in Bulgaria prepares its staff excellently for the forest industry and for the protection of the forest wealth of our country. Students with great interest master disciplines related to the use of modern technology of wood processing and furniture. In the field of forestry, the institute prepares future engineer-technologists for the production of furniture and environmentally friendly wood processing. In which wood is used for the production of veneers, paper, laminated timber, the manufacture of engineered and solid wood and wooden structures, the production of flat materials, furniture production, etc. The University of Forestry and Wood Technology in Bulgaria prepares specialists in the field of woodworking and furniture industry. In the Master's degree, management, specialization and methodological research disciplines are studied in more depth and at a higher level, selected depending on the chosen specialization. There the methods of furniture production; conservation and restoration of wood products and woodworking machinery and equipment are studied in much greater depth. Training at the University of Forestry and Wood Technology in the country is carried out in full-time and part-time form. In recent years, students have been very interested in the new more modern trends in engineering design also known as interior design or design for indoor furniture. A new direction is the production of garden wooden furniture from wicker or impregnated laminated wood. Another main field of study at the University of Forestry is forestry engineering and the training of constructors and designers of furniture for residential and public buildings. Graduates of this specialty in our country are realized as designers and constructors. They successfully work in consultancy companies and companies exercising activities in the furniture industry. Some of the graduates find work as consultants, experts and organisers in the development of projects related to the forestry sector and the production of furniture from it, and also as teachers in

vocational schools of forestry and forestry. Often, students who have successfully graduated from forestry universities in the country manage design offices, small and medium-sized enterprises in the furniture industry. In the bachelor's degree they receive design and engineering training, certified by a diploma of higher education and acquire the professional qualification "Design Engineer in Engineering Design". In the Master's degree, management, specialization and design disciplines are studied in more depth and at a higher level, selected according to the chosen specialization: product design; design of the living environment and design of the urban environment. The training is carried out in full-time form. Since we live in a technological age in which the use of artificial intelligence is already a real fact, the Forestry Institute offers training aimed at mastering computer technology in the furniture industry. General engineering and prepares engineers for the needs of the furniture industry with competencies in digitalization, digitalization and CNC technological processes. The Bachelor's and Master's degrees provide fundamental knowledge in furniture engineering and digital technologies and informatics based on the Industry 4.0 platform, including cloud technologies, internet technologies, augmented virtual reality and engineering information management. Graduates of this specialty are realized in all areas of industry as technologists and designers, working with modern computer methods for design and management in the furniture industry, consultants, experts and organizers in the development of technological and innovation projects, as well as teachers in vocational schools. The Bachelor's degree provides engineering training, certified by a diploma of higher education, and acquires the professional qualification of "Engineer of computer technologies in the furniture industry". In the Master's degree, management, specialization and methodological research disciplines related to the digitalization of furniture production are studied in greater depth and at a higher level management, specialization and methodological research disciplines related to the digitalization of furniture production.

In our country, apart from the Forestry University Sofia, in the field of forestry and its sustainable management work partly Technical University_Varna, Technical University-Gabrovo, University of Economics-Varna in the specialty of Agricultural Economics and specialty of Ecoeconomics, Plovdiv Agricultural University. Some of the universities are even developing joint programmes. Such a good example can be pointed out between the Forestry Technical Institute Sofia and the Technical University of Gabrovo with the Master's programme "Furniture Industry 4.0"The training in this specialty is only in the master's degree and is in the full-time form of training. Graduates of the specialty "Furniture Industry 4.0" receive knowledge, skills and acquire competencies for computer-aided design and automated control of technological processes for furniture production, as well as technologies directly related to the digitalization of the furniture industry. Graduates of the Master's program are realized in all areas of industry as technologists and designers working with modern computer-aided design and management methods in the furniture industry. Often students graduated from these programs work in the field of automation and robotization of furniture companies, as well as in consulting companies and companies specializing in the implementation of digital technologies and Internet-based systems in companies

from the furniture industry. They also work as consultants, experts and organizers in the development of technological and innovation projects, as well as teachers in vocational schools of forestry. In addition to their Bachelor's and Master's degrees, students in our country can also obtain a doctoral degree and defend their PhD in the following fields: Ergonomics and Industrial Design; Wood Science and Wood Materials;Machinery and Equipment in Forestry, Logging, Woodworking and Furniture Industry;Technology, Mechanization and Automation of Woodworking and Furniture Industry. It is logical that technical universities should teach mainly technological subjects, while economic universities should look at the economic effects of the application of forest resources as well as their social effects. For example, at the University of Economics Varna, the subject of Ecological Practices in the Agricultural and Forestry Sector is of great interest to students, where the application of forest belts and their extraordinary effect on soil moisture conservation, the fight against water and wind erosion, the conservation of biodiversity in them, as well as the biological balance in the Dobrudja region where they are mainly located in Bulgaria are discussed. In their long history, universities working in the forestry and agricultural sectors have built excellent relationships with related faculties and universities in many countries. Facts that illustrate the international authority of Bulgarian universities are the participation of the faculty in various scientific events abroad, such as conferences, round tables, symposia, exhibitions, fairs and other joint participations. In addition, a number of prizes won, scientific achievements; winning competitions for projects funded by international foundations; being awarded honorary degrees, members of WooDema, members of IUFRO; members of the American Society of Forest Engineers, etc. ; the graduates of the universities of forestry and forestry in Bulgaria, work together with other foreign universities (USA, Canada, Sweden, Japan, Chile, France, Switzerland, Germany, Croatia, Slovenia, Slovakia, Poland, Russia, Ukraine, England, etc.). Table 1 clearly shows that Bulgaria at the beginning of the analyzed period, which for it was the year of its accession as a member state to the European Union, had mainly and only strong contacts in the direction of developing joint training projects with Russia. After 2007, gradually with the entry of our country into the European Union things changed. Our country became much more active in participating and working on educational projects with other countries around the world. However, we believe that it could be much more active in this direction and that many more joint study projects could be developed in the field of forestry and the forest industry.

Today, the pupils and students from the country, as well as their teachers, successfully participate in international projects under the TEMPUS, PHARE and Leonardo da Vinci programmes. They do joint research work with teams from foreign universities (Russia, Slovakia, Serbia and Montenegro, Republic of North Macedonia, Greece, Switzerland, Poland, Belarus, Czech Republic, Hungary); They participate in the Erasmus programme. In addition, Bulgarian lecturers provide scientific and technical assistance to organizations and companies from third countries, for example: Sudan, Lebanon, Slovakia, Republic of North Macedonia, Czech Republic, etc.

Table 1. Countries involved in joint forestry training projects for Bulgaria

Countries	2007	2014	2021
USA	0	4	10
Canada	0	3	5
Japan	0	0	4
France	0	1	5
Germany	0	5	4
Croatia	0	2	4
Slovenia	0	3	3
Slovakia	0	4	3
Poland	0	2	3
Russia	8	2	1
Ukraine	0	2	1
England	0	1	2

3. MONITORING AND CONTROL OF THE FOREST SECTOR

In addition to training, resilience is also developed through forest inspections and systematic sanctions of violators. Over a five-year period in Bulgaria from 2019 to 2024 inclusive, almost 10,000 inspections have been carried out in the country. 350 violations have been identified, for which 232 acts have been issued, says the executive forestry agency. Sustainable forestry in our country is also developing thanks to the Union of Foresters in Bulgaria. It is a voluntary independent public-professional organisation, which has a statute and a platform for national forestry policy, established as a non-governmental organisation. As the Union of Foresters, it aims to be an independent public guarantor for the protection of national interests in the implementation of forest policy and works to promote the authority and rights of the Bulgarian forester. According to the Non-Profit Legal Entities Act the Union of Foresters is registered with the court and has a legally adopted statute. The structure of the Union of Foresters is: a general assembly, a governing council and 16 regional councils, as well as 151 societies per region in the country. The main control body in the field of the forestry sector is the Ministry of Agriculture and Forestry in Bulgaria, as well as the executive agency for forests. These two bodies are responsible for compliance and care of forestry farms in the country.

4. CONCLUSION

What can be the future directions in order to have a better continuity on the part of the young generation in their care and love for forests. In our opinion, this can be the creation of the so-called forest schools under the open sky, the construction of special

places with wooden tables and benches, where children can learn in living nature about its inhabitants, flora, fauna, rich flora and fauna. There are such schools built in Shumensko Plateau Nature Park, Golden Sands Nature Park and in other places in the country, but they are not enough. This could greatly motivate the young generation to get to know and love the forest and its inhabitants.

Another very good approach is to include more lessons on environmentally friendly practices for the protection of the forest sector already in the children's elementary course. Clarifying the possibilities of applying forest belts and their extremely important functions in the field of the agricultural sector, the preservation of biodiversity in the area, soil moisture, protection against wind and water erosion. And these are extremely important factors in relation to the global warming that has been observed in recent years. And last but not least, unifying the efforts of universities, schools, branch organizations and associations to achieve better indicators in the direction of sustainable use of the forestry and forestry sector in Bulgaria.

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5. SELECTED CREATING FACTORS OF THE INTEGRATED URBAN FOREST - THE CASE OF KOBIERZYN FOREST GARDEN IN THE KRAKOW METROPOLITAN AREA IN POLAND

Leszek Wanat

1. FOREST-BASED CITY - AND FOR WHAT?

Can you point to an effective 'creator' of garden-cities [1], as well as other friendly, sedate, urbanized living places, the so-called 'cittaslow' [11]? Let's take a risk, such a 'creator' is and can be a forest. This presence in the forest space teaches modern leaders more than just sustainability [13]. The forest becomes a promoter of integral human development [12]. An example of a large urban agglomeration where a future forest park has been made available to residents is the dedicated area of Krakow's Kobierzyn [2]. It was first a suburban village, then a city district. Today it is noted with surprise that this is still an undiscovered 'pearl' of the urban forest in Krakow. Why? Because a place has been set aside for the sick in the big city. Which ones? For 'special' patients, with mental disorder, for people of the 'last category', the excluded, the social margin [5]. The forest was therefore also 'excluded'. Meanwhile, unfunny jokes are still told about Kobierzyn.

So where did the idea of linking the city and the forest come from? Was it linked exclusively to sick people, and those afflicted in particular, mentally, called, sadly, idiots? No. It would appear that the modern promoter of the garden city idea was Ebenezer Howard (1850-1928), a British planner and urbanist. A young Howard, aged 21, emigrated to America and settled in the Nebraska state. He quickly decided that the farmer's life was not for him. He therefore moved to Chicago. In the big city he worked as a journalist. The fruit of his observations became the search for possibilities to improve living standards in the city, especially in the metropolis. In 1898 he published the book '*Tomorrow: A Peaceful Path to Real Reform'*. Four years later, the book, already as a reprint, was given new life and a new title: '*Cities - the gardens of tomorrow*'. What was new was the vision of slum-free cities enjoying a symbiosis of the city's benefits (development opportunities, jobs and high wages, culture and entertainment) and those of the village (natural beauty, fresh air, low cost of living) [4]. The idea took hold, fruited. New towns were created, suburbs of limited size, specially designed, surrounded by a permanent strip of greenery and farmland. So, as Howard thought, were 'Garden Cities' likely to become the perfect marriage of city and nature? Thus, since the idea was a proposal for healthy people, did it already mean exclusion at this stage? But no. After all, cities are not just made up of streets and houses, but of people, healthy and diseased, their dreams and hopes.

Today, when many of us are struggling with various mental problems, such as depression, the point of view is also changing. We are urgently seeking a possible effective therapy. It is not a new finding that man needs, only and until, another person, silence and a forest [17]. Some will ask: what's that? Forest in the middle of the city? And it's for everyone? For the so-called 'normal' and excluded together? Is this possible? Let's pose a challenging anthropological question about the forest [7]. Not only about its natural, economic, or social function [9, 14]. It's also a question about the healing, therapeutic forest function, even one as small as an urban or hospital forest park [6, 8]. Why does such research make sense? Because the answer, verified in the practice of life, is not at all so obvious.

2. HOW AND WHY TO STUDY THE UTILITY OF URBAN FOREST PARKS?

The starting point for a possible evaluation of urban forest parks and their importance, was a retrospective analysis. It was based on historical, but also current data sources. The experience of forest complex users in Krakow-Kobierzyn, where the Dr. Józef Babinski Clinical Hospital operates, was verified. One good place to talk about history and do survey research is the library (Figure 1).

Figure 1. Library in Hospital-city-garden in Kobierzyn in 2020 and at the beginning, in 1920. Source: Archives of the Dr. Józef Babinski Clinical Hospital in Krakow [4]

The library building is the gateway to the designed area: as a garden city. The case study for this place made it possible to assess the current situation and development dilemmas. A diagnostic survey completed the analysis. Opportunities and threats to the activities of the unique forest complex were studied. Ten specialists were invited to the expert survey. Individual in-depth interviews were conducted. They were supplemented by the authors' participatory observation during a visit to a forest-park in Kobierzyn. The results of the pilot study were aggregated as anonymous. Finally, key recommendations for new studies were identified.

What is the background to the proposed study? You never know when one of us might experience mental illness. What might the consequences be? The mentally ill are still the most socially stigmatised group of diseased people, not only in Poland. Their suffering is still the most diagnostically 'mysterious', socially misunderstood and economically unacceptable. It is interesting that by cutting costs in medicine, we are cutting costs most often (that is, psychiatric hospitals). Even the hypothetical healthcare savings programme operates on 'crazy papers'. Such an observation is shocking. We do not understand the mentally ill, we do not identify with their suffering. That is why we are afraid of them. In any case, we try to keep a 'safe' distance from them. Admittedly, we know that the mentally ill do not infect. But if they somehow 'virtually' give us their mental suffering...? What to think: and who needs a diagnosis here?

The de-stigmatisation process begins with the establishment of some form of contact between a healthy person and a mentally ill person. It thus involves the creation of a relationship, from the simplest one to a progressively more mature, multidimensional one, up to a creative, active interpersonal closeness. This is also supported by the closeness of the environment, and, of course, to nature and the forest.

It used to be the case, if only a century ago, that psychiatric hospitals were built outside the city, at a safe physical and mental distance from the people. It is enough to point to: Steinhof near Vienna, Bohnice near Prague, Kulparków near Lviv and Kobierzyn near Krakow. Today, they (built a century or so ago) have all been 'absorbed' by large urban agglomerations. The cities moved closer to the diseased and finally assimilated the psychiatric hospitals, but did the hospitals move closer to the cities? The same can be said of the forest. Once upon a time, in an era when forested areas dominated, it was in the forest space that people sought, or created, a place for their home. Then, gradually, human settlements moved away from the forest. They created their own space, urbanised. Today, the two spaces, forest and urban, are looking for each other again.

The majority of psychiatric hospitals, erected at the turn of the 20th century, had large-scale park and garden territories. Places for the treatment of the mentally ill were surrounded by a deliberately composed landscape, created according to the trends of garden architecture. Why? Because being in a beautiful, natural environment, communing with nature, understood according to the idyllic image of the village at the time, was supposed to be conducive to the treatment of diseases, including mental illnesses. The Kobierzyn Hospital, based on this design concept, has an area of more than 52 ha, and lives up to Ebenezer Howard's idea of a garden city. Today's Krakow needs the 'yesterday's' Kobierzyn of a hundred years ago. The metropolis needs beautiful green space, it needs a well-kept forest park.

Since the built-up, crowded 'Krakow', needs the green 'Kobierzyn' and 'takes it for itself', it is worth understanding what sense this makes. Why is it that the space of isolation for the mentally ill, which attracts with the beauty of nature: plants, trees, forest, is increasingly frequented, consciously or not, by ordinary residents? Is this

a natural and useful social process? For these reasons alone, it is worth exploring the natural, social, but also the ‘human’ phenomena identified in Kobierzyn's forest park.

3. THE CASE OF KOBIERZYN GARDEN CITY IN THE KRAKOW AREA

First, scientific and practical sources were analyzed. Hospital gardens were created as early as the 18th century, based on monastery viridarii. This was not done without a reason. Was it a nostalgia for the Eden garden? Maybe. However, it wasn't until the third decade of the last century that the hospital's forests began to be cultivated. They were successively profiled. So-called balanced, harmonious gardens were created. Initially, the goal was 'balance’. This 'consonance' of plants made 'harmony’: a symphony of colors, shapes and smells pleasing to the senses. This 'symphony orchestra' was completed by animals, especially birds. Is this a stable image of the forest park? Unfortunately, no. Despite the scientific recognition the methods of hortiterapia or sylvaterapy relatively rare support the healing. One forgets that medicus curat, natura sanat. And the creation of new forest parks faces formidable barriers. What are they? The barriers are: first: ignorance, and immediately after: costs. It may be possible to overcome the first. So will economic terms be the determining barrier? Data in the literature have been verified [7, 8, 19].

Figure 2. Hospital-city-garden in Kobierzyn in 1917 (balloon view).
Source: Archives of the Dr. Józef Babinski Clinical Hospital in Krakow [4]

It was noted that a utilitarian approach to the use of hospital lands still prevails: greenery only serves aesthetic and isolating functions. This is not enough. The idea of a circular economy has been forgotten [9]. Adequate natural therapy, can reduce treatment time, improve its effectiveness. How? Creating a human-friendly forest space can minimize the 'stress of treatment' and, as a result, the length of a patient's hospital stay.

The case study explained how the Kobierzyn forest came to be. More than 100 years ago, the hospital complex's designers were, to use today's slang, 'innovative'. They thought of greenery, harmony, a friendly urban arrangement and an interesting architectural style. For designers, it was the norm, the obvious. The buildings were constructed between 1907 and 1914, and the hospital began service in 1917 (Figure 2), and formally started on the first of January 1918.

Figure 3. Hospital-city-garden in Kobierzyn in 2023 (drone view).
Source: Based on the 'lovekrakow.pl' photo album [19].

The State Institute for the Mentally and Nervously Ill (Państwowy Zakład dla Umysłowo i Nerwowo Chorych) in Kobierzyn, was then a very modern hospital for the treatment of the mentally ill in Europe. Since 1999, the hospital complex has been listed in the Register of Historic Places. It is gradually regaining 'life', due to conservation renovations. But this place is still 'seen from the side', from a car or city bus drive through Krakow on Babinski Street. Nonetheless, more and more residents are going to this green area for a walk, or even taking a guided tour of Kobierzyn. The living 'urban forest' invites guests to visit and relax (Figure 3).

Forest hospital parks are 'garden areas', designed for recreational use. However, their value as partners in therapy has been recognized. In specialized clinics, green areas are adapted to the specific patient groups. Thus, hospital gardens for children,

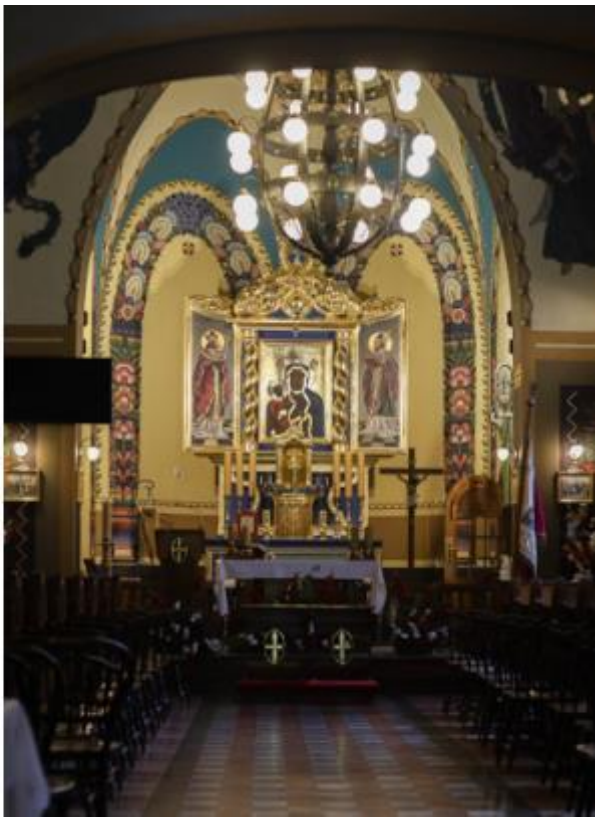
gardens for geriatric patients (Alzheimer's and dementia syndromes), for oncology patients, and for terminally ill patients are being created (Figure 4).

Figure 4. Hospital-city-garden in Kobierzyn in in 2023 (drone view).
Source: Archives of the Dr. Józef Babinski Clinical Hospital in Krakow [4]

Finally, as in the case of Kobierzyn, forest parks are being established for the mentally distressed. This 'special forest' links two essential goals: recreation and therapy. Recreation is dedicated to the healthy: hospital guests and medical staff.

Figure 5. Hospital-city-garden in Kobierzyn in in 2023 (drone view).
Source: Archives of the Dr. Józef Babinski Clinical Hospital in Krakow [4]

Therapy in nature helps patients. However, the most important cumulative goal is inclusion. In the forest we are all equal. The forest accepts no one's exclusion. This is the power of urban, open forest parks and their greatest advantage (Figure 5). And the defects? The costs of setting up and developing a hospital park was identified as the main 'disadvantage'. However, when a forest park becomes an open space, an urban common resource, it is easier to manage. Thus, it is necessary to the common good, accepted by foresters, as well as by the municipal government - as its own task, implying the need for cooperation [15].



Figures 6-7. Forest park chapel in Kobierzyn / Our Lady of Czestochowa Chapel view. Source: Based on [author's photo by Ewa Gil-Kobiałka, Kraków 2023] and [2].

The finding of the study visits and surveys is clear: for Kobierzyn Psychiatric Hospital, besides its medical resources, the key is its forest park. A friendly, well-managed hospital forest is the best place to destigmatize the mentally ill and integrate the healthy. It's not about some 'part of therapy', but about integral human development: physical (this is where medicine helps) and spiritual (this is where culture, leisure, nature and faith can be helpful). In the drama of illness, a person's questions about spiritual life are also not ignored. It is interesting that the value of religious experience brings everyone without distinction to the chapel of Our Lady of Czestochowa: believers and non-believers (Figures 6-7). Right next door, the hospital's historic, newly renovated pavilions are full of patients. The intensive work is ongoing: medical doctors, therapists, chaplains [6].

On the forest park paths everyone is equal - no difference. They meet on the same roads: the healthy and the ‘crazy’, the ‘varia’ (from the Latin: varia, varius - meaning different, another, otherwise ill, otherwise suffering) [2]. Many people still feel uncomfortable and insecure in this place. It is not easy to share physical and social space with the mentally disordered. Meanwhile, the forest provides certainty and hope. You can't chicken out, run away, from illnesses, from the Other. We are 'doomed' to each other, in a good way, of course [4, 18]. This is the anthropology, the simple fraternity of people and nature, that the forest permanently teaches us.

4. FOREST-BASED SYMBIOSIS OF CITY AND NATURE: RECOMMENDATIONS

The management of urban forest areas, especially with a metropolitan structure, should be based on the support of those factors that promote the modeling of an integrated urban forest [3, 10, 16]. The case of Krakow's Kobierzyn provides proof that it is possible to: (a) symbiosis of the city and nature, (b) limited forest management in a dedicated forest park area, (c) availability of forest recreational space, (d) nature conservation in a forest garden, as well as (e) development planning.

It is important to note that Kobierzyn as a place for the treatment of mentally ill people (52 hectares of beautiful forest in the city, a forest park) has already opened up to the community of Krakow multidimensionally. Unfortunately, for the time being the community of Krakow is not yet open to the community of mentally ill and suffering people and their place of treatment. This urban forest of healing is still tainted in the mentality of many people by a mechanism of social behaviour. This mechanism has a name: it is the mental illness stigmatisation.

How to revitalise the de-stigmatisation process? Maybe we need to start with information, with an interest in the city forest in Kobierzyn. It is necessary to get to know this place of suffering and healing for the mentally ill, to learn about its history and specifics. How to do this? Simply by being. To be in person, to discover this ‘garden town’ physically, to experience the presence of the mentally ill.

Then you will find that… we are the same, and in a beautiful natural and architectural space, together we become healthier, better, joyful, and more happy.

Based on the documents assessment, data collected during the study visits, as well as comparative and descriptive analysis, the following conclusions and recommendations were formulated:

1) Using the case of the hospital forest in Krakow-Kobierzyn, it was noted that in Poland it is difficult to overcome the so-called 'utilitarian' approach to the management of hospital lands. Institutional, closed, hospital forest performs only aesthetic and isolating functions.

2) The diagnostic survey confirmed that a change is possible and needed, that is, an orientation toward an active, therapeutic function of the forest in a garden city, even a metropolitan one. At least two ‘arguments for change’ were identified.

3) The first, quantitative argument for change is the effects of the work of therapists, including priests (hospital chaplains) with patients. Any form of activation

based on forest space, allows patients to more quickly return to mental balance, to find the meaning of life, and therefore to relative normality. The group of 'rescued', recovering patients is steadily growing. Unfortunately, the volume of new patients also too.

4) The second, visual argument for change, is the increasing return of patients with psychiatric dysfunction to normal daily activities. The space of Kobierzyn forest is visited by 'healthy' residents, families with children, seniors. They are not afraid of stigmatization, exclusion. Together with patients, they create in the urban forest an inclusive space for integral human development.

Just against the background of the pilot study in Kobierzyn one can see the tasks for medicine and for forestry. Various forms of activation in the forest park can serve not only the treatment of hospital patients, but also the development of forestry, even on a micro-scale.

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6. FROM PAST TO PRESENT: THE STRUGGLES AND SOLUTIONS FOR REUSING WOOD IN MACEDONIAN ARCHITECTURE

Marija Miloshevska Janakieska

1. INTRODUCTION

In Macedonian architecture, wood had always been a very important material. It had been used as a structural and decorative material, which improved both the exterior and the interior aesthetics of buildings. Sadly, despite its broad application in the past, nowadays in Macedonia wood is mostly used in weekend houses in the mountain regions, in interior decorations as furniture, and as a façade cladding due to its beautiful aesthetics. There is a new wave of companies specializing in the production of timber single-family houses, but when it comes to bigger buildings, reinforced concrete and steel are leading structural materials.

In the past two decades, a new category of wood products has been developed, laying the foundation for a diverse range of increasingly functional building solutions, unifying performance and sustainability aspects. This evolution happened with the innovative industrial processes that made wood a material with better properties. The result is a class of products commonly known as engineered wood products (EWPs) applied in architectural designs. The engineers in Macedonia are trying to follow these trends observed in more developed countries, integrating the application of EWPs in their construction processes.

Moreover, the circular economy has become the focus of many EU policy programs, hence the reuse of different construction materials is becoming more and more important, especially in the building sector. The usage of reclaimed wood is inspired by factors such as environmental advantages, distinctive aesthetics, historical significance, and a commitment to sustainability.

Macedonia is making efforts to promote building sustainability and circular economy, while at the same time focusing on the strategic goals related to the catalysis of green industry and green production, which is included in the new industrial strategy 2018-2027.

This chapter aims to investigate the challenges for reuse of some building materials in Macedonia, with a focus on wood, a topic which is relevant because it addresses the practical aspects of sustainability within the forest-based sector, focusing on how wood, a key resource, can be reused in construction, highlighting both challenges and potential solutions. The context of Macedonia adds a regional perspective, especially by providing specific examples of how these challenges manifest in different areas.

1.1. Wood Application in Macedonia

Wood has always been an inseparable element of Macedonian architecture. The pile dwelling settlements which were built on the Macedonian lakes, Ohrid, Dojran, and Prespa Lake, are a perfect example of sustainable architecture, through the connection with nature and natural materials application (Figure 1).

Figure 1. Prehistoric settlement in the Bay of Bones near Gradishte on Ohrid Lake - example of wood application in the structures from the past [https://muzejohrid.mk/museum-on-water/]

The availability and ease of use have made the wood indispensable since ancient times, which led to its organic integration into Macedonian vernacular architecture. Wood was applied as a material for the structure of the building and architectural elements such as stairs, doors, and window frames. Traditional Macedonian dwellings combined high technical standards with comfortable living, providing a holistic residential experience. It is important that wood was used as a structural material in the Macedonian vernacular architecture for the walls, slabs, stairs, and roof structure. The walls were designed from a timber frame structure, created by vertical, horizontal, and diagonal wooden carriers. These carriers were cladded from outside and inside, creating a specific wall structure, called the “bondruk” structure. Besides the structural stability, these walls had very good insulation properties. Some of the wall carriers were left visible on the façade, creating a very nice façade aesthetics (Figure 2).

Figure 2. The Ottoman Era Houses in Ohrid, Macedonia – the wooden structural system (bondruk system) of the traditional Macedonian house

Unfortunately, in the last few decades, wood has not been used so much in Macedonian architecture, compared to its previous application. The material choices in Macedonia have become increasingly limited, with designers, investors, and companies sticking to non-wood materials. The widespread use of steel and concrete, particularly following the 1963 earthquake in Skopje, has diminished the importance of wood.

On the other hand, the progressive practices across Europe are focusing on environmentally friendly materials, especially wood and various EWPs. Implementation of new products in Macedonia often encounters limited awareness and uncertainty among investors, engineers, and designers. The situation is slowly changing and people are starting to see the positive features of living and using sustainable EWPs. However, there is a need for greater dissemination of information regarding EWPs, especially about their application.

The limited adoption of EWPs in Macedonia can be a result, in part, of the absence of cross-laminated timber (CLT) or glued-laminated timber (GLT) production facilities within the country. When there is a need for these specific types of EWPs, they are typically sourced through import from neighbouring countries that possess established production capabilities. Commonly, CLT and GLT find their application in the construction of roof structures in buildings. The absence of local production in Macedonia leads to elevated prices for these essential structural components, thereby causing discouragement among investors. Architects are trying to convince investors to incorporate these elements, yet the ultimate decision rests with the investors, who care most about economic viability.

Architectural students and young architects are especially motivated to implement timber and EWPs in their projects. Figure 3 shows a project for a Botanical Garden in Skopje with GLT application for the main structure. The choice of materials is completely aligned with the function and the location of the building. This building is designed in a city park, a natural environment with a lot of greenery. Its purpose is a botanical garden, so the choice of using glued laminated timber came very naturally to complement the function and the context.

Figure 3. Project for Botanical Garden in Skopje, designed by Faton Kalisi

In Macedonia, the wood sector has a very long tradition and has always been an important segment of the country's economy. To get a better picture of the importance of the forest sector, some additional information regarding relevant forestry statistics is presented in Table 1. Table 2 identifies the key differences in wood-based construction in Macedonia.

Table 1. Macedonia – Selected Forestry Data, 2023

Population*	2 093 599
Total area (km^2)**	25 713
Surface area of forested land (km^2)***	10 015
Forested area (%)***	39.71%
Number of naturally occurring tree species	319
Growing stock (m^3)	$75.94 \cdot 10^6$
Annual growth of growing stock (m^3 forest)	$1.62 \cdot 10^6$
Annual harvest (m^3 forest)	$1.34 \cdot 10^6$
Hardwoods (m^3)	-
Softwoods (m^3) **Sawn wood**	-
Consumption per capita (m^3/y)	0.1

* Worldometers. Available online: https://www.worldometers.info/world-population (Accessed on 24th of March 2024)
** Worldbank.org. 2020. Available online: https://www.worldbank.org/en/home (Accessed on 24th of March 2024)
*** World Data Atlas – North Macedonia – Forest Area – 2021. Available online: https://knoema.com/atlas/North-Macedonia/topics/Land-Use/Area/Forest-area (Accessed on 24th of March 2024)

*Table 2. Wood-based Construction in Macedonia**

Share of detached houses in residential construction (%)*	n.a
Market share of wood in detached houses (%)*	2–5
Market share of wood in multi-story construction (%)	-
Maximum number of floors allowed from wood, with sprinklers, in 2024	Not specified in the fire-fighting standards
Key wood construction techniques	Timber panel Traditional timber-frame Massive timber
Organizations promoting wood at national levels	Faculty of Civil Engineering Skopje, University "Ss. Cyril and Methodius"; Faculty of Engineering, International Balkan University, Skopje; Building companies such as Geo-Ing Wood Construction in Skopje, Eco House MK in Skopje, Hot-Hot Construction – Representative Office in Skopje, Tehcom from Kochani and Ken Panel from Skopje
Sawn timber consumption per capita (m^3/y)	0.1

*MKD: North Macedonia in numbers, 2022, Republic of North Macedonia, State Statistical Office, Skopje

2. INTEGRATING CIRCULAR ECONOMY STRATEGIES IN BUILDING CONSTRUCTION

A circular economy (CE) emphasizes the repeated use of products, significantly reducing CO_2 emissions, minimizing waste, and delaying the demand for new materials [7].

Nevertheless, realizing these advantages demands involving stakeholders throughout the value chain in the transformation of behavioral and social systems. It also includes designing industrial economic and production systems that facilitate, embrace, and endorse circularity within the system [9]. Circular economy (CE) stands as a crucial policy objective in Europe, making sustainability and life cycle thinking progressively focal points of attention [4, 5].

Buildings are responsible for about a third of global energy consumption and a quarter of CO_2 emissions [3]. Architects, engineers, designers, investors, construction companies, and all other involved parties should feel responsible about this and should try to implement circular economy strategies as much as possible.

The European construction sector pointed out the importance of reducing operational energy consumption to lower the negative effects of the buildings on the environment, which is huge. However, as buildings are improving their energy efficiency following the new standards, the environmental impacts associated with the phases of production, construction, maintenance, and depositing of building materials represent a growing part of a building's overall environmental footprint. Following this trend, the Circular Ecomomy (CE) is acknowledged as a crucial method in sustaining the efforts to decrease negative environmental burdens of buildings [7]. Therefore, using the principles of CE in the construction sector is highly recommended.

2.1. Circular Economy Strategies

When it comes to the circular economy a framework is applied based on 10 common strategies for achieving it, i.e. recover, recycle, repurpose, remanufacture, refurbish, repair, re-use, reduce, rethink, and refuse. Figure 4 shows these 10 common strategies.

Smarter product use and manufacture	R0	Refuse	Make product redundant by abandoning its function or by offering the same function with a radically different product
	R1	Rethink	Make product use more intensive (e.g. through sharing products or by putting multi-functional products on market).
	R2	Reduce	Increase efficiency in product manufacture or use by consuming fewer natural resources
Extend lifespan of product and its parts	R3	Reuse	Re-use by another consumer of discarded product which is still in good condition and fulfils its original function
	R4	Repair	Repair and maintenance of defective product so it can be used with its original function
	R5	Refurbish	Restore an old product and bring it up to date
	R6	Remanufacture	Use parts of discarded product in a new product with the same function
	R7	Repurpose	Use discarded products or its part in a new product with a different function
Useful application of materials	R8	Recycle	Process materials to obtain the same (high grade) or lower (low grade) quality
	R9	Recovery	Incineration of material with energy recovery

Figure 4. CE strategies, from Potting et al. (2017) – colours modified. [8]

All these strategies can be applied in the construction sector. "Refuse" means all the materials, ornamentations and decorations don't have to be used. "Less is more" functions perfectly in architectural designs. Rethink implies different thinking in the design of functionality, and in using alternative materials. "Reduce" can be achieved by reducing the number of materials needed and reducing the floor area. "Reuse" refers to the process of using an item or material again for the same or a different purpose without significantly altering its form. "Repair", "Refurbish" and "Remanufacture" implies fixing and restoring something without creating additional waste. "Repurpose" is creating a new purpose for one material or element and can be

implemented easily in architecture. Materials can be “recycled” and “recovered” as well.

2.2. Wood and Circularity

Engineered wood products are receiving many acknowledgments within the frame of the Circular Economy as environmentally friendly and sustainable alternatives suitable for new constructions, renovations, interior design, furniture, and various innovative applications. Furthermore, they possess the ability to effectively capture substantial amounts of carbon, which helps in the process of reuse and recycling in different stages of their lifespan. Figure 5 illustrates material flows in the forest-based sector as potential opportunities for circular practices.

Unlike conventional building materials such as concrete and steel, which have significant carbon footprints, EWPs offer a renewable and low-carbon alternative. Moreover, the production processes of EWPs have been optimized to minimize waste and maximize the use of every part of the tree, which further enhances their environmental benefits.

EWPs offer the possibility of implementing circular economy strategies, such as recovering, recycling, repurposing, remanufacturing, refurbishing, repairing, reusing, reducing, rethinking, and refusing.

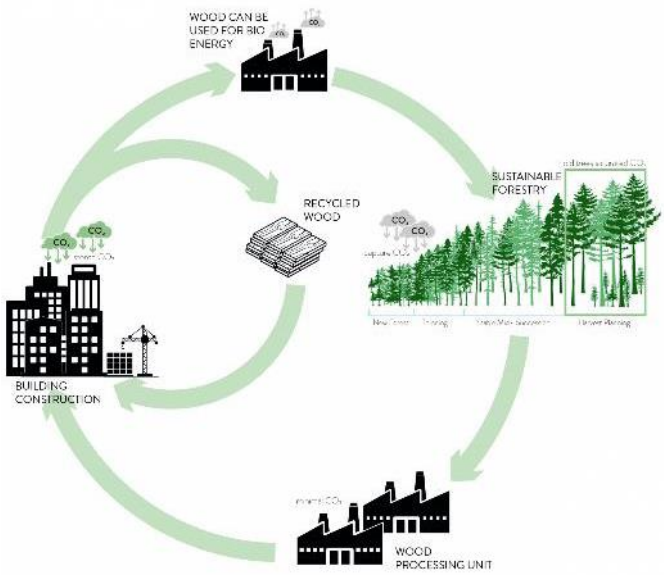

Figure 5. Circularity of wood [1]

3. REUSING WOOD IN BUILDING CONSTRUCTION IN MACEDONIA

Macedonia is embracing current circular economy trends through initiatives like the Bio-hack My World Project in Skopje. This project aims to establish a biohacking laboratory that will involve local communities in developing sustainable solutions for

biowaste management challenges in the country. The lab will utilize biowaste as a catalyst to drive innovation, education, and community engagement in tackling the country's environmental issues. By providing essential equipment, the biohacking laboratory seeks to empower innovators, entrepreneurs, students, and educators to experiment with, learn about, and test ideas and social innovations related to biowaste. [10].

The circular economy strategy of reuse is becoming important in Macedonia, striving to keep up with the latest examples in developed countries. This is especially emphasized in the construction sector. Many materials are reused in building constructions in the country. Although the process is going slowly, some initial steps have been taken.

One of the most used building materials in Macedonian architecture is concrete, especially reinforced concrete which is used as a structural material for the building structure. Recycling concrete reduces a significant amount of construction waste, and construction costs, but also reduces the amount of CO_2 emissions when creating new concrete. A special machine - crusher is used to recycle solid concrete, which is used to produce a material known as "recycled aggregate". Until recently, recycled concrete was used only for the production of foundations and slabs, but tests have shown that concrete aggregate with efficient technologies can provide structural elements of 30 to 40 MPa. It is also very important that recycled aggregates are 10 to 15 percent lighter than "original" concrete, which means less volume per cubic meter of structure, as well as lower cost for transportation.

Steel is also used in buildings in Macedonia, mostly as a structural material for columns, beams, and trusses in the structural frame system, as well as for the production of reinforcement in the reinforced concrete. Steel recycling dates back to the Roman Empire when soldiers collected military items left on the battlefield and used them to make new weapons. Namely, steel can be endlessly transformed into new products without losing quality. Rebars, wires and various metal profiles, are mostly made from recycled steel in Macedonia.

Expanded polystyrene, commonly known as Styrofoam, is also recyclable. This material can be used for the production of new plastic products and also for the production of coatings and paints.

The use of "recycled wood" has become extremely popular in recent years. Solid recycled wood can be used for making larger structural elements or it can be used in the shape of slats for the production of crates, pallets, or carriers for various purposes. This wood can also be used to make formwork for the reinforced-concrete structural elements, which can be applied over and over again on construction sites, which also contains the concept of re-use.

Softer wood, which is usually cheaper, can also be recycled and is often used for the production of different panels. Moreover, recycled wood is often used to make medium-density fiberboards (MDF boards) as well.

Another product made from recycled wood is the Wood-Plastic Composite (WPC) which is a decorative panel. It is an innovative and environmentally friendly material created from recycled wood and plastic powder. WPC panels combine the natural

appearance of wood with the durability of polymer materials, offering several benefits: they are waterproof, resistant to wood-attacking insects and parasites, UV-resistant, and resistant to acids, alkalis, abrasions, and scratches. These panels require no painting and are fully recyclable. They boast a long service life without corrosion, cracks, deformation, or waste, and require no maintenance while offering high load capacity. Additionally, WPC panels have an attractive appearance, are easy to install, and require minimal maintenance, saving time and labor while ensuring high efficiency. These features make them an excellent choice for various customer needs, particularly as a wall decoration in interior design, as shown in Figure 6. [12]. These panels are commonly used by architects and interior designers in Macedonia, mainly for interior decoration.

Figure 6. WPC panel used as a wall decoration [12]

Repair, refurbish, remanufacture and redesign of used furniture is part of the strategies for circular economy that is gaining momentum in our country. "URBAN OLD" from Skopje received a Special Award for redesign of used furniture (Figure 7), which deserves attention not only from an aesthetic but also from an environmental point of view [9].

Figure 7. Redesigned furniture in Macedonia [9]

Applying the principles of circular economy is going slowly in Macedonia, and it is adopted mainly in the choice of materials especially in the interior design. However, there is a trend of constructing eco-houses from natural materials and it is attracting

attention lately (Figure 8). In these houses, wooden window frames and wooden doors that have already been used before are applied. Instead of being thrown away as waste, they are reused as part of these new eco-houses. The roof structure of these houses can be different, but it can be done with wooden carriers as well. All materials used for these houses are natural and many of them are reused or repurposed. Moreover, these houses incorporate the aspects of energy efficiency, sustainability, and biophilic design [2].

Figure 8. Building eco-houses in Macedonia [2]

4. CONCLUSIONS

Macedonian architecture has a rich history of wood application, which is now being revisited and revitalized within the framework of the circular economy. While wood has traditionally played a crucial role in both structural and decorative applications, its modern use in Macedonia is largely limited to smaller-scale projects and aesthetic purposes. However, with the growing awareness of sustainability and the introduction of engineered wood products (EWPs), there is an emerging shift towards integrating wood more extensively into contemporary construction practices.

Macedonia is trying to follow the European circular economy trends, which is evident through different initiatives, including the promotion of biohacking and the reuse of materials in construction. Although the adoption of circular economy principles is still in its early stages, particularly in the building sector, there is clear growth potential. By embracing innovative practices and fostering greater awareness among investors and designers, Macedonia can advance its efforts toward a more sustainable and environmentally friendly construction industry. A greater dissemination of knowledge is necessary. The principles of using timber and EWPs are not well-known among architects. They could be good promotors of an increased use of EWPs, but their knowledge must be expanded, through demonstration projects, and collaboration among representatives of the wood industry, architects, builders, and housing associations, to achieve a better understanding of the potential of wood. A more diverse group should be targeted in this region, e.g. including contractors and civil

engineers. Moreover, it is important to have technical specifications and also experience to ensure an understanding of the performance of bio-materials in buildings, from design to construction, to use. The change is always difficult and the barriers to wood are complex, but with the right focus, the wood industry can make a difference. EWPs application can create new business opportunities.

The reintroduction and reuse of wood, supported by local and regional strategies, offer a promising path forward. By continuing to develop and implement circular economy strategies, Macedonia has the opportunity to lead by example in the region, contributing to global efforts to reduce the environmental impact of the construction sector. As these practices become more mainstream, they will not only preserve Macedonia's architectural heritage, but also ensure a sustainable future for its built environment.

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7. SUSTAINABLE WOODEN CONSTRUCTION IN POLAND - DEVELOPMENT PERSPECTIVES

Renata Stasiak-Betlejewska

1. INTRODUCTION

Modern wooden construction is part of the broadly understood "green" and "sustainable" construction, and therefore basic trends of "construction of the future". Eco-construction, and therefore wooden construction, has been included in the state policy among strategic sectors that can be a driving force for the development of the Polish economy and among the so-called flagship projects, i.e. programs whose implementation is of particular importance for achieving the assumed development goals of the country. Modern wooden construction is part of the broadly understood "green" and "sustainable" construction, and thus the basic trends of "construction of the future". And in Poland, in a situation of still unmet housing needs, it can also be a significant stimulant for the development of the housing market and the growth of housing resources. Eco-construction, and therefore wooden construction, has been included in the state policy among strategic sectors that can be a driving force for the development of the Polish economy and among the so-called flagship projects, i.e. programs whose implementation is of particular importance for achieving the assumed development goals of the country (Bidzińska et al. 2020).

Sustainable wooden construction, using timber frame technology, is becoming increasingly important in the context of global efforts to protect the environment and combat climate change. The main advantage of this approach is the ability of wood to store carbon dioxide, which is absorbed by trees during their growth. As a result, wooden buildings become "carbon stores", contributing to the reduction of the total amount of CO_2 in the atmosphere. Modern wooden buildings are characterized by a low carbon footprint and good insulation properties, thus fitting well into the assumptions of EU climate policies. Modern construction materials made of wood with high parameters in terms of load-bearing capacity, durability and fire safety are successfully used not only in single-family construction, but also in multi-storey buildings. Wooden modules are also increasingly used to erect public utility buildings (e.g. kindergartens), hotels, office buildings or industrial facilities. Wood has very good insulating properties, which is not without significance in times when home heating is a nightmare for many families. Proper insulation translates into significantly lower costs associated with the operation of the building. The short construction time is also important, especially in the case of modular houses. Ecology is an important aspect. Wood is a natural raw material with a negative CO_2 index. It is interesting that during the entire life cycle of a wooden building, its carbon footprint is reduced by as much as 25%. If we also take into account the production itself, the difference between a

wooden and a brick building becomes even greater. The European Green Deal promotes the use of natural products in construction. Additionally, the use of wood as the main building material minimizes the need to use high-emission raw materials, such as concrete and steel. The production of these materials is energy-intensive and generates significant amounts of carbon dioxide. Replacing them with wood allows for a significant reduction in the carbon footprint of the entire construction process (Burkietowicz 2022, Balkiewicz – Żerek 2022, Mazur 2021).

Another important aspect of sustainable timber construction is its impact on energy efficiency. Timber frame houses are characterized by better thermal insulation, which translates into lower energy demand for heating and cooling buildings. This in turn reduces the consumption of energy from fossil fuels, additionally reducing CO_2 emissions. Energy efficiency of a building is, in simple terms, the amount of energy needed for its optimal heating, cooling, ventilation, preparation of hot water and lighting of rooms. However, it is extremely important that the increase in efficiency does not come at the expense of lowering the conditions of use of the house. Thanks to high energy efficiency, the cost of maintaining a house can be significantly reduced without reducing the comfort of living. Wooden houses with a frame structure are almost devoid of thermal bridges, thanks to which heated air remains inside the building. Additionally, the occurrence of thermal bridges can be reduced by using appropriate structural elements. Thermal bridges most often occur in the place where the wall connects with surfaces such as roofs, wreaths, lintels or balconies. These are places that release much more heat to the outside than other surfaces, so for energy efficiency it is important to have as few of them as possible. Equally important is the fact that wood is an ideal material for prefabrication, which means repeatability of lightweight partitions and higher quality of their execution than in the case of masonry structures. In practice, this also translates into a lower cost of building a house. And because the load-bearing elements and insulation occur in one layer, the thickness of external partitions is 20 to 30% smaller than in structures based on masonry technologies (New House 2024).

The concept of sustainability emerged in the 1970s and is a complex relationship closely linked to environmental, economic, and social security (Marsili et al. 2017, Zheng and Lai 2018, Bajno et al. 2021, Mazur 2022).

EU legislation implemented sustainable development concept as on of the most important objective. According to UN data, in terms of the implementation of Sustainable Development Goals (STGs), Poland is an outstanding country in the international arena, Poland is in 9th place out of 166 countries included in the ranking. According to research by the Polish Economic Institute (PIE), only 43% of large companies and only 2% of medium-sized ones have comprehensive strategies for achieving the Sustainable Development Goals. Polish companies most often identify their impact on promoting the well-being and health of employees. However, they attach less importance to the objectives related to innovation, economic growth and environmental issues (trade.gov.pl 2024).

In summary, sustainable wooden construction not only supports the fight against climate change by reducing carbon dioxide emissions, but also contributes to

increased energy efficiency and promotes the use of renewable raw materials. It is a direction that harmoniously combines environmental needs with the requirements of modern construction, creating the future of sustainable architecture and construction.

According to the Architecture 2030 report, construction is responsible for 39% of carbon dioxide emissions into the atmosphere. The European Green Deal assumes a reduction of this indicator. The ideal way to achieve this is to popularize wooden construction. Wood is the only fully renewable building material, which is also characterized by negative CO2 emissions. The difference between a multi-story building made of wood and the same in concrete technology is as much as 1.4 thousand tons of CO2. The world is striving to achieve climate neutrality (AIA 2022).

According to estimates by the UN Environment Programme (UNEP) presented in the report “2021 Global status report for buildings and construction”, buildings and the construction sector were responsible for 37% of global CO2 emissions and 36% of global energy consumption in 2020. The need to reduce greenhouse gas emissions in construction is indicated by the European Green Deal, which assumes, among other things, that the EU will achieve zero net greenhouse gas emissions by 2050, and the related New European Bauhaus program, which promotes, among other things, the use of natural products in construction. It is also worth emphasizing that the wood raw material used to build a house can be reused or reused in the future after its demolition, which extends the life cycle of the raw material (GlobalABC 2021, UNEP 2021).

Customers are concerned that wood used in the building will pose a fire hazard. It is worth making investors aware that prefabricated sustainable wooden construction is extremely resistant to fire. Modern wooden structures have higher fire resistance than other materials. In buildings erected using wooden technology, the structure can remain intact in the event of a fire. In addition, an experiment conducted by the Institute of Building Technology proved that in this type of structure, fire does not spread to other rooms. Wood has thermal insulation properties, thanks to which we can significantly reduce the consumption of fossil fuels. This type of structure has a lower energy demand for heating rooms.

Wooden structures are prefabricated in modern plants, which significantly reduces construction waste. Elements of wooden frame houses are made with extraordinary precision, and material consumption is optimized to the maximum. If the investor cares about time, the technology of wooden frame walls is the ideal solution. Weather conditions cannot delay the work, because all elements are made in the factory. Sustainable wooden construction is the ideal solution for today's times. Agenda 2030 is a strategy for the development of the world until 2030. Sustainable development goals are the path we should follow. Development is desirable provided that it is not destructive to other areas of life and remembers other generations. Sustainable development is a trend from which there is no escape. The construction in wooden technology is our future and the future of future generations (Švajlenka and Kozlovská, 2020, Wrzesiński et al. 2023).

2. WOODEN BUILDING DEVELOPMENT IN POLAND

Wooden construction has great development potential in Poland. It can be based on some of the largest forest and timber resources in Europe, and it can also benefit from the potential of the timber sector, which is important for the Polish economy. However, this potential is still not fully exploited, while energy-efficient wooden construction, including multi-storey construction, can enable, with an appropriate housing development strategy, a reduction in the housing deficit that has been persisting in Poland for many years (Bidzińska et al. 2020).

In 2020, over 900 wooden houses were put into use in Poland, and over the past five years their popularity has more than doubled - data from the Central Statistical Office show. This is due to the fact that wooden construction is more energy-efficient and environmentally friendly. Over their entire life cycle, buildings are responsible for approx. 40% of CO_2 emissions into the atmosphere, and reducing this indicator is an EU goal included in the Green Deal. The use of the wood in construction, which is characterized by greater thermal capacity and negative CO_2 emissions, can therefore contribute significantly to combating climate change.

According to data from the Central Statistical Office in Poland, 905 wooden houses were built in Poland in 2020, compared to 708 the year before and 348 in 2015. The company Polskie Domy Drewniane indicates that although this is still only about 1% of the total construction (for comparison, in Germany this share exceeds 18%), the popularity of wooden structures is growing and the market potential is much greater. Its estimates show that over the next two decades (until 2040) the share of wooden construction in the entire sector may increase to 20%, and every year in Poland as many as almost 15 thousand wooden buildings may be built.

Data from the Central Statistical Office indicate that 1,160 wooden-frame buildings were put into use in 2021. This constitutes only 1.1% of all new buildings. Despite the low percentage of such buildings, the growth dynamics is higher than in the case of their traditional counterparts. Experts from the Wooden House Association estimate the actual number at 5-6%. The average area of wooden-frame buildings is about 108 m2, which is less than the average in brick houses. The construction time is definitely shorter, which is a significant advantage for investors. It is estimated that there are about 580 companies in Poland that deal with construction using wooden technology. In addition, there are about 260 companies building log houses (GUS 2022).

The growth dynamics of the wooden construction segment in Poland is high, as indicated by both the Central Statistical Office data on the number of wooden-frame residential buildings put into use, as well as data on mortgage financing in the PKO Bank Polski Group for the construction of new houses - the number of contracts for financing single-family wooden-frame buildings increased in 2021 by as much as 80%, which significantly exceeded the growth for the entire single-family construction segment. According to data resulting from the above-mentioned report "Industry monitoring. Sector analyses" from July 2022, the popularity of wooden construction is growing. There is a growing interest in mortgage financing on the construction market as part of erecting wooden-frame buildings. In 2021, an 80% increase in the number

of contracts for financing such construction was noticed (GUS 2023, Balkiewicz – Żerek 2022).

Poland is the third largest exporter of prefabricated wooden houses in the EU, after Estonia and Lithuania. The export value reached EUR 115.1 million in 2021, recording high growth dynamics (+52.7% y/y). The largest recipients of prefabricated wooden houses from Poland are Germany, Great Britain and Norway (Balkiewicz – Żerek, 2022, GUS 2022).

The share of wooden-frame buildings in all new apartment buildings put into use in Poland in 2019–2021 is presented in Figure 1.

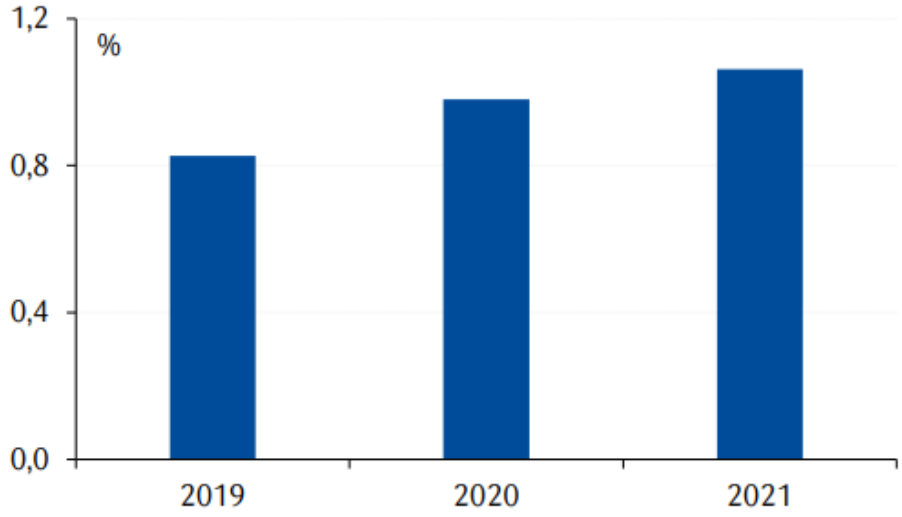

Figure 1. The share of wooden-frame buildings in all new apartment buildings put into use in Poland in 2019–2021 is presented in Figure 1 (GUS, PKO Bank Polski)

The wider use of wood in construction can significantly contribute to combating climate change. According to data cited in the KAPE report, prepared on behalf of the Ministry of the Environment, ("Environmental aspects of modern wooden construction"), the entire construction sector is responsible for 30-40% of total greenhouse gas emissions and 40% of energy consumption in the world, and each year the construction industry uses about 3 billion tons of raw materials (which corresponds to 40-50% of the total demand for them). In turn, according to data from the European Forest Institute, cited by the PDD company, concrete buildings - taking into account their entire life cycle - are responsible for the consumption of about 42% of total energy, 35% of greenhouse gas emissions and 30% of water consumption. In the case of wooden structures, these indicators are much lower (KAPE 2019, Newseria 2021).

3. POLISH GOVERMENTAL INITIATIVES

The current legal regulations in the field of construction in Poland do not block the development of wooden construction. Therefore, there is no need for legal changes in this area. However, there are many misunderstandings, even among decision-makers

in state or local government institutions regarding wooden construction technology. Therefore, it seems necessary to carry out activities promoting wooden construction (KAPE 2019).

In 2023, Polish Ministry of Climate and Environment completed the implementation of a project aimed at (KAPE 2019):

- increasing the share of buildings with almost zero energy consumption in the total number of buildings;
- promoting pro-ecological solutions in construction and disseminating information about available forms of support for this type of investment;
- creating a fashion for eco-construction in Poland and environmentally friendly building materials and construction methods, including in particular the use of wood in structures.

The project included:

- scientific conferences entitled Architecture and construction in the face of climate challenges;
- competitions for students;
- study visit for students (competition winners);
- competitions for leaders of ecological construction for the best completed building design;
- competition for the general public entitled "My house with climate";
- 4 episodes of podcasts on issues related to the adaptation of cities to climate change;
- a guide on wooden construction addressed to contractors, architects and investors was developed.

The project website, where news and specialist materials were published, enjoyed great interest from users. Numerous promotional activities were also conducted on the Internet. The educational component of the project was financed by the National Fund for Environmental Protection and Water Management. The task was an element of the sustainable development policy pursued by the Ministry of Culture and Environment and the implementation of the provisions of the medium-term development strategy "State Environmental Policy 2030".

The development of the wooden construction is one of the priorities of Polish Government. In accordance with the arrangements made by the Housing Council in the Chancellery of the Prime Minister, it is advisable to take action to increase the share of wooden technology in residential construction, and the wooden construction sector can significantly contribute to the implementation of the objectives of the National Housing Program," said Minister Henryk Kowalczyk, summarizing the meeting. The meeting was also attended by representatives of the Chancellery of the Prime Minister, the Ministry of Investment and Development, the State Forests, the Polish Committee for Standardization, the General Office of Building Supervision, the Institute of Building Technology, the Institute of Wood Technology, as well as associations from the wooden construction industry: the Wood Center Association in Czarna Woda, the Wooden House Association and the Energy-Efficient Ready-Made Houses Association (Ministerstwo Środowiska 2024).

One of well recognized initiative is project named “Polskie Domy Drewniane” (The Polish Wooden Houses) that is a development activity of Polish State Forestry. It is aimed at introducing the principles of sustainable environmental management into the common application by (Młynarczyk 2018):

- improving the carbon balance (storing CO_2 in wooden buildings and thus reducing CO_2 emissions generated during the production of building materials used for masonry technology - cement, polystyrene, etc.) - construction of energy-efficient buildings made of wood for own needs;
- improving the energy balance - lower consumption of primary energy necessary to maintain buildings;
- promoting the effective use of wood raw material as a building material;
- collecting and sharing a knowledge base and good practices related to wooden construction for own needs and the public sector.

The project is part of the implementation of the national Strategy for Responsible Development developed in the Ministry of Development, in the flagship project Eco-building - stimulating the preparation and implementation of selected ecological construction products (including those made from natural raw materials) taking into account the energy efficiency requirements of modern building materials - SOR - version of 20.12.2016.

Project objectives concern:

- reducing CO_2 emissions through the wider use of wood as the most pro-environmental building material,
- developing and implementing technical standards for energy-efficient construction from wood used in PGL LP,
- protecting architectural heritage and disappearing professions related to wood processing by supporting vocational education,
- actively supporting innovative solutions related to the use of wood in energy-efficient construction,
- increasing the number of energy-saving investments using wood as the main building material,
- reducing energy consumption in PGL LP.

Another initiative is that of the National Fund for Environmental Protection and Water Management, leader governmental institution in implementing European funds and foreign mechanisms for financing environmental protection in Poland.

Main Beneficiaries of the National Fund for Environmental Protection and Water Management (NFOŚiGW) are: local government units, enterprises, state budget units, universities, non-governmental organizations, state administration, individuals.

The priorities of the NFOŚiGW’s activities are shown in Figure 2.

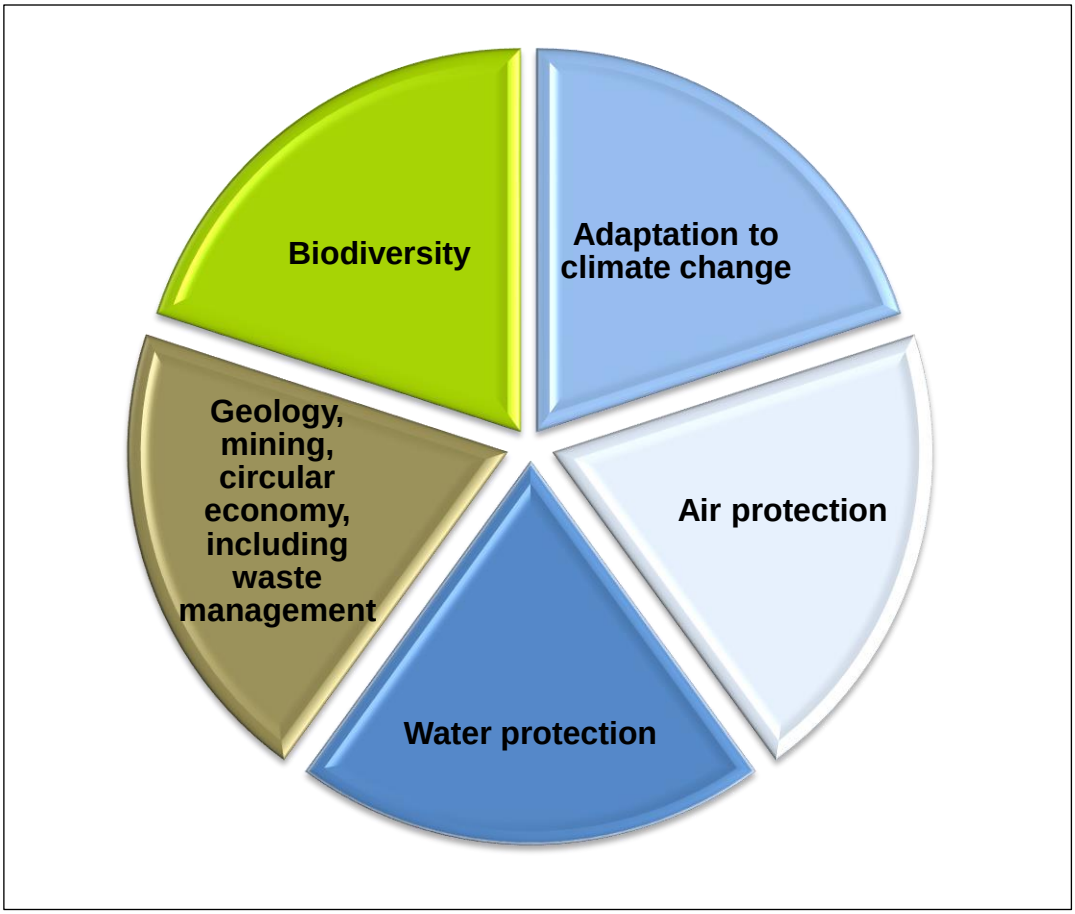

Figure 2. The priorities of the NFOŚiGW's activities.

The experience of the National Fund for Environmental Protection and Water Management in financing the construction of energy-efficient houses is related to the activities indicated below. The National Fund for Environmental Protection and Water Management implemented the Priority Program "Efficient use of energy. Subsidies for loans for the construction of energy-efficient houses". The program was aimed at individuals building a single-family house or buying a house/apartment from a developer (also understood as a housing cooperative). It was the first nationwide support instrument for those building residential buildings with low energy consumption. Cooperation agreements were concluded with banks that applied to participate in the program. As a result of these, 349 loan agreements were concluded for a total subsidy amount of PLN 12 million (Nowak 2018).

New goals of the National Fund for Environmental Protection and Water Management include goals related to wooden building that are:

- supporting ecological projects and entities that cannot be co-financed from EU funds and other foreign funds from domestic funds,
- intensifying activities in the field of promoting and supporting the use of ecological materials, with particular emphasis on raw materials that contribute to the reduction of CO2 emissions into the atmosphere,
- increasing the offer of the National Fund for Environmental Protection and Water Management in the field of financing energy-efficient and passive construction.

The National Fund for Environmental Protection and Water Management is involved in the promotion of wooden construction, supporting it with the fact that the construction of wooden houses reduces CO_2 emissions during the production of materials used for construction and slows down the emission of carbon accumulated in wood in the form of greenhouse gases. Funding for wooden construction is part of:

"Strategy for Responsible Development until 2020". The goals of the National Fund for Environmental Protection and Water Management, which include supporting projects aimed at improving air quality, located in less developed regions of the country.

The subject of the subsidy is the construction or purchase of a single-family wooden house, in the standard defined in the "National Plan aimed at increasing the number of buildings with low energy consumption", i.e. buildings whose energy standard will meet in advance the conditions that newly constructed residential buildings must meet from 31 December 2020. The program was implemented in the years 2018 - 2022, where: commitments (understood as signing agreements) were made by 30.12.2020, funds were spent by 31.12.2022. The subsidy amount compensates for the increased construction costs to achieve an energy standard better than that required by technical and construction regulations. The expected material effect of the programme is the construction of approximately 1,400 single-family wooden houses meeting the requirements of the "National Plan for increasing the number of low-energy buildings", referred to as "nearly zero-energy buildings" in accordance with Article 2, point 2 of Directive 2010/31/EU.

Planned effects of new activities:

- reducing energy consumption,
- reducing CO2 emissions into the atmosphere by supporting the construction of buildings with low energy consumption,
- using wooden technologies additionally strengthens the effect of reducing CO2 emissions,
- supplementing the government program "Mieszkanie Plus" in non-urbanized areas,
- stimulating new investments - using financial leverage,
- supporting the creation of new jobs.

The intentions of the Ministry of the Environment related to the promotion and development of wooden construction are related to European Union initiatives.

The European Commission in its report "Roadmap to a Resource Efficient Europe" indicated construction as one of three sectors on which further actions for efficient use of resources will focus (2011). It is important that the development of construction aims at sustainability. Modern wooden houses are ecological and energy-efficient and provide high user comfort. They are becoming a good alternative to brick construction. The role of the Ministry of Environment is primarily to initiate cooperation between government institutions for the promotion of wooden construction in Poland. The topic is cross-sectional, it concerns many ministries, therefore an impulse for cooperation is needed. It is necessary to develop solutions that go beyond the scope of the Ministry of Environment's activities, which is why it is so important to establish cooperation with other government administration bodies - e.g. MIiB, NFOŚiGW. Moving away from

government silos is consistent with the provisions of the Strategy for Responsible Development (Kamiński 2018).

The role of the Ministry of Environment in activities supporting wooden construction is following (Kamiński 2018):

- anchoring issues related to wooden construction in government strategies and programs,
- initiating and coordinating cooperation with government administration bodies, including those concerning changes in regulations,
- representing the position regarding wooden construction at government forums and promoting the idea of wooden construction,
- leading to the creation of financial support mechanisms,
- starting work on equipping the administration with appropriate statistical data.

The search for energy-efficient, time-saving, easy to prefabricate, environmentally friendly, and above all safe and economically competitive building technologies means an increasing favour for solutions using wood. This has been reflected in government work, e.g. initiatives of the Ministry of Climate. While government initiatives are intended to create the right climate and legal conditions for the broader implementation of wood-based technologies, it is the responsibility of companies providing construction solutions to provide the market with safe and comprehensive solutions that architects and constructors will be able to use when designing new buildings using wood-based technology (Sulik 2022).

The response to this demand is, among others, the SAINT-GOBAIN initiative in the form of the publication "Prefab Systems", which is a compendium of knowledge on system solutions based on a wooden frame intended for wide use in construction. Sustainable development is based on the principle of responsible use of natural resources. We cannot forget that we are reaching for non-renewable resources that may run out in time. The Saint-Gobain Group's comprehensive sustainable development strategy covers the entire product life cycle: from resource-efficient extraction of raw materials and continuous reduction of CO_2 emissions, through ensuring the comfort and health of building users, to thoughtful waste management.

"House with a climate" is the other project of the Ministry of Climate and Environment, the aim of which is to:

- increase the share of buildings with almost zero energy consumption in the total number of buildings,
- support local governments implementing projects that increase the energy efficiency of buildings;
- promote pro-ecological solutions in construction and disseminate information on available forms of support for such investments;
- create a fashion for eco-construction in Poland and environmentally friendly building materials and construction methods, including in particular the use of wood in structures.

The project provides for activities in the areas of legislation, financing and education.

The actions taken by the Ministry of Climate and Environment are part of the EU's drive to increase the energy efficiency of buildings. However, it is necessary to take additional actions that will reduce the average energy consumption in households and increase the share of zero-emission energy carriers in the final energy consumption in residential buildings. The result of these actions will primarily be the improvement of

air quality and a significant reduction in greenhouse gas emissions. The project is part of the third pillar of the Polish Energy Policy 2040 - Good air quality in relation to the promotion of passive and zero-emission houses using local energy sources. The project is part of the third pillar of the Polish Energy Policy 2040 - Good air quality in relation to the promotion of passive and zero-emission houses using local energy sources.

However, the popularity of wood-based technologies in Poland is much lower than in Europe. There is a lack of common knowledge in this area, and access to the latest publications is also limited. This often causes difficulties in designing and erecting buildings with a complex wooden structure and raises investors' distrust of choosing such solutions.

The Ministry of Environment and Climate, recognizing all these problems, organized a series of training courses for construction supervision employees and the State Fire Service in 2019-2020 entitled "Wooden construction in Poland in the light of design, implementation and fire protection regulations". Continuing the process of raising the level of knowledge among participants of the construction process, another project was also implemented in 2022, as a result of which guides entitled "Wooden construction, or a collection of good practices in the field of wooden construction with particular emphasis on structure" were created, intended for: the investor, contractor and designer, respectively.

Modern wooden construction, assessment of used wood in terms of reusing this raw material and organization of forests while maintaining a balance between economy and ecology - these are the topics of three projects with the participation of Poles, selected in the ForestValue2 Call 2023 competition financed by the Horizon Europe program. The ForestValue2 project is an initiative in the Horizon Europe program, which aims to support research in the forest management sector. As part of the competition, international research consortiums submitted applications for the implementation of interdisciplinary projects covering various aspects of forestry. As many as three out of four projects selected for funding will be implemented with the participation of researchers from Poland - reported the National Science Centre (NCN). Scientists will look for ways to use forests for the benefit of society, climate, environment and economy. The budget allocated to Polish teams is over PLN 2.7 million. Scientists want to develop an innovative system of wooden structures suitable for multi-story buildings with open spaces. They want these structures to be more durable than current solutions, and their components to be reused in the future. More ecological and economical methods of construction are to contribute to better environmental protection. The budget for the Polish part of the work is over PLN 1.1 million.

The next project related to sustainable wooden construction idea realization is project “Decarbonisation of construction processes – introduction of natural materials with zero carbon footprint, including wood, into the circular economy in construction” that is implemented by the Institute of Environmental Protection – National Research Institute and the Polish Natural Building Association and financed from the funds of the Financial Mechanism of the European Economic Area 2014-2021 under the “Environment, Energy and Climate Change” programme. The European Economic Area funds represent the contribution of Iceland, Liechtenstein and Norway to creating a green, competitive and socially inclusive Europe. This project presents a roadmap for the promotion of natural building including the implementation of basic, accepted

practices for the construction of partitions and thermal modernization based on available raw materials and technological possibilities.

Roadmap Objectives:

Objective I: Climate neutrality in construction

- We strive to control and reduce the carbon footprint in the processes of thermal modernisation and adaptation of buildings.
- We introduce carbon footprint calculations based on general indicators in the methodology for preparing energy certificates and audits in the thermal modernisation process.
- We will use this data as the basis for detailed product calculations.

Objective II: Comprehensive approach to reducing the carbon footprint

- We will link the processes of reducing the carbon footprint in the area of building modernisation, energy efficiency and use.
- We will adapt the requirements of national law to EU directives, also in the area of single-family housing.
- We will introduce carbon footprint reduction as an element of renovation passports.

Objective III: Natural CO2 absorption technologies

- We will use the accumulation and rapid accumulation of carbon by plants and trees in the process of climate mitigation.
- We will create conditions for the dissemination and standardisation of solutions based on natural technologies.

Objective IV: Valuing the impact on the environment

- We will simplify, disseminate and make legible the values resulting from limiting the impact on the environment of the production of materials and technologies of building construction.
- We will calculate the ability to accumulate a carbon footprint by organic materials and the avoided carbon footprint by materials from recycling processes and the closed-loop economy.
- We will develop a coherent methodology for all stages of the building life cycle.

Objective V: Construction waste management

- We will organize ways to reuse and dispose of organic building components, ensuring emissions are reduced in combustion and natural decomposition processes.

Objective VI: Promotion of "natural construction"

- We will build clear communication of the values of "natural construction" in the area of striving for climate neutrality.
- We will focus on education and raising public awareness of the benefits of ecological solutions in construction.
- We support the exchange of information and best practices in the field of "natural construction".

In general, these goals aim for a comprehensive approach to decarbonizing the building sector, encompassing both the reduction of greenhouse gas emissions and the promotion of sustainable technological and material solutions.

Objective VII. Implementing the principles of the Circular Economy in construction

Implementing the principles of the Circular Economy (CE) in construction requires a comprehensive approach, encompassing changes at different stages of the building life cycle. There are many practical ways to support this idea, both at the individual and systemic level.

4. CONCLUSIONS

The use of wood in our designs is embedded in the broader context of sustainable solutions. Efficient and environmentally friendly technologies are the answer to global climate challenges. The key to decarbonizing the construction sector is, among others, frame construction, which is currently enjoying increasing popularity among Polish investors. It is a way to build less expensively, faster and more efficiently compared to erecting traditional structures, which is why our portfolio could not be without solutions and systems designed for frame and modular construction. The materials and systems used in frame construction that we produce and distribute have a significant impact on the comfort of human life and a better future for all of humanity, so they respond to the challenges of our times, such as ecological construction, economical management of resources and combating climate change.

Sustainable construction is a growing awareness of the impact that buildings have on the environment, leading to an increase in the popularity of sustainable building practices. This includes the use of low-carbon materials, energy-efficient design solutions and renewable energy technologies.

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8. DEVELOPMENT OF QUALITY MANAGEMENT APPROACHES IN FOREST-BASED INDUSTRY

Anna Šatanová

INTRODUCTION

Current trends in quality management focus on several factors rather than just creating a quality product that should meet customer requirements.In addition to customer satisfaction, it is now expected that all stakeholders (employees, shareholders, owners, banks, suppliers, partners ...) and the environment in which the organization is located (citizens, city, state, non-profit organization) will benefit from the organization. An organization's priority is sustainable development. We are talking about a shift from product quality to the quality of the organization.It is clear that meeting quality management system requirements according to ISO 9000 or ISO 9000, or industry standards (such as TS 16949), form only a small part of meeting the expectations of current movement to a successful and prosperous organization.

1. INTEGRATED MANAGEMENT SYSTEM

In order to improve performance and competitiveness, different methods, tools and approaches that put the organization into a new light are applied. However, we should remember that the basis of all methods used will be effective and functional if the organization is process-driven and applies a procedural approach (Paulová et al., 2010).

Here are some of the selected methods and approaches currently applied to increase the success and competitiveness of an organization. In all spheres of economic and social life, there are increasing demands on business behavior. There is growing interest in maintaining and improving product quality, the environment and safety at work. Organizations are forced to re-evaluate their status and implement effective management systems - quality, environment and security. For an organization, integrated management systems are a very convenient way to create a system that takes into account not only the quality of products and services, but also access to the environment and occupational safety and health. It effectively supports maximizing market value and organizational growth. An Integrated Management System (IMS) is based on the vision of integrating the structure of international standards relating to quality management, environmental management, occupational safety and health management, capital management, information security management, etc.

The starting point of almost all of the listed management systems is a process approach that allows process-based integration into one system. The key factors that influence this system are customers and suppliers, the company and the public, employees and shareholders. The impact of individual factors acting integrally encompasses all dimensions of sustainable development, economic, environmental and social.

IMS may consist of the following management systems:

• Quality Management System (QMS)
• Environmental Management System (EMS)
• Occupational health and safety management system – OHSAS

If required, the scope of an IMS can be extended to other management systems (see Figure 59), such as the Information Security Management System – ISMS IT service management (ISO 20000), corporate social responsibility (ISO 26000), food safety management system (ISO 22000).

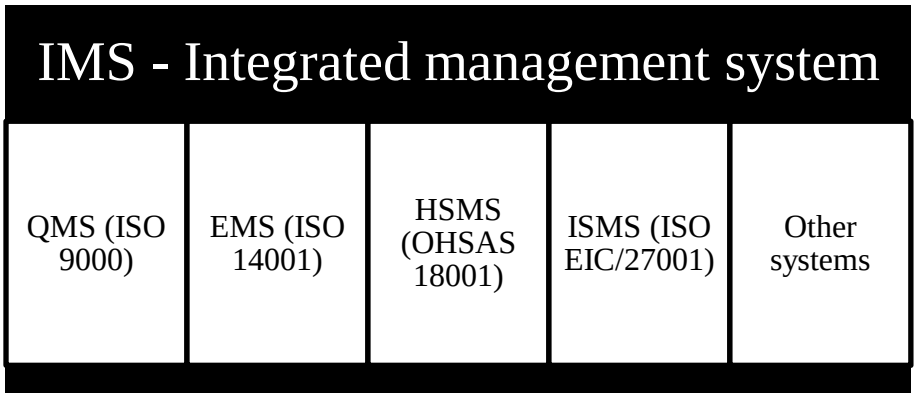

Figure 1: Integrated management system scheme
Source: own source

A major revision of ISO standards in 2000 has opened the way to integrating quality management, environmental and safety management systems. The structure of the newly introduced standard ČSN EN ISO 9001: 2009 is most closely related to ČSN EN ISO 14001 standard. As the ČSN EN ISO 14001 environmental standard is very similar to the OHSAS 18001 safety standard, there is nothing to prevent the use of all 3 management systems together in the form of an integrated module. Each of these management systems defines their specific requirements, but the categorization of the main requirements is the same. The core requirements for integration can be the basis for all three systems. These include the following areas:

- The responsibility of top and middle management
- Systematic structure of documentation
- The goal of continuous improvement
- Conformity with requirements
- Maintenance and operation of systems

An organization standardizes its processes in its growth, and it can be characterized as a system with a solid structure, declared powers and responsibilities that considers cost minimization, high performance in transparent processes, and a flexible information system at the core of its success. Integration of management systems means connecting individual customer-oriented systems (customer, public, employee, and owner) into one organization. It is the process of organizing individual parts into a unit of a higher level, which ensures the efficient functioning of all its parts. In terms of a system approach to processes that affect the quality of production, it cannot be considered a by-product of the process of degradation of the environment or threatening the health of employees. Activities related to ecology and the working environment are an integral part of all processes from the production stage to disposal (Hrubec et al., 2009).

New modern theories of managerial thinking and negotiation place the synergistic effect first. There is no one universal management system, there are only systems that, depending on the conditions in which they are implemented, can effectively help drive rationalization. An integrated management system is an opportunity for organizations to demonstrate their commitment to sustainable development in relation to the customer, the environment and occupational safety and health, and managerial information security.

The reasons for system integration are as follows (Hrubec et al., 2009):

- Reducing duplication and therefore financial costs
- Reducing risks and increasing profit
- The balance of conflicts
- The exclusion of conflicting responsibilities and relationships
- Increasing business goals
- Formalization of the information system
- Harmonization and optimization of procedures
- Improving communication
- A learning organization

2. APPLYING A TOTAL QUALITY MANAGEMENT SYSTEM

Total Quality Management (TQM) is an attitude and philosophy, as well as a process that emphasizes the personal responsibility of all employees who strive for continual improvement, and as such it never ends. At the same time, it is also a system consisting of organizational, administrative and technical procedures, methods, techniques and tools.

The basic concept of TQM is focused on the customer, the organizations own employees on processes, the working environment, the environment and the company. Its essence is to define a strategy on the basis of which objectives are defined and their fulfilment is monitored over the results. TQM is an integrated

philosophy that includes strategic, cultural and technical systems. It is characterized by the fact that the whole organization is involved in improving product quality. All business managers are responsible for the enterprise, and in complex quality management they create a management tool based on customer oriented organizations.

TQM is an open system that may include everything that can help maximize the satisfaction of all stakeholders and the environment and trust, and minimize funds spent on mistakes and shortcomings. This creates prerequisites for maximizing profits, increasing organizational competitiveness and minimizing costs of poor quality.

TQM has the following features:

- It is a philosophy built on the active participation of educated and appropriately motivated people to improve the quality of work in a personal or team form
- Its priority is the quality of processes that enable achieving a high-quality result, reducing costs and time, reducing the number of errors and their flexibility in response to changes
- Tactical data processed in the form of information that reduces the equivocality (entropy) of a given subject or phenomenon become an impulse for improvement
- By including as many employees as possible, the awareness and importance of the quality of production and processes increases, and then it is possible to gradually shift from strict rules to quality culture
- Increasing emphasis on process quality, its management and continuous improvement with the help of various techniques and tools
- Applying the internal customer principle

Total Quality Management applies to the entire organization, and it brings about changes in the following important dimensions:

- Strategic activity is the most important activity of top management in order to formulate the main objectives and planning of all activities related to the efficient management of all processes (using the PDCA cycle)
- An organization’s culture is an open system where all suppliers, customers and stakeholders are included in processes

Experience from the application of total quality management can be summarized as follows:

- Total quality management can only work when leaders understand quality as part of organizational management in all activities
- Teamwork is an important pillar of TQM; management teams that define objectives and create conditions for their fulfilment and teams to improve process quality play an important role
- It is necessary to respond quickly to teamwork outputs and create conditions for change

- Gradual change in the behaviour of an organization's employees based on leadership, training and motivation of employees
- Apply process improvement technology down to the level of production workers
- Practical use with organizational and motivational support must follow as soon as possible after training

The TQM model is suitable for both large and small businesses to improve existing quality management systems. TQM approaches can be applied using models. In Europe, the EFQM Excellence Model is the most used in the business sector.

3. RESPONSIBLE ENTREPRENEURSHIP AND SUSTAINABLE DEVELOPMENT

The concept of sustainable development was first used in the book “Limits of Growth” written by Donell and Dennis Meadows and William Behrens in 1972. There are many definitions, and there are many discussions and debates at an international level on sustainable development. The basic aspect of sustainable development is probably best illustrated by the following definitions.

The most well-known and also the simplest definition of sustainable development comes from the report "Our Common Future" issued by the United Nations World Commission on the Environment and Development (1987): "*Sustainable development is a way of development that meets the needs of the present without compromising the possibilities of future generations to meet their own needs*." (Keeble, 1988).

This concept has developed since 1987 and individual dimensions and principles are identified. It is important to emphasize that the concept of sustainable development is much wider than environmental protection.

Czech law defines the term "sustainable development" as development that preserves the opportunity to satisfy basic needs while not reducing the diversity of nature and preserving the natural functions of ecosystems for present and future generations (§ 6 of Act No. 17/1992 Coll.).

The European Parliament later defined sustainable development as follows: "Sustainable development means improving the standard of living and well-being of people within the limits of ecosystem capacity while preserving natural values and biodiversity for present and future generations." (European Parliament and Council Regulation 2493/2000 2494/2000).

However, under current conditions these are statements that overlook the fact that the capacity of some ecosystems has been exceeded for decades. There are a number of other definitions (see Agenda 21[1]: Annex II of the "Report of the UN

[1] There is an environmental program developed over 800 pages. It is divided into four sections with up to 40 program areas. It is an expression of global agreement and political determination to work together to tackle

Conference on Environment and Development", Rio de Janeiro, 1992; Czech Ministry of the Environment issued in 1998).

The following definitions are presented below:

- "*A sustainable way of life – this is a way of life that is closer to the ideals of humanism and the harmony of human-nature relations, in a timeless horizon. It is based on a sense of responsibility towards today's generations and future generations, and respect for both living and inanimate nature*. " (Vavroušek, 1994).
- "*Sustainable development is a comprehensive set of strategies that enable the use of economic resources and technologies to meet human material, cultural and spiritual needs, with full respect for environmental limits; it is necessary to redefine the socio-political institutions and processes at a local, regional and global level to make this possible on a global scale today.*" (Rynda, 2000).

At the level of the general principles of sustainable development, there is a broad consensus. We can say that this is a new value orientation of mankind and direction of the development of human society, where the basic needs of all inhabitants (we speak of interpersonal solidarity) are satisfied, when the opportunities and freedoms of the existing generation are not at the expense of the possibilities and freedoms of future generations (we speak of intergenerational solidarity), and when the harmony between humanity and nature is promoted (respecting the intrinsic life value of nature and the rights of other living species).

For better understanding, it is also appropriate to define sustainable development negatively. This means briefly describing what sustainable development is not (Rynda, 2000):

- Mere survival. This means that human needs can be met at a constant population size. Permanent quantitative (economic) growth is not a major goal, but qualitative development and a higher quality of life are.
- The manifestation of prognostic pride or socialist planning. Estimating or planning what next generations will want and need is not the goal of sustainable development. TUR should keep nature, resources and potentials intact for these generations to handle them as best they can.
- The megalomaniacal concept of bureaucrats. The crooked course of unsustainable civilization trends cannot be straightened on a mere local level, so international cooperation, coordination, exchange and sharing of experience and sustainability principles are essential. It’s obvious that humanity will not be saved by local self-sufficiency.
- Centralist rule, world government. The report titled Our Global Neighbourhood explains in detail that cooperation is necessary (not government or governance). Even in sustainable development there is a market, market-

the most pressing environmental problems today and in the 21st century. Chapter 11 is important for forestry, declaring a fight against deforestation.

compatible instruments and subsidiarity, and they are more effective than regulation and control, command and prohibition. In society and in nature, stability provides the best possible diversity (biodiversity) through negative feedback. It is often more beneficial for society to learn to respect others, individuals and groups, to live in conscious, deliberate and tolerant consensus.

- Culture as a choice of a particular historical human civilization model. Certainly, the unity of general rules and principles of sustainability apply in the widest variety of local and regional applications according to natural, cultural and historical conditions, values, memory and traditions. Languages, art and culture should be kept as much as possible for the enjoyment of diversity and cultural wealth. In this case, however, these are generally valid principles, formulas, paradigms.
- Equal to ecology. Ecology is a science that has its subject and method. Sustainable development uses its knowledge to protect nature and respect its limits. However, TUR is much wider than science and far outweighs the techniques of protecting all components of the environment itself.
- Ideology. Sustainable development is rather conservative in terms of returning to traditional, antique and Christian values, as well as traditional Eastern thinking.

Three pillars of sustainability are derived from the definition of sustainable development:

- Environmental
- Social
- Economic

According to Mezřický (2005), these three pillars are often in conflict (e.g. nature protection versus motorway construction, etc.). In the chapters below, these pillars are dealt with more closely.

The environmental pillar is based on the fact that in a limited system, unlimited growth is not possible. Therefore, the value of ecosystems and their services must be constantly acknowledged and appropriately valued (spiritually or materially) and well guarded.

It is evident that the environmental pillar affects both the social and economic levels. Efforts to protect the environment have led to today's form of sustainable development, which, however, highlights both the social and the economic level. Sustainable development is sometimes mistakenly understood only as a synonym for nature (environmental) protection.

In the right concept, however, it is absolutely necessary to place the same emphasis on all three pillars (equally). The fundamental prerequisite for the environmental pillar is the protection of biodiversity in all its forms. Rynda (2000) states: "The highest level is to be understood as cultural diversity that is no less

important than biological diversity for the preservation of ecosystems to maintain the dynamic balance and stability of human communities."

For the sustainability of environmental development, material and energy flows must meet the following three conditions (Daly, 1991):

- The intensity of use of renewable sources must not exceed the rate of regeneration
- The intensity of use of non-renewable resources must not exceed the rate at which their sustainable renewable substitutes are developed
- The intensity of pollution must not exceed the assimilation capacity of the environment

It can be said that current development of modern industrial society does not meet these conditions.

The social pillar activities consist in balancing inequalities between individual social groups or individuals. The basic prerequisites for the social pillar include the eradication of poverty, both within and between regions, and in global conditions between countries and geopolitical entities. Equal access to basic hygienic conditions and medical care, the suppression of discrimination, racism and xenophobia and religious intolerance are all within the social pillar. It also includes issues of intergenerational cohesion and social inclusion of excluded groups. Rynda (2000) adds: "*Indeed, a higher quality of life that is not based on consumption leading to alienation, but on its own active and creative approach to the world, allows a paradigm of conscious modesty that can deliberately renounce all that is non-essential. The complementary value is selective difficulty, namely the right to use human ingenuity and its products wherever they truly allow and support the fulfilment of the human purpose, namely self-improvement and the fulfilment of good*."

It is clear that the economic aspect of sustainability is closely linked to the social aspect. The economic pillar consists of all economic activities, interactions between them and the interaction between the environment and society. Most common (macro) economic indicators correspond to the growth orientation of mainstream economic science. Costs, losses and damage to natural resources are not considered. For example, the following macroeconomic indicator of gross national or domestic product includes, without distinction, activity contributing to well-being and activities the consequences of which are clearly degrading the quality of life and the environment. These include arms production, ecologically damaging farming, and land devastation by surface mining.

Responsible business is a concept in which companies voluntarily incorporate social and environmental aspects into their business operations and relationships with stakeholders. This involves the organization's overall relationship with all stakeholders - customers, owners-investors, employees, public authorities, suppliers, competitors, communities, etc. It includes the organization's commitment to develop its economic activities effectively and responsibly towards society and the environment, considering the interests of all stakeholder entities. Each stakeholder influences the competitiveness of an organization in a way. Owners and shareholders

are interested in the growth and prosperity of an organization, employees assess working conditions, customers are interested in the quality of products and services, the government is interested in reducing unemployment and creating appropriate business conditions, and citizens are interested in the behaviour of organizations at their place of work.

Through responsible business, organizations of all sizes can help balance the realization of economic, social and environmental goals in cooperation with their stakeholders. Responsible entrepreneurship is becoming an increasingly important topic in the debate on globalization, competitiveness and sustainable development.

The meaning of responsible business lies in reflecting the core values of society. It is important for individual enterprises, large or small, to improve their economic, environmental and social characteristics through innovative products and services, new capabilities and stakeholder involvement in the short and long term. Responsible entrepreneurship is important for people working in enterprises, and for businesses that can help create a working environment. At the same time, it is also important for those who buy from businesses for consumers who are paying increasing attention to the social, environmental, or product-related characteristics they buy. It is important for local communities where businesses – communities who want to know they live among organizations that share their values and concerns – are important. It is also important for investors who feel the need to encourage responsible behaviour by businesses, as well as people from other parts of the world who expect European businesses to behave in accordance with European and international values and principles. Currently, by opening up the market, customers/citizens perceive the market in a more complex way and are interested in products and services from companies whose goals are not only economic but also social and environmental. This is a challenge for small and medium-sized organizations.

The involvement of small businesses in the social and societal spheres is not as well-known and visible as in large corporations. Unlike large companies that are motivated by external influences, in small companies the internal aspect and the personal motivation of the owner are probably the most important moment of involving SMEs in responsible business.

Personal interest, inner satisfaction, a sense of moral responsibility, the desire to implement modern business practices, and the effort to give something back to the local community are the main motives that small business owners attribute as reasons for engaging in responsible business. Many small organizations are dedicated to employees, increasing their skills, responsibility for their health and satisfaction, work-life balance, morale, team building, and motivation within the organization. Environmental activities also focus on the impact of their activities on the environment, recycling or reduction of waste generation. Engagement in the local community often focuses on working with schools, volunteering and participating in charity events.

For small and medium-sized enterprises, it is also important that they are much larger than large businesses in the community in which they operate. They manage their people who live in the local community and understand its problems. Therefore,

these businesses should tend to address social and environmental problems in their geographical location. The condition of the economic environment of a city or region determines the viability of business activities in the long run.

We can state that responsible business is not a new concept. This is primarily about the new approach and attitude of leaders and the creation of conditions for the fulfilment of all three pillars – economic, environmental and social, in balance, to the full satisfaction of all stakeholders. The change of approach is in many ways reminiscent of the philosophy of total quality management (TQM), where the primary goal is to compete and be exceptional in business. If small and medium-sized organizations want to prosper, it is not enough to just produce products or provide services that will satisfy customers during their use. If an organization wishes to prosper, it must be perceived positively by its surroundings. This leads to the implementation of responsible business (Młkva et al., 2016).

4. CERTIFICATION AND SUSTAINABLE FOREST MANAGEMENT

In forestry, voluntary PEFC forest certification standards (Programme for the Endorsement of Forest Certification) are used for quality management. It is the world's largest forest certification system. Through its standards, the system ensures that all environmental, social and economic benefits of forests can be used by current and future generations.

There are currently 2 standards in force that deal with the management system of the group certification process, i.e. Group certification of forest management (1002), but mainly the TUOL standard Sustainable forest management (1003), which is created in the structure of ISO ECE 17021.

Group certification of forest management (1002:2021)

The national governing body of the Slovak forest certification system is PEFC Slovakia, which is made up of representatives from forestry, the woodworking industry and other interest groups. This document applies the standards and procedures created by Organization for Standardization (ISO) and the International Accreditation Forum (IAF) as set out in the document PEFC ST 1002:2018 Group certification of forest management - requirements. PEFC SK supports gender equality. Thus, any term in the document that refers to a specific person (eg. Operator, owner, participant) includes women and men equally, without further emphasis.

The requirements stated in thi document are the minimum requirements of PEFC SK for group forest certification. The document describes the organization and management of the group form of forest certification. It sets out the goals and describes the group certification scheme in detail, specifies the tasks and duties for the group representative and directs the proceedings and determines the conditions for the participation of forest owners/managers in group certification.

Sustainable forest management (1003:2021)

Products with PEFC statements and labels provide a guarantee that the raw material used in their production comes from sustainably managed forests and from trees growing on non-forest land, recycled and controlled sources. This document applies ths standards and procedures created by the Organization for Standardization (ISO) and the International Accreditation Forum (IAF). It represents a set of requirements fot a qualified, independent and objective assessment of the level of forest management. Their complience is a necessary prerequisite fot issuing a certificate confirming that forests are managed in accordance with the principles of sustainable forest management. Existing information characterizing the state of forest ecosystems and their management system is used to the maximum extent so that costs associated with the certification process itself are minimazed. The requirements stated in this document apply to forest owners and managers, as well as to suppliers and other operators who operate in PEFC certified territories. They can vary depending on the size of the managed forests and the legal status of the forest manager.

The aim of the chapter was:

- To define an integrated management system such as the integration of quality management, environmental management, occupational health and safety management, capital management, information security management, etc.
- To introduce a comprehensive quality management system
- To understand and apply responsible entrepreneurship and sustainable development in organizations
- Certification and sustainable forest management

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