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The development of natural construction in Poland in the opinion of young people from towns and villages

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Abstract: Since the implementation of sustainable construction has been recently increasing, so it has become essential to learn about the opinions young people have towards bio-building. The paper presents an analysis of survey data related to six research areas (popularity, materials, costs, benefits, barriers, and environment). Research has shown that young people (mainly from rural areas) are aware of ecological and energy-saving solutions (their opportunities and barriers to development) and are interested in implementing such practices in the future. Moreover, the authors observed that the opinions of these young people (rural and urban) differ much according to all research areas. The authors emphasize the accuracy of the applied methods and confirm the research results obtained from them.

Keywords: natural buildings, natural construction material, bio-construction, university students, fuzzy logic

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Introduction

The term “ecological construction” is not yet very representative in Poland and Europe. It is often applied to examples of construction that use natural building materials or focus on energy-saving solutions. Ecological construction values highly,

materials that are processed as little as possible, meaning those materials with the lowest primary energy (PEI) are chosen for the building process (Kamieniarz, 2016). Buildings, that are ecologically built, use materials that can be produced locally, are minimally processed, and are plentiful or renewable. Their design takes into account the climate, geographical location, and longest possible duration of the building. The designers try to use widely available materials or ensure the buildings can be repaired over the their lifespan (*Natural building around the world*, 2020). According to Woollery and Walker (MacDougall, 2008), straw bale construction and rammed earth construction are examples of natural buildings. These materials are an alternative to conventional building materials such as concrete and steel because they are low in energy and low in carbon. For straw bale construction, waste material with excellent insulating properties is used. The next main advantage of many natural materials is regulating the humidity in the rooms of a building. The following benefits are toxicity reduction and biodegradability at the end of its service life. Undoubtedly, the archetype ecological raw material, apart from clay and straw, is wood. Wood is, of course, a sustainable building material. Unfortunately, most areas suffer from a lack of it and have to import timber resources from other countries or regions. Thus, it is necessary to know how to import sustainable sources to improve wood sustainability used in construction (Li et al., 2018).

Shubbar et al. (2019) state that, nowadays, people want to use more such materials produced from environmentally-friendly and low energy-consuming methods. Moreover, the authors present the current state of knowledge considering different techniques for manufacturing clay-based materials. This problem is also discussed by Reeves et al. (2006). Furthermore, Giyasov et al. (2019) draw attention to the importance of clay in modern architecture. Garas et al. (2009) and Pragyan et al. (2012) describe the benefits of straw in construction. Carbone (2003) discusses the current use of straw and its impact on the environment. He also considers the advantage of its use in future construction and building design and presents a method of natural resources classification.

Construction is a multi-billion dollar industry and needs the continuous production and collection of millions of tons of various raw materials to meet global demand. Consequently, the amount of building material used in the industry is gigantic. The whole building industry uses 3 billion tons of construction material annually, and it is thought that only half of all manufactured products are quantified (Howe, 2010). Hence, scientists and engineers seek solutions that while being environmentally friendly, ensure a continued comfort of living. Progress in environmental protection combined with construction development depends on the pro-ecological awareness of the present and future generations (Kietliński, 2015). Therefore, this study looks at the state of knowledge of young people in implementing the use of environmentally safe natural resources. The study was carried out based on four research groups (rural and urban men and women) to check whether the collected opinions on natural buildings differ depending on the place of residence of young people and their gender. The studies were pilot studies, and the preliminary results were published in 2019 (Cichowska, 2019). The significance of this subject is due to

the problems related to the degradation of the natural environment, and the fact that new construction solutions are becoming increasingly important (Gumińska, 2017; Borucińska-Bieńkowska, 2017). Social commitment to the success of undertaken activities is undoubtedly the factor that may decide the speed of uptake of green technology. However, it needs to be emphasized that the interest in "natural houses in Poland is still in the initial phase and is dictated by the fashion for ecological buildings" (Cichowska, 2019).

The article's content may be of significant importance for the broader implementation of bio-construction by presenting areas where barriers and benefits related to such investments are visible.

1. Material and methods

The work results from several stages of methodological activities, requiring the adoption of appropriate methods and the sequence of the research procedure. In the first stage, at the turn of 2018/2019, diagnostic tests were carried out among the target group of students from one of the universities in Bydgoszcz (250 people) which was consisted of 30 questions.

The study aimed to establish the opinions of young people in the field of natural building development in Poland in 6 research areas:

- $A1$ – the popularity of this type of construction in Poland,
- $A2$ – knowledge of the raw materials used in the construction of ecological buildings,
- $A3$ – natural construction costs,
- $A4$ – the benefits of using ecological materials in construction (from an architectural point of view),
- $A5$ – barriers to the development of natural housing for people potentially interested in them,
- $A6$ – opportunities for environmental protection resulting from this type of investment in the country.

To analyze the opinions of the participants among these research areas, 18 questions from the questionnaire were chosen:

- $Q1$ – Do you think natural construction is sufficiently popularized in Poland?
- $Q2$ – Do you think natural construction is currently a niche in the country?
- $Q3$ – What materials do you know are mainly used in natural construction?
- $Q4$ – How did you first learn about natural construction?
- $Q5$ – Do you think that natural houses fit in with any landscape space (urban and rural)?
- $Q6$ – Do you think that the cost of building a natural house is higher than a conventional one?
- $Q7$ – Do you think that Poland has proper conditions for the development of natural construction?
- $Q8$ – Do you think the natural house costs will be paid off during the use phase?

- $Q9$ – Are you considering building a natural house in the future?
- $Q10$ – Do you think that your attitude (action) can improve the environment?
- $Q11$ – Do you think that building a natural house requires the employment of qualified specialists?
- $Q12$ – Do you think natural houses can have or have a modern look?
- $Q13$ – Do you think that natural houses are durable (have a permanent structure)?
- $Q14$ – Do you think that natural houses have good sound insulation?
- $Q15$ – Do you think there are great interior design options in a natural home?
- $Q16$ – Would you choose a natural house for your holiday accommodation?
- $Q17$ – Do you think that natural houses should be promoted in Poland?
- $Q18$ – Do you know what the environmental awareness of your relatives and friends is about natural building?

In the second stage, the data were coded in the following way. In the case of questions 3 and 4 (relating to identifying sources of knowledge about natural construction and raw materials mainly used in these ecological investments), we assume that a maximum of 4 answers from the respondents is taken into account. There are assigned the following weights respectively: in four answers, we assign 1, three – 0.75, two – 0.5, one – 0.25, and the number 0 if there was no answer. In the case of the remaining questions, consisting of a series of statements, to which the respondent was to reply by indicating one of the statements of the proposed alternatives ("definitely yes", "yes", "definitely not", "no", "I don't know") are assigned the following values: 1, 0.75, 0.25, 0 and 0.5. The applied Likert scale is the result of respondents' answers to the question to what extent they agree (or disagree) with a given statement (Sołoma, 2002). The point was to establish the respondents' opinion on whether natural construction is properly promoted or remains a niche. Diagnosing the difficulties related to the construction of such investments and their benefits is essential for getting to know young people's plans in terms of living in such buildings.

The following stages are based on fuzzy logical methods and defining fuzzy relations, so in the third stage, we define spaces and relations between them. If people use imprecise language, fuzzy logic gives opportunities to describe the situation (Zadeh, 1965; Zadeh, 2002). For example, if people say "the cost of buildings constructed from clay is high" or "it is better to use straw and clay than concrete", the fuzzy relation can describe levels of truth or correctness of these kinds of sentences much better than classical logic. People, with the use of fuzzy logic, can estimate levels of truth belonging to the interval [0,1]. Moreover, fuzzy logic gives methods for data manipulation and possibilities to find levels of knowledge and understand the research areas, not only the questions.

When we consider classical logic, we use the characteristic function to describe the point/object's membership to the set. Hence, for $x \in Z$, the characteristic function of set Z for x is equal to 1 and is equal to 0 otherwise. For the fuzzy set, instead of the characteristic function, we use the membership function, which can take values from the interval [0,1]. Thus the fuzzy set is the set of pairs (x, μ_X), where X is a set, and $\mu_X: X \to [0,1]$ is a membership function. In the case of the space $X \times Y$ and the membership function $\mu_{X\times Y}: X \times Y \to [0,1]$, we called it a fuzzy relation.

We define three spaces:

- $X = \{A1, A2, \dots, A6\}$ – the space of research areas;
- $Y = \{Q1, Q2, \dots, Q18\}$ – the space of questions;
- $Z = \{P1, P2, \dots, P250\}$ – the space of young respondents.

Between these three spaces, there are defined the three fuzzy relations:

- $R_1 \subseteq X \times Y$, where $R_1(Ai, Qj)$ denotes the level that the question Qj corresponds to the research area Ai for $i = 1,2, \dots,6$ and $j = 1,2, \dots,18$;
- $R_2 \subseteq Y \times Z$, where $R_2(Qj, Pk)$ denotes the estimation of the answer of the person Pk to the question Qj for $j = 1,2, \dots,18$ and $k = 1,2, \dots,250$; the explanation of this estimation is presented in the paragraph above;
- $R_3 \subseteq X \times Z$, where $R_3(Ai, Pk)$ denotes the calculated estimation of the knowledge and understanding of the person Pk to the research area Ai for $i = 1,2, \dots,6$ and $k = 1,2, \dots,250$.

In the fourth stage, values of relations R_1 and R_2 are defined. In the case of the first relation, R_1, the values are estimated by experts (the authors), and they show the level of the relation between the research areas and questions. For example, $R_1(A1, Q1) = 1$ means that question $Q1$ is entirely related to $A1$, and $R_1(A1, Q2) = = 0.75$ means that the membership function of relation R_1 equals 0.75, so question $Q2$ relates to $A1$ in 75%. Table 1 presents part of this relation.

Table 1. Part of the fuzzy relation R_1 between research areas and questions (*own study*)

Question / Area	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10
A1	1	0.75	0	0	0	0	1	0	0	0
A2	0	0	1	0.75	0	0.75	0	0	0	0
A3	0	0	0	0	0	1	0	1	0.75	0
A4	0	0	0	0	0.75	0	0	0	0	0
A5	0	0	1	0	0	0.5	0.75	0	0	0
A6	0	0	0	0	0	0	0	0	0	1

Based on the results of the second stage of the survey, the values of Table 2 are prepared. This method of coding ensure that values of relation R_2 belong to interval [0,1].

In the fifth stage, values of relation R_3 are calculated. This relation shows estimations of levels of knowledge and understanding of these research areas presented by respondents. With the recognition of fuzzy logic methods, we do not have to ask complicated and difficult questions about abstract research areas. However, it is enough to define simple questions related to different degrees within research areas and then use the composition of fuzzy relations to obtain the values of the relationship between the research areas and respondents. To calculate the values of the result relation R_3 between research areas and surveyed people, we apply the S-T composition of fuzzy relations:

$$R_3(x,z) = S_{y \in Y}(T(R_1(x,y), R_2(y,z)) \quad (1)$$

for $x \in X$ and $z \in Z$. For the T-composition and S-composition, we use

$$T(a,b) = a \cdot b \text{ and } S(a,b) = a + b - a \cdot b \quad (2)$$

Table 2. Part of the fuzzy relation R_2 between questions and surveyed people (*own study*)

Question \ Surveyed Person	**P1**	**P2**	**P3**	**P4**	**P5**	**P6**	**P7**	**P8**	**P9**	**P10**
Q1	0.5	0	0.25	0.25	0.25	0.75	0.5	0.75	0	0
Q2	0.5	0.75	0.75	0	1	0.5	0.5	0	0.75	0.75
Q3	0.5	1	1	0.5	1	1	1	1	0.5	1
Q4	0	0.25	0.25	0.25	0.75	0.5	0.25	0.25	0.25	0.25
Q5	0.5	0.75	0.75	0	1	0.5	1	0.75	0.75	0.25
Q6	0.5	0	0.75	0.75	0.75	0.75	0.75	0	0	0.75
Q7	0.5	0	0	0	0.75	0.75	0	0	0	0
Q8	0.75	0	0	0.75	0.75	0.75	0.5	0.75	0	0.75
Q9	0.75	0.5	0.25	0.5	0.75	0	0.75	0.5	0	0.75
Q10	0.5	0.75	0.75	0.75	1	0.75	1	0	0.75	0.75

In the case of n-values, for S-composition, we use the following formula:

$$S(a_1, a_2, \ldots, a_n) = 1 - (1 - a_1) \cdot (1 - a_2) \cdot \ldots \cdot (1 - a_n) \quad (3)$$

where n denotes the number of people in the considered group. Let us calculate one of the values of relation R_3 using values from Tables 1 and 2 and formulae (1)-(3). Hence

$R_3(A1,P1) = 1 - (1 - R_1(A1,Q1) \cdot R_2(Q1,P1)) \cdot (1 - R_1(A1,Q2) \cdot R_2(Q2,P1)) \cdot \ldots \cdot (1 - R_1(A1,Q10) \cdot R_2(Q10,P1)) = 1 - (1 - 1 \cdot 0.2) \cdot (1 - 0 \cdot 0.75) \cdot (1 - 0 \cdot 0.5)^4 \cdot (1 - 0 \cdot 0) \cdot (1 - 1 \cdot 0.75) \cdot (1 - 0 \cdot 0.75)^2 = 1 - 0.8 \cdot 0.25 = 1 - 0.2 = 0.8$

The results are the values of fuzzy relation R_3, and Table 3 presents only a part of these results.

In the sixth stage, the values of relation R_3 are aggregated to achieved values of knowledge and understanding of research areas by the respondents' group. To achieve it, we applied one of the optimistic fuzzy aggregation norms (Sokolov et al., 2018). Let $I = [0,1]$. Then $S_o: I \times I \rightarrow I$ is called an optimistic fuzzy aggregation norm if it fulfills the following conditions for each $x, y \in I$:

$$S_o(0,0) = 0 \quad (4)$$

$$S_o(x, y) = S_o(y, x) \tag{5}$$

$$S_o(x, y) \geq max\{x, y\} \tag{6}$$

The following optimistic fuzzy aggregation norm was applied

$$S_o(\mathrm{x}, \mathrm{y}) = \mathrm{x} + \mathrm{y} - \mathrm{xy} \tag{7}$$

Since the groups of respondents were not equinumerous, we dived each value from Table 3 by the group size. The results achieved with the application of the optimistic fuzzy aggregation norm S_o (7) are presented in Table 4.

Table 3. Part of the relation R_3 between areas of research and the surveyed people (*own study*)

Question / Area	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10
A1	0.96	0.81	0.79	0.67	0.99	0.98	0.86	0.89	0.56	0.81
A2	0.92	1	1	0.91	1	1	1	1	0.9	1
A3	0.98	0.38	0.8	0.98	0.99	0.94	0.98	0.93	0.56	0.99
A4	0.94	0.97	0.95	0.8	1	0.92	0.98	0.94	0.97	0.94
A5	0.88	1	1	0.92	1	1	1	1	0.88	1
A6	0.9	0.84	0.84	0.88	1	0.92	1	0.86	0.92	0.95

Table 4. The estimated levels of respondents' opinions (*own study*)

Group	Urban men	Rural men	Urban women	Rural women	Men	Women	Urban students	Rural students
A1	0.6	0.611	0.607	0.61	0.604	0.607	0.602	0.609
A2	0.626	0.631	0.629	0.634	0.626	0.63	0.626	0.631
A3	0.583	0.602	0.602	0.603	0.59	0.601	0.591	0.601
A4	0.601	0.606	0.607	0.607	0.602	0.605	0.603	0.605
A5	0.629	0.632	0.631	0.634	0.629	0.631	0.628	0.631
A6	0.594	0.595	0.608	0.598	0.593	0.602	0.6	0.595

Thus, describing this six-stage method, it can be noticed that it is necessary to describe abstract research areas, questions, and estimate the relation between them. Then, after questioning respondents, the results have to be coded so that the achieved values belong to interval [0,1]. Based on these two relations, we can apply the fuzzy logic methods to get the relation between research areas and groups of respondents.

2. Results and discussion

Based on the data from Table 6, Figure 1 presenting levels of knowledge and understanding of respondents is prepared.

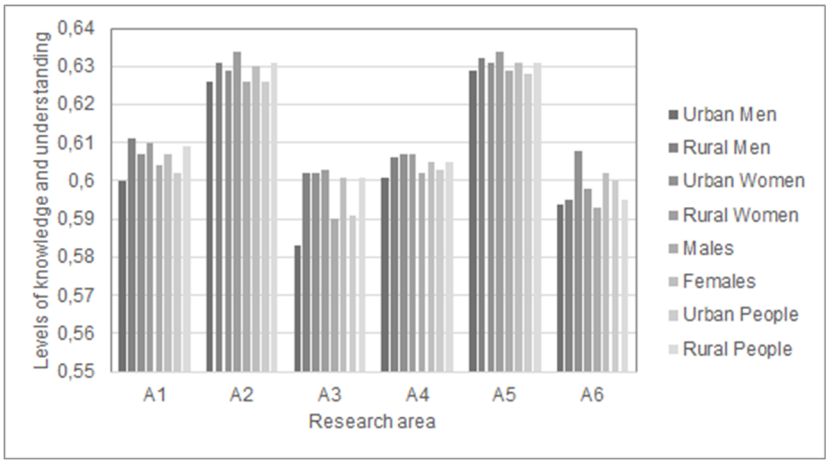

Fig. 1. Levels of knowledge and understanding of young people related to six research areas (*own research*)

The conducted analyzes showed that in the area of "popularity" (Figure 1, Research area A1), the rural inhabitants, first of all, expressed the opinion that natural construction in Poland is adequately widespread. Their estimations suggest a wide range of information is reaching potentially interested recipients of this construction technology. At the same time, out of all respondents, women confirmed ("definitely yes" and "yes"), more often than men, that the conditions for such investments are favorable in Poland. Nevertheless, they noticed (mainly rural women who answered "definitely yes") a market niche in this respect. Men, on the other hand, (especially those from the countryside) emphasized more often than rural women that unconventional construction requires continuous popularization ("definitely yes" vs. "yes") to enable it to develop more dynamically. Respondents noticed that in this industry, a market niche might be associated with green construction products. We can assume that widespread (and so far chiefly unnoticed) availability of such raw materials may become attractive for investors.

Women, mainly from rural areas, had the most knowledge about natural materials (Figure 1, Research area A2). They were able to name most and have researched natural construction using various sources. People from rural areas were more convinced that the price of real estate, built from natural materials, was much higher than that of buildings made of traditional raw materials. Simultaneously, it was determined in the area of "costs" the economic side of this project and the fact that the invested funds will be returned in the use phase of the buildings. This fact was emphasized by the respondents from the countryside, and more often by women

than men (Figure 1, Research area A3). They were also more likely to invest in this type of buildings in the future, expressing confidence in its durability and long life.

In the area of "benefits" (Figure 1, Research area A4), the villagers also noticed the architectural possibilities of natural houses, namely their effective integration into the aesthetics of not only the property itself but also the entire landscape space. In addition to the external space, respondents from rural areas (mainly men) see great opportunities for the interior design of such buildings and their good sound insulation, which may be poorly perceived through the prism of the materials used as not meeting the relevant requirements. The style of natural buildings is perceived as modern, emphasizing the nature of the arrangement. The data analysis allowed us to determine that a similar opinion was expressed by women from cities in general (but there was a slight advantage concerning the answers obtained from women from the countryside).

Apart from the positive aspects related to the development of natural construction, young people (mainly from rural areas and mostly women) also observed difficulties in this field (Figure 1, Research area A5). It is not only about the costs of the entire project or the generally unfavorable conditions of the external environment (state aid in the promotion of ecological activities in the construction market), but in their estimations mainly the lack of availability (liquidity) of raw materials, as well as of qualified staff with experience and knowledge. The elimination of these obstacles will allow more dynamic development of sustainable construction technologies, which in turn will improve the quality of the environment through the use of unprocessed and renewable materials (i.e., straw, clay). In this research area, "environment" (Figure 1, Research area A6), women in general (mostly those from cities), and men from rural areas are convinced of their positive attitude towards the environment. They also think that their closest family and friends are highly aware of environmental needs. They also often expressed a desire to choose a natural home as holiday accommodation, which may indicate the need to rest in a healthy environment and identify with attitudes (behaviors) serving environmental protection.

The results from the fuzzy-logic-based method conducted in the six distinguished research areas confirmed the results obtained in 2019. Among all respondents, women most often assessed the development of natural construction in the country positively. They were more likely to mention the measurable environmental and health benefits of green building than men. They also identified more obstacles in the development of natural construction due to the low popularity of the technology (Cichowska, 2019).

Many authors promote natural construction as ecological and environmentally friendly. Bucka (2016) sees in it "benefits and needs for the good of man and his environment, taking into account the aspects of energy efficiency – both in the process of building and operating." She draws attention to the possibility of using simple materials obtained directly from nature, focusing her study on buildings made of straw (straw bale technology) (Bucka, 2016). The authors of this study note that mainly young people from rural areas have more knowledge about natural building than those from cities (and mainly women). On the one hand, this group of people

can notice that "dissonant objects appear in urban areas that invade the cultural landscape of rural areas," as discussed by Mamcarczyk-Wilkosz et al. (2020).

On the other hand, it is the process of semi-urbanization and buildings with modern architecture that disrupt the existing housing structure by directly interfering with the landscape of the village. Perhaps young people from the countryside see the protection of rural heritage through the development of natural buildings. This topic probably requires more research to be able to unequivocally support this statement, according to Mamcarczyk-Wilkosz et al. (2020), who draw attention to "the number and types of objects interfering with the rural landscape", and thus conclude that there has been an imbalance.

According to Feng (2011), green buildings can provide "a healthy, comfortable, and safe living space," but the whole concept is mainly in architects' minds. According to the authors of the study, this is a crucial aspect raised by Feng because, unlike young people from the countryside, the respondents from cities may believe that building materials such as clay, straw, or reeds are impermanent and that the construction will be uncomfortable and inept in the future. Currently, natural construction breaks such beliefs (*Biobudownictwo – budowa domu z naturalnych surowców*, 2016) because, for example, houses built in the straw-bale technology (mainly made of clay and straw) are durable (the oldest straw house in Montargis, France, is over a hundred years old). The building of such houses does not only meet the rigors of low energy consumption in the operation phase, but, above all, does not require high energy consumption in the material production and construction phase. The dissemination of this technology can significantly contribute to the reduction of gaseous pollutant emissions, waste, noise emissions, and radiation vibrations (Backiel-Brzozowska, 2014).

Bucka (2016) highlights that "the benefits and need of developing natural construction for the good of mankind and environment regarding the aspect of energy efficiency both in the process of building and operation." In general, young people perceive natural construction as having a positive impact on the environment by using natural raw materials in construction methods. Similarly, MacDougall (2008) emphasizes their beneficial influence on the environment and writes, "in the case of straw bale construction, people use a waste material with excellent insulation properties." Furthermore, after Walker, he cites that "other benefits of many natural materials include their ability to passively regulate humidity in a building, reduced toxicity, high thermal mass, and biodegradability at the end of life." However, despite the observed benefits, he also highlights several obstacles to using natural resources (difficulties in estimating their actual performance, lack of experience in using them), which may lead to the belief that they are poorly advanced technically. According to the author, this view is slowly changing, as scientific reports show that natural materials can successfully compete on the market with conventional building materials.

According to Bucka (2016), natural buildings have a beneficial effect on people and the environment and are also functional and modern in appearance. The study by the authors indicates that adolescents see enormous design possibilities in natural

buildings and the desired style and ecological effect. "The diversity of natural building materials, its uniqueness in terms of both physical and decorative properties, environmental friendliness, ease of use – are undeniable advantages for the formation of sustainable architecture" (Ilvitskaya et al., 2019). The differentiated responses perceived about the selected research areas among people from rural areas and cities may be dictated by the fact that the latter perhaps see opportunities to develop natural construction in mainly rural areas. It is easier to obtain valuable raw materials (clay, straw, or wood) from local suppliers (sawmills or farms) and maintain constant cooperation. Nevertheless, architect J. Dowgiałło points out that ecological construction is not only limited to single-family houses. According to him, it is public buildings made of natural materials that can most change public awareness. He reports that many countries support this type of ecological investment (e.g., Germany, where there are schools built of natural resources or a large educational center from France) (Jęksa, 2017). The advantage of the obtained answers among rural women may be related, on the one hand, to a greater degree of awareness and knowledge in the field of bio-building, and, on the other hand, to a manifestation of an emotional attitude towards environment-friendly solutions.

In Poland, bio-building is in the initial stage of development, and the lack of popularity is related, as the respondents reported, mainly due to the lack of proper promotion. For the urgent development of green construction (in the context of increasing carbon dioxide emissions and energy consumption), and also "taking measures to enhance awareness of stakeholders, strengthening technology research and communication and establishing codes and regulations", as indicated by Li et al. (2013). Chan et al. (2017) also write about the need to develop appropriate strategies to promote green building technologies (GBTs). The research results show that the lack of knowledge about ecological technologies may become a severe barrier hindering their development, just like the lack of experienced specialists on the market or too high investment costs. Although in the case of the latter, Świderski (2017) states that the expenses are low (the price of the material for building a house using straw-bale technology is about 120 m^2 with finishing, but without utility connections, a fireplace insert and white installations, in the range of PLN 50-60 thousand). The final cost of building the house will depend on whether we commission the complete construction to a specialized company or we will erect the building (or part of it) on our own. MacDougall (2008) emphasized the importance of bio-building, who wrote that green or sustainable construction could become an alternative to conventional construction. This study also noted the positive view of young people in this regard. It is not without reason that the pilot studies were conducted on this group of people (those aged 20-24: 73.5% and 19 years: 21%). It is characterized by greater susceptibility to changes than older age groups, thus the possibility of more frequent implementation of ecological construction methods. According to Kwiatek & Skiba (2017), "in the face of the environmental crisis and depletion of significant natural resources, the issue of using natural sources that generate capital benefits is of particular importance." Nevertheless, Feng (2011) points out that the transition from green theory to practice requires time and the need for social involvement,

manifested in a new approach to life and new moral attitudes. Referring to the moral factor, to which Feng points out, it should be emphasized that also in Poland, building the ecological awareness of society in the field of this type of construction should be strengthened by various tools.

Moreover, the considerations on the expected life and maintenance of buildings conducted by Brito & Silva (2020) give rise to the conclusion that in the case of natural buildings, there is also a need to forecast their service life and raise awareness of the existing tools for optimizing maintenance and repair activities (in buildings using, e.g., clay, cracks often occur if the starting material is not well prepared). Thus, various obstacles must be considered when implementing sustainable practices. Their analysis was undertaken by Trindade et al. (2020), who pointed out the problems, whether in the planning phase of construction projects or the insufficient technical knowledge of the workforce. Therefore, their suggestions should be transferred to the field of bio-building (e.g., in error assessment methods for the service provided). It has to be considered that "the rising interest in ecological and energy-saving constructions include the whole life cycle of a building – starting from materials and ending with remains that a building leaves in the environment" (Nowak & Kołaczkowski, 2015).

Feng (2011) reports after Hao Juan that "no matter which technology would be used, green building is always based on the principle of 3R (Reduce, Reuse, Recycle)".

Conclusions

1. First of all, the lack of promotion and high investment costs limit natural construction development in the country. In turn, the determinant of development, in the opinion of young people, may become a better promotion of green technologies in the context of caring for the environment. Perhaps respondents note that the concept of using natural resources in housing construction is an opportunity to minimize waste and rationally use resources in the future.
2. Natural construction is becoming an area that, according to the respondents, is conducive to broadly understanding the protection of the environment and may become an inspiration for architects to create projects based on natural materials.
3. Implementing construction solutions made of natural raw materials appealed more to rural inhabitants than those in cities (mainly women). They also had more knowledge about them, which may be dictated, on the one hand, by the fact that they either had direct contact with such pro-ecological projects, or they follow the development of this niche market in the country on an ongoing basis. Undoubtedly, the application of sustainable materials management is, in this respect, more associated with the countryside, where the availability of raw materials such as straw or clay is more comfortable and more economically profitable. That is why, from a practical point of view, in this research group, we can expect an increase in interest and sustainable construction in the future.

4. This study's advantage is the fuzzy-relation-based method used for data analysis, which is fundamentally different from other calculation methods and is a useful tool in assessing natural building development.
5. The construction industry is one of the most dynamically developing sectors of the country's economy. The ecological trend in returning to natural construction is becoming more and more noticeable not only on the domestic market but also globally. Therefore, an essential element is the continuous monitoring of the market to develop the discussed product.
6. The authors will deepen this study among various age groups and supplement it with examples of this construction trend on the Polish market.

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