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Educational tourist route based on renewable energy sources as a manifestation of sustainable tourism

Abstract: The aim of the study is to present an educational tourist route using renewable energy sources in the context of the idea of sustainable tourism. The research area is the Kujawsko-Pomorskie voivodeship, more specifically the route leading from the dam in Włocławek through the photovoltaic farm i n Czernikowo to the ecological landfill site in Toruń. The study has both practical and social implications. In pursuing its objective, a field query was conducted. Conceptual work on the tourist and educational path was preceded by diagnosing the needs and expectations of potential young tourists, i.e. students of the Nicolaus Copernicus University in Toruń (NCU). The students – representatives of generation Y – are familiar with renewable energy sources and they have a positive attitude towards them. In addition, most respondents showed that they had been to an educational route before.

Keywords: renewable energy sources, educational tourist route, sustainable tourism, Kujawsko-Pomorskie voivodeship

1. Introduction

Sustainable tourism is playing an increasingly important role in meeting the tourist needs of various social groups. It is associated with reverence to natural, cultural and social values of tourist areas. Overall, it is about respecting and protecting natural resources as well as traditions of local communities, at the same time using the opportunities for economic development of a region offered by tourism as such (Kowalczyk, 2010). Sustainable tourism is also a management method that combines the needs of a tourism sector with the needs and natural resources of local residents (Zawistowska, 2014). The concept of sustainable tourism is primarily based on the fulfillment of three basic principles: maintaining the economic order (the appropriate rate of renewal of the resources used by the tourism economy), promoting the socio-economic efficiency of tourism activities, and ensuring the benefits of cooperating parties (Panasiuk, 2011). The World Tourism Organization defines sustainable tourism as one that responds to the needs of both tourists and host regions, while protecting, supporting and facilitating their development in the future. The main goal is to maintain the social and economic benefits of tourism development while preserving the natural environment (UNWTO, United Nations World Tourism Organization). The principles of sustainable development are an important issue in terms of the impact of tourism growth on the environment, including economic and socio-cultural aspects in the long term, and the three above-mentioned areas (UNEP, United Nations Environment Program). However, one should also bear in mind that the dynamic socio-economic development entails degradation of natural resources, which are being exploited at a very fast pace. It thus became necessary to introduce the rules on environmental protection. Therefore, in 1978, the report of the World Commission on Environment and Development (WCED) proposed a definition of sustainable development. It follows that the current socio-economic development should be based on satisfying the needs of the present generation without diminishing the chance for future generations. It should also be

noted that the idea of sustainable development in Poland has constitutional status; Article 5 of the Constitution reads that the Republic of Poland, among other things, provides environmental protection whilst upholding the principles of sustainable development (Konstytucja Rzeczypospolitej Polskiej z dnia 2 kwietnia 1997 r.). Additionally, contemporary society must live by these principles so as not to diminish the opportunity for future generations to have their needs satisfied. One of the dimensions of sustainable development is energy transition and the search for renewable energy sources (RES) that contribute to the protection of the natural environment. They replace fossil fuel and therefore contribute to improving air quality and, by extension, the standard of living. Energy from RES comes from recurring natural processes and is obtained from non-fossil energy sources (wind, water, solar radiation, tides, waves, geothermal energy, biogas, solid and liquid biofuels, including the natural environment energy used by heat pumps) (Ustawa z dnia 20 lutego 2015 r. o odnawialnych źródłach energii) (Fig. 1).

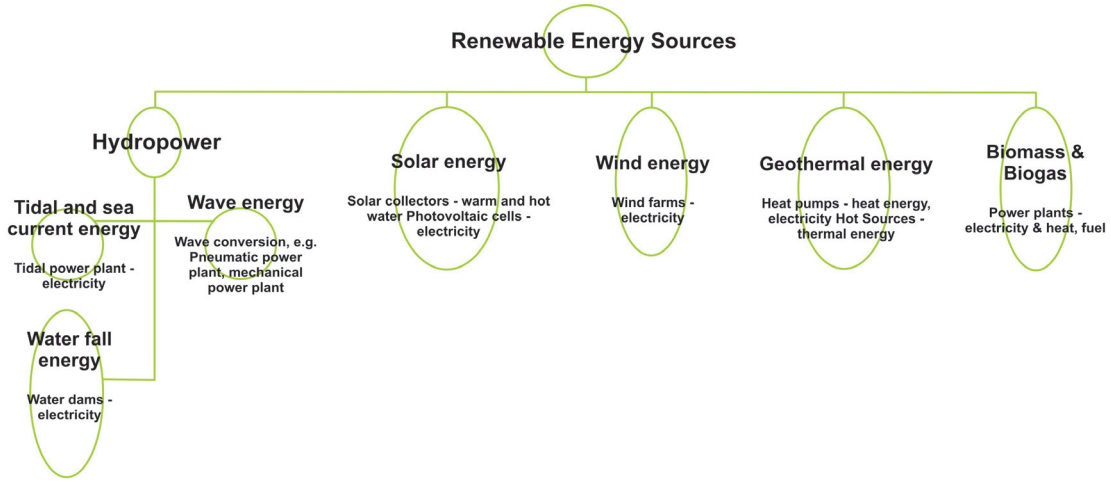

Figure 1. Division of renewable energy sources (Source: own study based on Ustawa z dnia 20 lutego 2015 r. o odnawialnych źródłach energii)

Caring for the environment is the responsibility of public authorities and every citizen has the right to information on the state and protection of the environment as such (Konstytucja Rzeczypospolitej Polskiej z dnia 2 kwietnia 1997 r.). In connection with these premises, one of the methods of civic education regarding the respect for the environment is creating educational paths, which are both cognitive and educational in nature and usually associated with school activities. The overriding principle is to educate the student's perception of the surrounding world (Antczak, 2003). Therefore, they serve the residents, but also tourists. It is worth mentioning that educational paths are usually associated with appropriate infrastructure as well: walking trails established in such a way as to include as many natural objects as possible, together with architectural and technical monuments. In addition to marking, they are distinguished by information boards related to specific objects, natural processes or phenomena contributing to the improvement of the environment. The basic function of such paths is education based on one main theme (http://www.szlaki.szkolenie.pttk.pl/pliki/prezentacje/Szlaki_definicje.pdf). Despite their growing popularity in the tourist space, they do not yet have a precise scientific definition (Wojtanowicz and Sokołowska, 2012). When planning an educational route, one should first of all consider how to communicate information regarding environmental problems to its users. Participants should be involved in exploring the natural environment and willing to discuss and reflect on the surrounding nature (Falchetti and Margnelli, 2006). The research conducted in Austria in Linz shows that universities have the potential to implement education and other information activities regarding sustainable development in the region (Radinger-Peer and Pflitsch, 2017). Educational paths can be one of the new ways of educating societies in the field of sustainable development principles, including energy transformation. Their informal formula facilitating active leisure activities in close

contact with nature is seen as a promising alternative to the official school curriculum. They are becoming ever more important during the period of social distancing resulting from the COVID-19 pandemic and the related re-opening of the tourism sector. Since said paths are also usually situated in peripheral areas, distant from city centers, it allows for the fulfillment of tourist needs with due consideration given to all restrictions and, above all, the expectations of potential users.

Following the authors' research to date and continuing analyses in the field of environmental education (Chodkowska-Miszczuk et al., 2016; Rogatka, et al., 2017; Ryszkowska et al., 2018), the study pursues to present the concept of a tourist and educational path using RES in the context of the idea of sustainable development. The proposed path is located in the Kujawsko-Pomorskie voivodeship, more specifically the route leading from the dam in Włocławek through the photovoltaic farm in Czernikowo to the ecological landfill site in Toruń. Conceptual work on the tourist educational path in question was preceded by diagnosing the needs and expectations of potential tourists (young people), namely students of the Nicolaus Copernicus University in Toruń (NCU). In order to achieve the aim of the study, the authors sought answers to the following research questions: Q1) What are the expectations of potential users of the route, i.e. young people? Reference was made to the example of students of the NCU. Q2) What should be a model natural educational route using RES?

2. Materials, research methods and characteristics of research area

The study was implemented in two fundamental steps. The first constituted the diagnosis of the expectations of potential tourists. In general, the main objective of the study was to obtain information on knowledge of the topic regarding unconventional energy sources and collect opinions on tourist educational paths. For this purpose, an anonymous survey was carried out among representatives of generation Y, which is considered to be the most dynamic, innovative and creative, as well as capable of shaping the public space, economy and culture (Hopkins and Stephenson, 2014). That being said, a sample of NCU students responded to the questionnaire between August and December 2018. There was 200 of them in total, among which 35% were men, and the remaining 65% were represented by the female part of the academic community. The age structure of surveyed NCU students was as follows: the largest group were people aged 23 (33%), followed by 22-year-olds (16%), 20-year-olds (15%), 24-year-olds (13%), and 19-year-olds (11%). The least numerous group constituted students over 25 years of age. One of the questions included in the questionnaire concerned the voivodeship the students of NCU come from. A great majority of respondents (61%) stated that they come from the Kujawsko-Pomorskie voivodeship. The subsequent question was related to their year of study. The largest number of respondents were students in the 3rd (26%) and the 5th year (24%). The other proportions were as follows: 19% of surveyed students were in their 1st year, then 16% in their 4th, and 15% in the 2nd year of studies. The results of the survey were analyzed using the IBM SPSS program. For the purpose of in-depth research, cross-analyzes were also carried out, taking into account the socio-demographic characteristics of the respondents.

The results obtained by dint of the questionnaire survey became the basis for the next step of the study, namely the conceptual works related to the proposal of the tourist educational path. The area in question was thoroughly examined through exploration and against photographic documentation. As such, the field query covered the terrain stretching along the Vistula river from Włocławek to Toruń. The route features tourist, natural and historical values of the areas adjacent to said river within the borders of the Kujawsko-Pomorskie voivodeship, as well as certain facilities using RES (wind, water, solar energy). The proposed path was created in such a way as to be cyclist-friendly, with its level of difficulty defined as moderate. It runs through forests and peripheral areas; the already existing network of unfrequented dirt roads was brought into use. When taking this route, one may stumble upon the most popular facilities using RES in

the Kujawsko-Pomorskie voivodeship along the way. The largest building in the area is the dam in Włocławek, the construction of which led to the creation of the Włocławski Reservoir. Initially, the dam was supposed to be a part of the lower Vistula cascade, but the project was abandoned, and other dams were never erected (Kowalski, 2010). On another note, the photovoltaic farm in Czernikowo is one of the largest in Poland. It covers an area of 7.7 ha in total (https://energa-oze.pl/obiekty/farmy-fotowoltaiczne/19957/czernikowo).

3. Research results

The first stage of research both verified the young people's knowledge of sustainable development and RES and identified their needs in this area. The results were as follows: 39% of surveyed NCU students stated that they are sufficiently informed on the topic of RES, whereas 35% of them were well-acquainted with it. Another 8% were of the opinion that RES are very well-known to them. Only 17% of respondents admitted to having poor knowledge of the subject matter, and 1% – none at all. When asked about the types of RES known to them, the students most often indicated three energy sources: sun (80%), wind (78.5%) and water (69%). Other RES included geothermal energy (56.5%), biogas (42.5%) and biomass (38.5%). The NCU students were also asked about the perception of alternative energy sources. It so transpires that the majority of them are positively disposed towards them. To be more specific, 59% of those surveyed responded with 'very positive,' while 36% decided that 'positive' describes their attitude best in this regard.

After obtaining the opinions on renewable energy (RE), respondents were asked about their knowledge of educational paths in the Kujawsko-Pomorskie voivodeship. It was necessary to verify whether potential users of the route proposed in this article had stumbled upon similar tourist offers in the region before. In that respect, the survey showed that almost a quarter of the students were familiar with the educational kayaking trail to the 'Bachotek' floristic reserve located in the Brodnica poviat, Zbiczno commune. They found this path particularly attractive because, while taking it, one can observe aquatic vegetation, nesting sites for swans or ducks, and spend time actively kayaking at the same time. As for other educational paths, they were known only to individuals.

Subsequently, the respondents were to say which RES installations could be used to establish a tourist educational path. 120 of 200 students participating in the survey (60%) claimed that solar power plants would be an interesting object to see there, the second most frequently selected answer being wind power installations (51%). Many other respondents believed that hydroelectric power stations were also appealing as far as RES are concerned (39%). Such answers led to these three above-mentioned RES installations being deemed the most adequate elements of the planned path, the leitmotif of which are new industrial installations in the form of RE-based devices and facilities.

Other than that, there are also other values that determine the future of such a route in terms of tourism. As the results of the study show, the location in a picturesque area is considered attractive by 60% of respondents, whereas rest areas were almost as popular an answer (59%). The infrastructure of the path should also include properly allocated parking spaces for: bicycles (40%) and, to a lesser extent, individual cars (27%). When it comes to such undertakings, they need their informational side to be appropriately developed as well. 48% of respondents emphasize that dedicated mobile applications would allow for more effective promotion of this new tourist product, and 47% articulate the need to install information boards concerning said path. The ideas related to the construction of an information center on energy and RES near the path are less popular among the surveyed students (28%).

Furthermore, the obtained results were examined in the context of the demographic characteristics of the respondents. For this purpose, the cross-analysis method was used. The table below presents the knowledge regarding individual types of RES exhibited by students of the NCU, which, apparently, is very similar between both sexes. Solar energy is the best-known source of RE among both men and

women, and the same applies to wind energy (Table 1). Owing to their size and shape, wind turbines belong to landscape dominant features, raising the most concerns and general discussion on the possible transformation of the landscape they are placed in. The location of a power plant, especially in places not yet related to energy production, not only changes and diversifies the function of a given area (or one of these factors), but also transforms the structure of an existing cultural landscape and its perception (Ryszkowska et al., 2018).

Table 1. Cross-analysis of knowledge regarding particular types of RES by gender of respondents (Source: own study based on the results of the survey, N = 200)

	Water energy	Solar energy	Wind energy	Biogas energy	Geothermal energy
Women	21	25	24	13	17
Men	21	24	24	13	18

The NCU students were then asked if they had encountered a tourist facility that uses RES before. Among the most frequently chosen answers was 'city bike,' indicated by 16% of women and 19% of men participating in the survey. As such, city bike stations are powered by solar energy thanks to small photovoltaic panels placed on them. Other RES-based tourist facilities commonly known to both the male and female students included hotels / guest houses (16% and 15% respectively), cars (14% and 14%) and buses (16% and 13%). For that matter, hotels and guest houses are supplied with electricity and heat by virtue of solar energy, and, as for cars and buses, they are being more often fitted with hybrid engines to reduce exhaust emissions. Furthermore, women proved to be less familiar with water trams and RES installations (6% each), whereas men encountered the water trams the least often in general (3%) (Table 2). To sum up, the most apparent ways of using RE in tourism, both for women and men, are RES installations that improve the quality of accommodation facilities and vehicles with hybrid engines.

The survey results show that the best-known RES installations are the objects that use solar, wind and water energy. To prevent fragmentation and polarization of consciousness regarding individual types of RES, the knowledge about other unconventional energy sources should also be promoted; as an illustration, biogas is not a widely known energy source that is also often stereotyped and believed to evoke negative feelings (Chodkowska-Miszczuk, 2019).

When proposing a new tourist product in the form of a path, one should also bear in mind other expectations of its potential users, including those related to active leisure activities in the surroundings of picturesque nature. The study conducted for this paper implies that the surveyed NCU students like to spend their time actively, as almost a quarter of the respondents explored the 'Bachotek' kayaking trail. For this reason, the authors proposed a tourist educational path that covers natural values (the route runs along the Vistula river and forest areas) and anthropogenic values (including the Włocławek barrage, the photovoltaic farm in Czernikowo and individual wind power installations that occur in the landscape along the route). Owing to the enrichment with information boards at key natural and anthropogenic locations, such tourist paths pose an excellent form of education about the region and an alternative to mass tourism and tourism in the post-pandemic period, requiring tourists to maintain social distance.

Table 2. Answers to the question: Have you ever encountered a tourist facility using energy from RES? by sex of respondents (Source: own study based on the results of the survey, N = 200)

	Women	Men
Hotel / guest house	15	16
Pool	9	8
Educational tourist route	10	12
City bike	16	19
Bus	13	16
Water tram	6	3
Car	14	14
RES installation	6	8

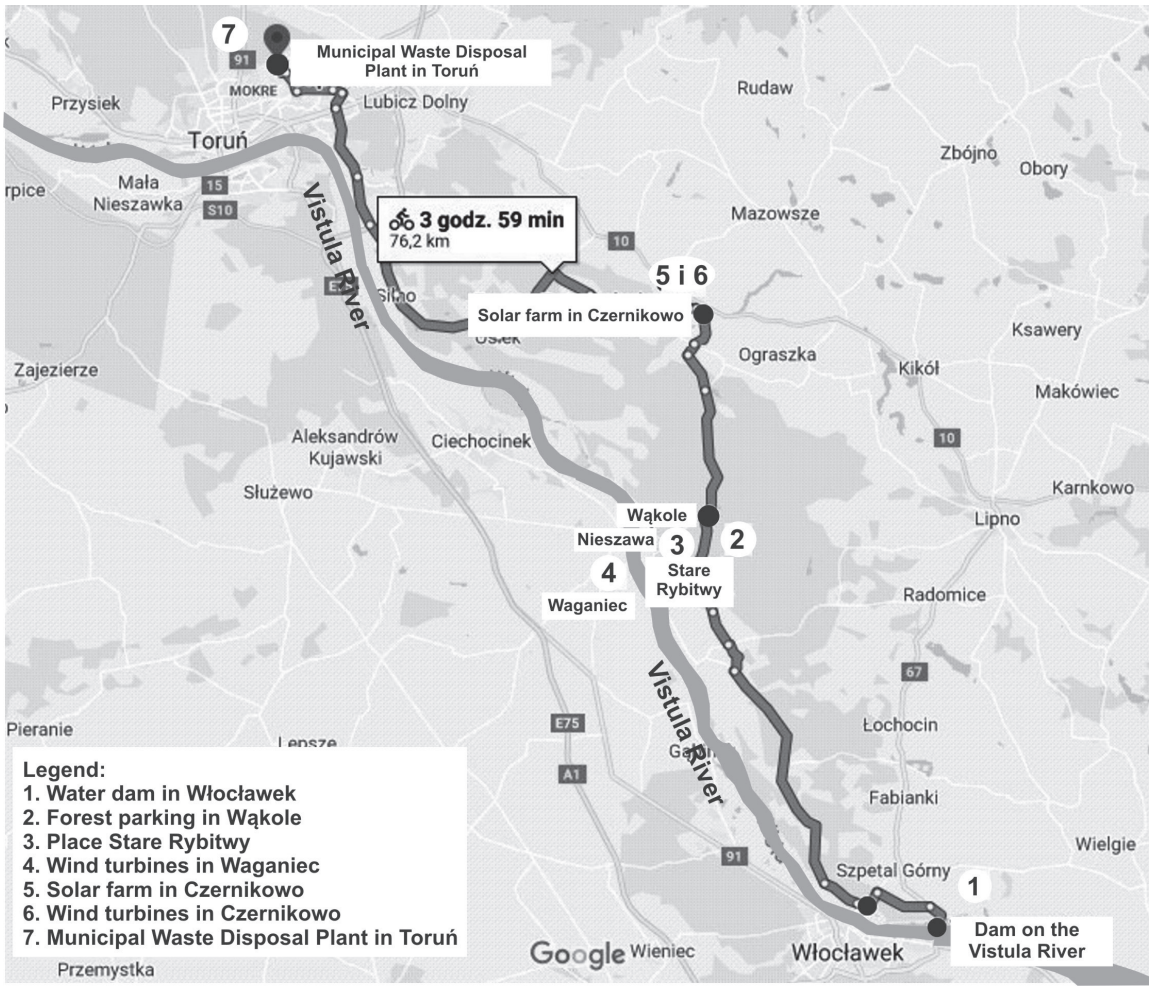

Figure 2. Proposed course of the educational tourist path using RES (Source: own study based on https://www.google.pl/maps)

The detailed description of the tourist path was carried out in the S–N direction, but it does not mean that it cannot be traveled from north to south. The first object on said path is the dam in Włocławek (Point 1, Fig. 2). This place is popular owing to the cross-monument consecrated by Pope John Paul II in 1991, which commemorates the martyrdom of Father Jerzy Popiełuszko. Apart from being a hydrological object, the dam is therefore a destination for religious tourism as well (Fig. 3A).

The Włocławek power plant was designed in the 1960s. The project involved the construction of eight dams on the Vistula river (https://warszawa.rzgw.gov.pl/o-nas/nasze-obiekty/zbiorniki-i-kanaly/stopien-wodny-wloclawek-na-wisle). To date, these plans have not been implemented and it is the only barrage that has been operating continuously for more than 40 years. In order to ease the load on the object, a plan to construct a dam in Nieszawa emerged in the 1990s (Kowalski, 2010). In 2015, the barrage finally underwent renovation that included reparation of the weir, sluice and fish ladder, as well as revitalization of a part of the waterfront.

The proposed educational tourist path leads through the Natura 2000 area Włocławska Dolina Wisły. The refuge includes the Vistula riverbed and flood terrace as well as the surrounding extent of land with the steep slopes of the valley. This very section is characterized by sandbars and mud deposits in the riverbed, which have their origin in accumulation of the material that is eroded from the bottom of the river at the dam in Włocławek. As for sandbars, they arise and disappear due to seasonal changes in the water level resulting from water exchange at the Włocławek power plant. The Natura 2000 area is of high natural value as it features eleven habitat types, fifty-eight animal species and three plant species that are crucial for nature conservation in Europe. The largest area is covered by forests and willow thickets on the riverbank – valuable natural habitats (https://wloclawek.torun.lasy.gov.pl/).

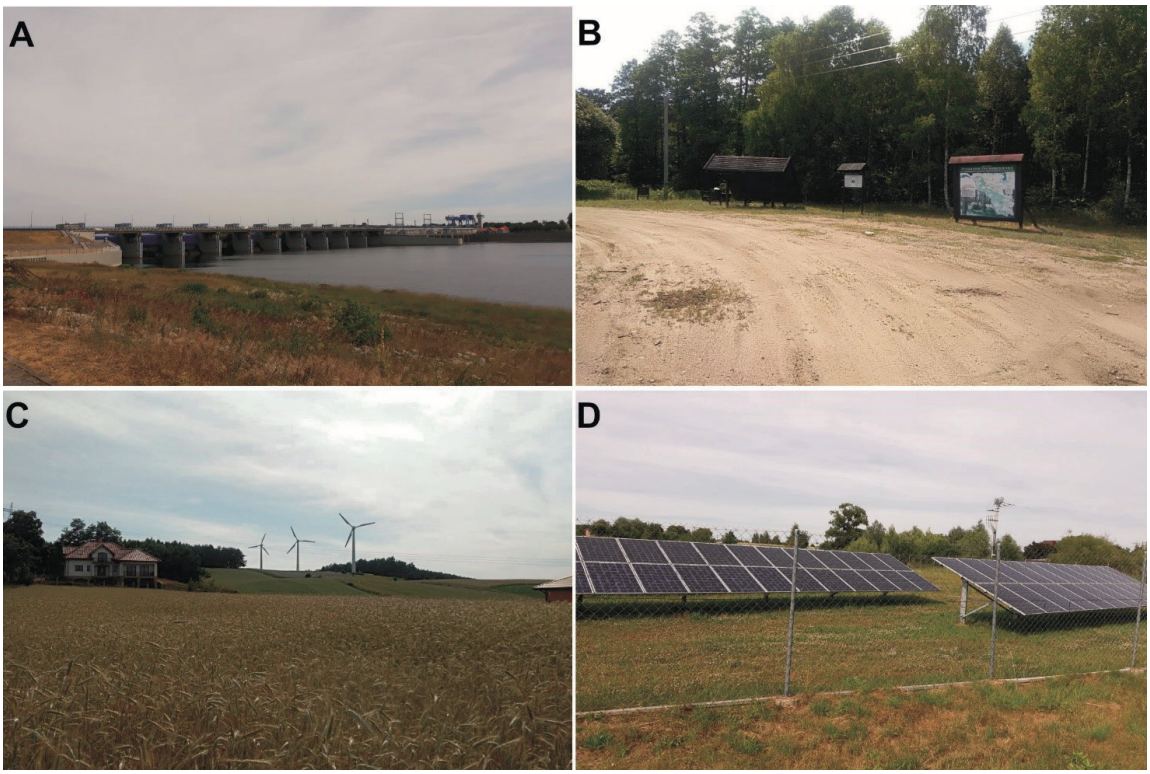

Figure 3. Examples of objects on the proposed path: 3A – barrage in Włocławek, 3B – forest car park near the 'Wąkole' forest district, 3C – three wind turbines in the commune of Czernikowo, 3D – photovoltaic farm in the municipality of Czernikowo

Furthermore, it is worth taking the ferry from Stare Rybitwy to Nieszawa, about 28.5 km north from the barrage (Point 3, Fig. 2). Crossing the river may be an attraction in itself, but it also allows one to experience the cultural landscape with five clearly visible wind turbines. One can then take a bike trail that starts in the town of Wąkole and goes through a forest car park and the 'Wąkole' forest district. However, it must be borne in mind that the parking does not have any sanitary conveniences, rest areas (tables or benches) – highly desired by the respondents – or any safe places for a bonfire or barbecue. As of now, there is a shelter for bicycles, a trash can, and an information board (Fig. 3B).

Another RES-based installation that can be found along the path is three wind turbines in an open agricultural area in the commune of Czernikowo. Since they are located on a hill, the turbines are clearly visible and their role as a landscape dominant feature is thus enhanced. It should also be mentioned that they are situated on a private property just 200 meters from residential buildings, their electric power amounting to 500 kW (Fig. 3C).

Within the same commune, one can find yet another interesting object – the photovoltaic farm (Point 5, Fig. 3D). Launched in 2015, it is one of the largest investments of this type in Poland, with an area of 7.7 ha. The installed capacity of the farm is 3.77 MW. What is more, it produces 3 500 MWh of energy annually, which equals the energy demand of approximately 1 600 households. The solar farm consists of about 16 000 panels (240 W each) and covers an area of 22 500 m in total – it is the size of several football fields. With such a large production of clean energy, around 3 000 tons of carbon dioxide are not released into the environment every year (https://energa-oze.pl/obiekty/farmy-fotowoltaiczne/19957/czernikowo, http://www.energa-wytwarzanie.pl/obiekty/lista-obiektow/czernikowo,56,obiekt.html). This very facility is crucial for the proposed path due to its size, the role it plays in the implementation of modern energy solutions in Toruń and its surroundings as well as the popularity of solar energy as a RES in general. The farm also constitutes part of the "Smart Toruń" program, which envisages the creation of an Intelligent Energy Network in Toruń and neighboring communes. The project also includes development of remote meter reading applications and programming of systems for network operation and management. In addi-

tion to the photovoltaic farm, intelligent lighting network with energy-saving lamps is planned in the Chełmża commune (Toruń poviat) (https://smarttorun.pl/o_projekcie.html).

The southernmost place to visit on the proposed tourist educational path is the Municipal Waste Management Enterprise (MPO) in Toruń (Point 7, Fig. 2). The importance of this facility stems from the fact that, besides its statutory tasks, it is also involved in environmental education in the field of waste management, its re-use as well as energy production. According to the results of the survey, there is a need for education in the field of less known manifestations of sustainable development, and a visit to the MPO allows for their presentation and raises awareness of the need to implement proper waste management.

Moreover, the ecological path designed by the MPO is 2 km long and may serve as the conclusion of the route put forward in this paper. Intended primarily for children and adolescents, the path features ten information boards as well as two outdoor games. The information and diagrams they contain aim to present the objectives and principles of modern waste management (https://mpo.torun.pl/71/o-centrum).

By and large, the route advanced by the authors starts at the dam in Włocławek and ends at the ecological Municipal Waste Management Enterprise in Toruń. It is over 76 km long in total, which makes for about 4 hours of continuous cycling. Due to the relatively long distance, the path can be covered by intermediate cyclists.

4. Discussion

Owing to the fact that the tourist educational paths are popular mainly among children and adolescents, particular research interest is focused on young people. As the terrain can be traversed on a bicycle (which is recommended by the authors), the trail's participants can take active part in the educational process. User activation is one of the pillars of educational paths as such (Rodzoś, 2001). Moreover, bicycles constitute the most popular means of transport in this very age group: it is environmentally friendly, gives joy and measurable benefits to people who engage in this type of activity, but also gives the opportunity to stop anywhere and contact with nature, not to mention that it improves the physical condition of the cyclist as well (Kamińska and Mularczyk, 2013). In the report published in 2013 *Attitudes of Europeans towards urban mobility* one can find information about bicycle users. Young people aged 15–24 are likely to use bicycles at least once a day (15%), more often than people aged 25–39 (12%), 40–54 (12%) and people over 55 years of age (11%). Bicycle users aged 15–24 declared that they would ride several times a week (25%), substantially more often than those aged 25–39 (18%), 40–54 (18%) as well as people 55 and older (13%).

The survey conducted in 2018 shows that the respondents most often used the educational path (29% of 200 respondents) while in primary or secondary school. People at this age acquire knowledge the fastest and it is the easiest for them to develop habits related to environmental protection. It is also worth mentioning that young people have a good understanding of RES. The authors are aware that the survey results may be influenced by the size of the studied group and the declarative character of the respondents' answers. Nevertheless, the findings on the perception of RES are confirmed by earlier studies in this area. The research conducted by Babula and Warchoł (2016) shows that about half of those surveyed (students) believed that they had knowledge about RES at a sufficient level (45%), and almost every fifth (19%) on a good level. What is more, 43% of respondents most often mentioned wind, water and solar energy. Similar results were obtained during this study as well. It transpired that 39% of surveyed NCU students defined their knowledge of RES as satisfactory and 35% as good. The respondents were also aware of solar energy and wind energy being brought into use.

One should bear in mind that renewable energy sources may favor the development of tourism. It is worth noting that an important aspect for the development of tourism activities is the promotion of sustainable tourism while maintaining the quality of natural values.

There are many examples of combining tourism with RES in Poland, which also vary in scope. Solar collectors installed on agritourism farms with only a few beds, but also all-year-round facilities, e.g. in Wetlina or Ustrzyki Górne (Podkarpackie voivodeship). They can also be used to heat water in swimming pools (e.g. in Głogów Małopolski or in the outdoor pool in Boguchwała (Podkarpackie voivodeship) (Dec and Krupa, 2012). On the same note, solar installations mounted on public buildings are another example of creating tourism space. By placing such devices in the most representative areas in a given commune, the local authorities promote methods of obtaining clean energy (Chodkowska-Miszczuk, 2012). As anthropogenic elements, unconventional energy sources can also be used as objects on a tourist educational path, rendering the route more attractive. Their educational function in shaping the environmental awareness of young people cannot be overlooked as well. The future of such tourist and educational offers depends largely on the scope and form of their popularization among the younger generation as well as residents and tourists alike. The importance of modern technologies should also be taken into consideration (Wojtanowicz and Sokołowska, 2012), along with the relevance of cross-sectoral cooperation (Lewandowska and Chodkowska-Miszczuk, 2019).

5. Conclusions

Based on the survey, it should be concluded that RES can be a tourist attraction. Young people (students of the NCU) with sufficient knowledge of this topic believe that if a tourist educational path using RES installations was created, it would be attractive to them. The route put forward in this article meets the requirements of sustainable tourism as it satisfies the basic needs of bicycle tourists, does not interfere with the environment and promotes solutions that protect the environment at the same time. The path in question is also a response to the needs of active, unconventional tourists looking for experiences beyond the beaten trails offering natural attractions and non-obvious anthropogenic values, such as RES installations.

The proposed route can (and should) be established and then actively used by residents and tourists of different gender, age and socio-cultural status. Its role in building social awareness on RES is invaluable. The advantage of the trail as such lies in the possibility of combining different RES installations and allowing people to learn about the operation, benefits and consequences of investing in various RES. Moreover, it also shapes the idea of diversification of energy sources. The common theme of each section of the route is undoubtedly the natural values of the Vistula valley.

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