Proceedings of the 2018 International Conference "ECONOMIC SCIENCE FOR RURAL DEVELOPMENT" No 49
Jelgava, LLU ESAF, 9 11 May 2018, pp. 48-55
DOI 10.22616/ESRD.2018.117

ECONOMIC AND ECOLOGICAL POTENTIAL OF THE PROTECTED AREAS IN THE PIENINY MOUNTAINS

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Abstract. The aim of this paper was a synthetic evaluation of selected aspects of the economic and ecological potential of the Pieniny, one of the most interesting medium-height mountain ranges in the Carpathians. The paper is an attempt to analyse the potential of protected areas of Pieniny Region, especially the Pieniny National Park. Economic interest and nature conservation as pursued by the national park and supported by the specific, individual farms, seem to be related to a significant extent. Except for the highly developed non-agricultural entrepreneurship in the Pieniny communes, including tourism and the related services, small-scale, dispersed agricultural production is important here. Sheep are kept in small herds and the majority of them are handed over for collective grazing during the season. They are grazed in 12 herds, one of which is involved in the environment-friendly cultural grazing in the Pieniny National Park. Sheep grazing in the pasture lands and abandoned arable land helps to maintain the biodiversity and the attractiveness of the cultural landscape, and tourists can buy sheep's cheese produced by the local people, who live in the Pieniny.

Key words: economic potential, natural values, the Pieniny Mountains.
JEL Classification: Q, Q5, Q57

Introduction

There are three main mountain ranges in Poland: the Carpathians, the Sudety and the Swietokrzyskie Mountains, of which the last one is in fact an upland, because of relatively small heights. The mountain range and geomorphological province, with the greatest area are the Carpathians, that are also among the largest and the most important European mountains. In the area of Poland, they are divided into several smaller mountain ranges, such as: Pieniny, Tatra Mountains, Beskidy and the Carpathian Foothills (Kondracki J., 2009; Zemanek B., 2009). In territory of the Carpathians, there are located as many as 141 rural and urban-rural communes, thus they are important from an economic point of view.

The paper is a dual analysis, combining the review part based on the analysis of the literature on the subject, including proprietary works, and the institutional analysis including the economic aspects of the area of Pieniny Mountains, with a special focus on agriculture, as well as some of their ecological potential. The economic part of the research is based on inductive-deductive method, related to institutional analyses. Moreover, the study is an original approach to illustrate interrelations between economics and ecology, including mountain landscape protection. An example has been presented, in the form of a case study, regarding economic activities undertaken, in order to maintain the biodiversity of the pasture lands situated in the Pieniny National Park, by cultural grazing of sheep. Some of the biotic resources of the Pieniny Mountains have been also presented, whose protection and maintenance is still an important challenge for the region. Source materials have been collected in January 2018 from the Directorate of the Pieniny National Park in Kroscienko and from the Regional Union of Sheep and Goat Breeders in Nowy Targ. Source data regarding mass statistics came from the Statistical Office in Krakow and relate to 2016.

The aim of the paper was the synthetic evaluation of the economic potential and ecological resources of one of the most attractive mountain ranges of the Polish Carpathians, that are Pieniny. Special attention was paid to the economic and institutional aspects of maintaining the

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DOI 10.22616/ESRD.2018.117

biodiversity in this mountain range, thanks to the support from the EU programs, that provide some financial assistance for cultural sheep grazing in the mountain pastures.

Research results and discussion
1. Polish Carpathians

The total mountain area in Poland is 878.4 thousand ha, of which the 77.2 % is the Carpathians, 18.8 % Sudety, and the Swietokrzyskie Mountains cover only 4 % of this area. Although part of the high-mountain range, the Tatra Mountains, is situated in our country (ca. two thirds of the range lies in neighbouring Slovakia), only 1.5 % of the area belonging to the farms, lies at higher altitudes than 500 m above the sea level. Mountain areas differ from lowlands or uplands because of a few specific features, such as: the climate, soil types, precipitation and flowing waters, but also flora and fauna. The climate in the mountains includes altitudinal arrangement of thermal and precipitation zones, as well as great diversity of the local climate types. A specific feature of this area is that the land is hardly useful for agricultural production, which includes a limited range of crop species and less opportunity for yields.

In the Carpathians, the temperature drops on average by 0.5 °C with each 100 metres above the sea level, and the precipitation increases by 30-50 mm per year. This favours farming on grasslands, at the same time reducing the chance for decent yield on arable land. The length of the vegetation period above the average altitude of 1 550 m above the sea level is reduced to 140 days, and the frost-free period is reduced to 110 days. Mountain areas also experience considerable precipitation, which may be quite diverse, spatially and seasonally. What is characteristic, is the increase of precipitation along with the increase of the altitude above the sea level. Maximum average annual precipitation is ca. 1800 mm for the average altitude of 1 850 m above the sea level and it drops by 15 mm with each 100 m upwards. The sloping of the land in the mountains is the main criterion for the way and intensity of land management, including its usefulness for plough tillage, assignment as permanent grasslands, or forest use, without alternatives (Kaim D., 2009).

When analysing the various aspects of the strengths and weaknesses of the Polish Carpathians, seen from the perspective of land factor, such as usefulness and attractiveness, we can see that the prominent problem is the agrarian structure. The land here is usually highly fragmented and dispersed, which accounts for its adverse layout. At the same time, the structure has been permanent for years, both as regards ownership and management. Trade in farmland is particularly low here, and in fact it's hardly noticeable, especially in the highlands of the Carpathians. Subregionally, it is more and more common for people to refrain from farming the agriculturally marginal land, which doesn't mean that the land is intended for sale or lease, though. A significant and progressive phenomenon in agricultural production is plant succession when it comes to the land use. Abandonment of arable land leads to its transformation firstly into grasslands, and then woodland. Apart from other production aspects, it is conducive to the reduction in the agricultural value of the land. Agricultural production, especially on arable land in the dominant part of the mountains, is rather traditional and extensive. The production most often takes place on small land plots (0.05-0.2 ha), where extensive farming of potatoes and cereal is maintained. However, this production is not only significant for the inhabitants of the rural areas in the mountains, but it is also a decisive factor for the people's lifestyle, by living close to the nature (Musial W., 2017).

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2. Economy of the communes situated in the Pieniny Mountains

Although the very range of Pieniny is relatively small, as it is ca. 30 km long, in fact it makes a geographical region of considerable economic, social and cultural potential. It is composed of three communes: part of an urban-rural commune of Szczawnica, a rural commune of Kroscienko and part of the Czorsztyn commune. The total area of these communes is 207 km^2 and their joint population is about 21.7 thousand. The communes are of similar size, however Kroscienko is the largest of these three (Tab. 1).

Table 1

Selected characteristics of the communes in the Pieniny Mountains

Specification	Communes			Total
	Czorsztyn	Kroscienko	Szczawnica	
Area (km^2)	62	88	57	207
Total population	7611	7322	6772	21705
Population per 1 km^2	104	83	119	99[1)]
Business entities per 10 thousand inhabitants	1395	2025	1572	1664
Registered unemployment (%)	7.4	8.5	7.1	
Agricultural land (ha)	1552	2134	1306	4992
Agricultural land (%)	25.0	24.2	22.8	24.1
Afforestation (%)	44.6	68.1	49.1	
Percentage of farms up to 3.0 ha	94.2	85.2	80.4	86.6
Tourist accommodation establishments	22	74	15	111
Cattle - physical count of animals/100 ha of agricultural land	23.1	25.9	9.2	20.7
Sheep - physical count of animals /100 ha of agricultural land	77.1	68.3	18.8	54.7
Tourist accommodation establishments	22	74	15	111
Total income of the commune budget per 1 inhabitant (in PLN)	4085 (950 EUR)	4049 (941.6 EUR)	3929 (913.7 EUR)	4021 (935.1 EUR)
Proportion of people using the:				
- water supply network	75.9	69.6	79.3	75.7
- sewage system	92.5	60.7	81.9	79.6

[1)]Converted with the rate: 1 EUR =4.3 PLN
Source: Statistical Guidebook of the Local Authorities, Statistical Office in Krakow 2016

The population density of the communes is fairly high, when comparing to the other rural areas in Poland and it's close to the national average value, from 83 people/km^2 in Kroscienko to 119 people/km^2 in the urban-rural commune of Szczawnica. Local population is employed both in agriculture and in non-agricultural sectors of economy, especially in services. In the structure of land use, forests are dominant, including the protective forests in the Pieniny National Park. The forests cover a total of 55.8 % of the analysed area and their individual share is from 44.6 % (Czorsztyn) to 68.1 % (Kroscienko). Agricultural land in the whole analysed area covers 4992 ha, and the average share in individual communes is similar, from 22.8 % to 25 %. Farms in this area are fragmented and spatially dispersed, whereas an average of 86.6 % of farms occupy from 1 to 3 ha, and in the Czorsztyn commune this proportion is as high as 94.2 %. This agrarian structure is negative from the point of view of economy and production. For this reason, agricultural production is largely focused on providing supplies for households, and on farms where animals are also kept, the production may partially focus on the market. The number of cattle is relatively low and is on average 20.7 animals/100 ha and it is still on the decrease. It is the result of a sharp drop in the

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profitability of the small-scale production (1-2 cows), and of the increasing requirements related to the animals' welfare.

The situation is far better with sheep breeding, as keeping these animals has been there a tradition for centuries and it is strongly rooted in the Pieniny culture (Drozdz A., and Twardy S., 2004). In particular communes, the number of sheep may vary and it is respectively: 77.1 animals/100 ha in Czorsztyn, 68.3 in Kroscienko, and 18.8 in Szczawnica. The population of sheep is largely made up of small and very small herds of ewes (a herd may include from 10 to 50 animals). The sheep is kept all year long on a farm, when there is enough feed, or they may be handed over for grazing on pasture lands during the season. The dominant direction in sheep production is the production of light lambs (12-16 kg/animal), which are intended for export. After the lambs are weaned, the ewes are grazed on pastures and milked, and the sheep's milk, usually mixed with cow's milk, is used to make cheese. Breeding sheep is a significant value from the perspective of evaluating the economic potential of agriculture in the Pieniny. There are a total of twelve large herds of sheep, grazed and herded collectively, by *baca* who is a chief shepherd, on pastures and arable lands, which are sometimes transformed into grasslands, plus a few dozens of smaller herds (5-30 animals). The number of sheep grazed in the Pieniny is rather constant and for many years it has been on average 12-13 thousand ewes, which give ca. 16-18 thousand lambs intended for herd reproduction and for export, as mentioned above. Low milk yield of the dominant breed, i.e. the Polish Mountain Sheep, explains the fact that during a single grazing season, 1 ewe gives 55-65 l of milk, which is used to produce ca. 10-12 kg of sheep's cheese known as *bundz*. Therefore, the aggregate production of the valued sheep's cheese from the Pieniny region varies from 120 to 150 tons and this number is increased by 10-20 % due to mixing sheep's milk with cow's milk from the local breeds, which is a legally permitted procedure.

However, the most important business activity from the economic perspective is the diverse service sector focused on tourism and entertainment. Professional boarding houses as well as large scale hotel facilities are located there, a total of 111 of them. There are also numerous farms that provide services that may be classified as agrotourism or small boarding houses, if their activity is not related to agricultural production. A considerable proportion of the local population is seasonally involved in tourism by providing catering services, manufacturing and selling souvenirs, and offering water transport services as well as working as tourist guides in the Czorsztyn and Niedzica castles. A lot of seasonal jobs, for 300-500 people, are created by an organised business entity providing rafting services on the Dunajec river. An important source of income for the local population is providing various construction services, often performed away from their place of residence, usually quite far and often abroad. However, this does not result in the outflow of people from the region, and in fact the migration balance is even slightly on the positive side. The discussed region is inhabited by entrepreneurial and hard-working people, who usually organise their own non-agricultural business activities using the base of their own farm and land, if they cannot find employment away from the farm and their home. Such business activities may include harvesting and processing timber, construction services, trade in construction materials and catering services. A tourist attraction and an important workplace for the local population is also the water dam on the Czorsztyn water reservoir and the water plant in Niedzica. Furthermore, the local population finds employment in supervising forests, in the directorate of the Pieniny National Park, in educational and care facilities and particular communes' offices. The Pieniny region has an attractive location and its value lies in the originality and uniqueness of nature. That's why the

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communes located within this mountain range are widely recognised in the whole country, which considerably strengthens their image and constitutes an important asset in the field of territorial marketing (Dabrowski P., 2008; Gorecki A., Popiela R., and Drozdz-Korbyla M., 2002; Wrobel I., 1997).

3. Cultural grazing of sheep in the Pieniny National Park - a case study

In the area of Pieniny National Park (PNP), only one herd of sheep is grazed, of twelve that are kept in the whole Pieniny Mountains. This herd and the grazing process itself are special, because as compared to others, this one is grazed within the perimeter of the PNP, and it is a so called cultural grazing, other than for different herds, where it is mostly commercial or mixed (commercial – cultural). At the moment, ca. 500 sheep are grazed on a pasture complex known as Majerz Pasture Land (*Hala Majerz*), located in Haluszowa village, and covering the area of 52,06 ha. One chief shepherd, who in the Carpathians is called *baca*, is responsible for the herd. Prior to that, there is signed a proper agreement between *baca* and the Directorate of the Pieniny National Park in Kroscienko. The shepherd is chosen following a tender procedure, and then a lease agreement is signed for five years. The current agreement is effective until 2019. The leased area includes non-forested and unfenced parts of 12 registered plots. In the agreement it is stipulated the main purpose of grazing, which is protecting the pasture ecosystem and maintaining the biological diversity. However, if there is not enough feed for the animals in pasture, the chief shepherd is allowed to graze the sheep in the special clearings. A pasture is leased along with farm buildings: the shepherd's hut, stables, and the drinking-troughs situated in the pasture, and fences for the meadows. According to the agreement, the annual lease fee is 25 300 PLN (i.e. 5 883.7 EUR), i.e. 485.9 PLN (113 EUR)/for 1 ha of the pasture land.

Furthermore, the tenant is obliged to observe following grazing rules: the grazing starts on 1 May of the specific year, and ends on 15 October, there must be no more than 10 sheep/ha, i.e. up to 500 sheep in the herd in the grazing season. The tenant has the right to graze individual cows, provided the number of sheep is reduced accordingly (1 cow = 10 sheep). What is more, soil fertilisation with the faeces of sheep is introduced in a continuous manner (the strip method), the density of sheep during the night must be no higher than 1 sheep/2-2.5 m². Other rules according to the agreement include: the distance between the place of fertilisation and the springs and banks of the streams, must be no less than 50m, the tenant does not have the right to lead the sheep to adjacent forests and is not allowed to use mineral land fertilisers without the lessor's consent.

What is more, the chief shepherd must conform to so called social and cultural requirements, e.g. related to the furnishing of the shepherd's hut. The mandatory equipment includes the traditional hearth, a kettle, equipment for processing meals etc. There must be also an access to electricity and water from a deep-drilled well. *Baca* undertakes production of the certified regional *oscypek cheese* and submits the production of the cheese to control, and his hut is located on the *oscypek cheese trail*. The chief shepherd must also display obtained certificates in a visible place in the shepherd's hut. As part of his activity, he may sell dairy products, provided they come from the dairy production conducted in the Majerz Pasture Land. The agreement also includes that on the specified days of the year, *baca* commits himself to appear in the full regional costume, and that also refers to all of his employees. However, according to some authors, there is not so much focus on other social and cultural elements, such as wearing traditional regional clothes and using the regional dialect, as in the neighbouring Tatra National Park (Kawecka A., Radkowska I., Szewczyk

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M., and Radkowski A., 2017; Molik E., Dobosz J., Kordeczka K., and Peksa M., 2017). Moreover, the chief shepherd and the people employed by him are also obliged to graze the animals in neat clothes. The tenant is also obliged to carry out any necessary renovations and current repairs of the shepherd's hut and the equipment used to process the milk, whereas such repairs must be performed at his own expense, i.e. the maintenance of the facilities and equipment. He is also to inform the tourists about the grazing procedure, regional traditions, but also about rules that must be followed when visiting the park.

Having a legal agreement for grazing, the chief shepherd may receive payments under the Common Agricultural Policy. These are subsidies for organic farming and direct payments, as well as there is another instrument of income support for the farmers' production in the less favoured areas (LFA). These payments differ slightly from year to year and they total to ca. 1650 PLN (384 EUR) i.e. in aggregate ca. 102.3 thousand PLN (23.8 thousand EUR) (Rural Development Programme, 2014). Moreover, another source of basic income for the chief shepherd, comes from obtaining sheep's milk, which is mixed with a small amount of cow's milk (from 2-4 cows). The milk yield of mixed sheep breeds is low, though, and in a single grazing season it amounts to 60 l of milk, i.e. ca. 30-32 tons of milk from the whole herd and 2-4 thousand litres from the cows (the Polish Red breed). This will produce 4.8-5.5 tons of cottage cheese (*bundz*), which is processed into hard rennet cheese (*oscypek*). It seems, that is especially important to sustain the organic farming in the region, as it is not only about the production of superior quality food, but also a method of environmental protection (Glodowska M., and Galazka A., 2017).

Furthermore, the chief shepherd undertakes grazing of the animals in accordance with principles of the environment-friendly agriculture, where it is also accentuated special ecological potential of the Pieniny Mountains. According to this rule, the chief shepherd is obliged to remove undesirable plant species, manually or mechanically, at his own expense. This refers to such dicotyledonous plant species as e.g. *Cirsium arvense*, which may appear in large quantities in the mountain pasture sward (Musial K., and Kasperczyk M., 2013; Wrobel I., 2003). Besides, a large part of non-forest ecosystems in the PPN are of the anthropogenic origin, and their condition depends on human activity. Thus, grasslands must be mowed twice in each grazing season, in May or June and in August. The most important and valuable non-forest communities there, are e.g.: Pienin's thermophilic meadow (*Anthyllidi-Trifolietum montani*), xerothermic grasslands (*Origano-Brachypodietum*), or wet meadows (*Veleriano-Caricetum flavae*) (Matuszkiewicz W., 2002; Wrobel I., 2003). What is more, at the moment, PNP is not interested in expanding the grazing scope, because in order to sustain the biodiversity in this area, mowing seems to be a better alternative: 100 ha of area in the park is mowed. Grazing is therefore supplemented with mowing with the use of mechanical mountain mowers in places where it is possible, or manually using a scythe. Ca. 90-100 ha of meadows and highland pastures are mowed each year. However, this is even more important as Pieniny Mountains are one of the "hotspots" of biodiversity, with documented existence of over 1,100 species of vascular plants, in a narrow strip of land. This place, apart from the richness of plant species, stands out also because of the endemic and relic species, that have preserved in their isolated position (Witkowski Z.J., 2003; Zarzycki K., 1982).

Conclusions

Mountain areas, compared to other regions in Poland, as lowlands and uplands, have a harsher climate, bigger precipitation, shorter vegetation period, as well as sloping land that may cause

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some technological limitations for agriculture. That is why, e.g. in the mountain range of Pieniny there are provided the best conditions for forest production. This, however, creates some significant limitations regarding the organisation of farms, which should focus on keeping ruminants, especially sheep and cattle. Further difficulties related to the production and farming, result of the location of the farms and settlements within protected areas. The Pieniny is a region of medium-height-mountains, characterized by a special beauty, thus it is especially attractive for tourists. The economic base of the local population is of dual nature and is based on the income from small farms breeding ruminants, as well as the well-developed non-agricultural business. Local breeds of sheep are intended for dairy and mixed production, i.e. the so called light lambs are bred, and once they gain the weight of 12-14 kg, they are exported, and the milk from the ewes is used to produce rennet cheese, i.e. *bundz* and *oscypek*, which are mainly sold to tourists. In the Pieniny National Park, cultural grazing is performed with one herd of sheep on the pasture land leased by a single chief shepherd. Organization of the cultural sheep grazing in this region, presented in the paper, may be a good example of searching for a balance between economics and ecology, which together make up for the sustainable development. The analysis confirms that under Polish conditions, in current economic relations of production costs, it is not possible, or it is just very difficult to run sheep grazing without external financial support. Therefore, for various areas, especially of special ecological value, various budget transfers are particularly important. That are subsidies for organic farming, direct payments and also for the less favoured areas.

In conclusion, cultural grazing in the Pieniny National Park (Majerz Pasture Land) has some ecological potential, but also some economic one. The first one is presented by grazing, that aim to maintain the non-forests ecosystems, thus preserve the biodiversity of this region. An alternative to it is mowing of sward every year or every other year, mechanically or manually. It is unproductive, yet effective and valued by scientists. Grazing and mowing are employed to sustain protected, endemic and relic species of the Pieniny, as well as the structure of its traditional landscape, composed of the fragmented arable land, grasslands and forests. Also economic potential appears, as there are tourists coming to that area and to adjacent communities. For them apart from the beautiful nature, crucial seems to be also a separate culture of this region, which includes cultivating the highland tradition, expressed by the cultural sheep grazing. Likewise, sustaining small farms, especially those related to animal production, especially breeding sheep in small herds, which are then handed over for collective grazing, is an important manifestation of the farmers' economic activity and an example of a good coexistence of agricultural business activity and nature conservation.

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