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The impact of mining on the environment in Poland – myths and reality

Introduction

Minerals are the basis of the high standard of living in modern society, supplying energy production, construction, road engineering and other branches of the economy. At the same time raw materials are essential for the development of industry and new technologies. Recent depletion of available mineral resources and harsher requirements aimed at ensuring the good quality of the environment demand implementation of adequate corrective actions by the mining industry.

In 2008 the European Union (EU) published an action plan for sustainable production and consumption, pointing out, among other things, the significance of minerals ([COM 2008/397](#)) and their availability for European industry, further development of resource base, recycling and substitution. As a result, in September 2013, the Strategic Implementation Plan of the European Innovation Partnership – Raw Materials (SIP EIP RM) was published and adopted. The document defined specific actions connected with technology, law regulations (non-technological) and international co-operation for the development and implementation of different instruments among others research, technology transfer, market and economy tools, methods of environmental impact assessment during the whole life-cycle as well as

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best practices and indicators of resources efficiency. These actions should avert the resources crisis and help to implement solutions ensuring stable access to different minerals.

The mining sector is an important one for the Polish economy, as its production value amounted to 50.7 billion zloty (5% of the sold production of the whole economy) and the gross financial profit was 5.1 billion zloty (net 3.6 billion zloty) in 2013. At the same time, mining provided employment for 161.4 thousand people, with the highest in Poland average monthly salary of 6 869 zloty (GUS 2014).

Despite of the technical and technological progress, environmentally collision-free methods of raw materials extraction have not yet been developed and implemented.

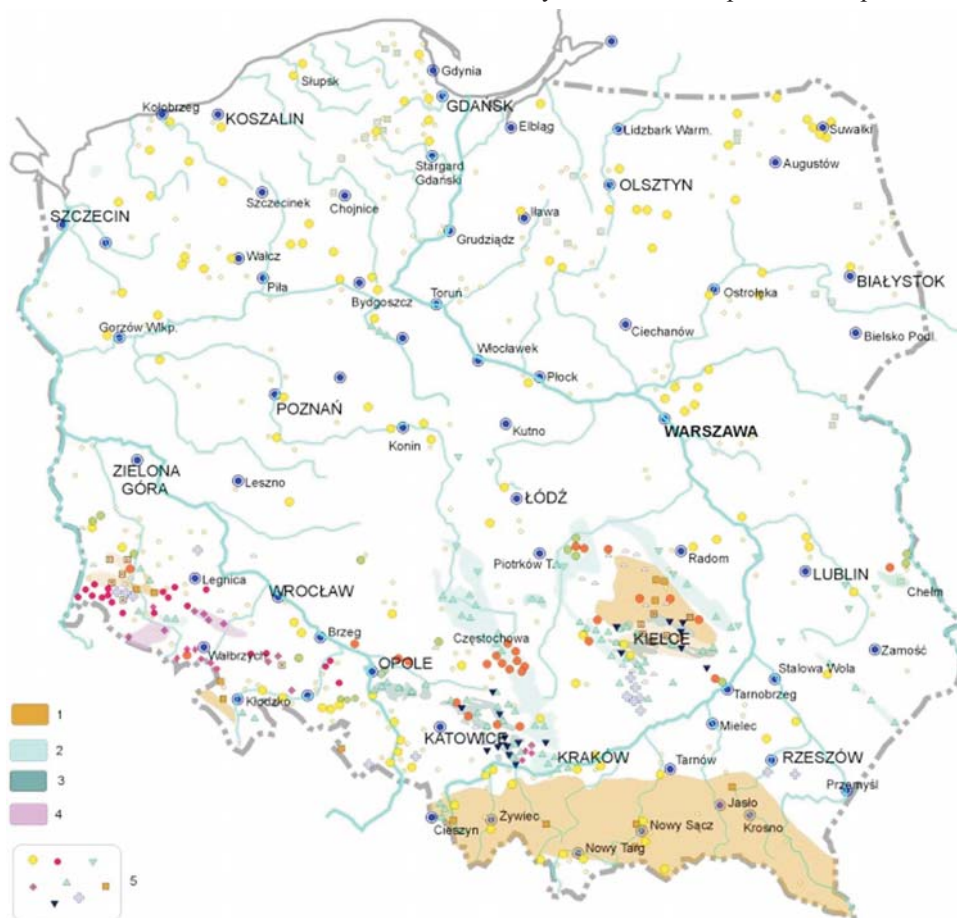


Fig. 1. Disposition of documented rocks deposits in Poland (prepared by E. Pietrzyk-Sokulska)
 areas occurrence of deposits; 1 – sandstones; 2 – limestones; 3 – dolomites;
 4 – granites 5 – individual deposits of various minerals

Rys. 1. Rozmieszczenie udokumentowanych złóż różnych kopalin skalnych w Polsce
 (oprac. E. Pietrzyk-Sokulska)

obszary występowania złóż: 1 – piaskowców; 2 – wapieni; 3 – dolomitów; 4 – granitów;
 5 – pojedyncze złoża różnych kopalin skalnych

Therefore, both global and Polish mining industries are still conducting research on the methods for, at least, minimization of environment transformation, i.e. *I2 Mine* EU project ([Innovative Technologies 2013](#)). On-going minimization of transformations that had already occurred is performed by the implementation of advanced pro-environmental technological solutions. This fact is confirmed in the reports on the corporate social responsibility (CSR) that have become an important medium of communication between the mining companies and society ([Koneczna and Kulczycka 2012](#)).

The society should take into account specific features of the mining industry that distinguishes it from other sectors of the economy. Its activity is inseparably connected with the occurrence of raw materials and it cannot be transferred into a more convenient area (i.e. of lower environmental values – Fig. 1). Some facilities, however, become valuable elements of cultural heritage after decommissioning, sometimes of global significance. Moreover, mining companies pay for the use of the environment via different types of charges and taxes which often represent significant financial income for the local (and national) budgets.

Minerals are used by all industrial branches, not only in the traditional one but also in medicine (drugs, mineral waters), environmental protection (sorbents for purification of exhaust fumes from industry, water treatment etc.), architecture, construction, art and tourism.

1. Resource base of raw materials in Poland – a possibility for development of the mining industry

Poland has centuries-old traditions of mining, dating back to the Paleolithic (Krzemionki Opatowskie) and also to later times connected with the extraction of salt (Wieliczka, Bochnia), gold in the Lower Silesia region, silver and lead from Olkusz and Tarnowskie Góry, and copper and iron ores from Świętokrzyskie Mountains. Extraction of these raw materials influenced the economic growth and significance of Poland in Europe during that time. Nowadays, Poland is also counted as one of the richest EU countries when it comes to the abundance of raw materials that enable development of mining as well as the processing industry.

Anticipated economy resources and the output of hard and brown coal are among the biggest in Europe (9th place in the world when it comes to extraction of hard coal and 6th in the case of brown coal) and are the base for the function of national power and heat production. In comparison, natural gas and crude oil resources are insignificant. The output of conventional gas extraction meets only around 1/3 of the national needs and in case of crude oil only a few percent. Chances of documenting the deposits of shale gas do exist but the process is time-consuming.

Copper and silver are extracted in Poland in big volumes, with Poland ranking 7th worldwide, while in the case of silver – 2nd ([Kudęłko and Kulczycka 2013](#)). Documented

deposits of zinc and lead ores will deplete soon with the extraction volume supplying the bigger part of national industry needs. Because of environment protection issues, very rich deposits of FE-Ti-V from the vicinity of Suwałki do not have current economic significance.

Polish deposits of native sulfur are the biggest worldwide and the only native sulfur mine in the world (Osiek) currently extracts 702 thousand Mg (PIG-BIP 2013). Other chemical raw materials in Poland are deposits of polyhalite salt (not exploited) and rock salt. Poland is also known for diversity (more than 50) of industrial minerals that are used in road-engineering, building and many other branches of the processing industry.

Exploitation of mineral waters and salt brines used in medicine and for consumption is also developed. In the recent years, exploitation of geothermal water for heating and recreation has also increased as a result of climate protection obligations.

2. Environmental impact of extractive methods on the environment

Raw materials occurring in Poland are extracted by using three methods: underground, opencast and borehole. The underground method is applied for deposits occurring at greater depths and underneath significant overburden rocks for coal and metallic ores, and also for rock salt. Opencast method is considered one of the oldest ways of extraction of raw materials occurring at shallow depths and under the not too great overburden (Uberman 1988). This method is used for lignite, peat and industrial rocks. The borehole method is applied for chemical raw materials (sulfur, halite), hydrocarbons (crude oil, natural gas) as well as for mineral waters, salt brines and geothermal water. The choice of method depends on geological and mining conditions of deposits, properties and quality of raw materials and economic reasons i.e. depth limit, along with the technological progress which is systematically lowered, i.e. in the case of opencast mining in Poland 250–300 m, and in underground extraction up to 1 500 m, but it often requires the use of costly ventilation and air-conditioning systems.

Therefore, all mining operations are related with the land surface occupied, which depends on the chosen method. Particular branches of the mining industry occupy in total the area of 38 259 ha (about 0,1%) of land in Poland (2012) of which brown coal (open pit) constitutes over 40% and industrial minerals (mainly open pit) the next 30.9% (Fig. 2).

Besides the occupation of land surface, each extraction method of raw materials is connected with changes in the morphology of the terrain, (Fig.3)

The pits can be hill-side, deep-hill-side or deep-seated, but the impact on the environment depends on the activities conducted during the reclamation (also during the exploitation process) and then the adaptation processes (Pietrzyk-Sokulska 2005). These actions can bring new utility values to mined-out pits that may become element enriching, increasing

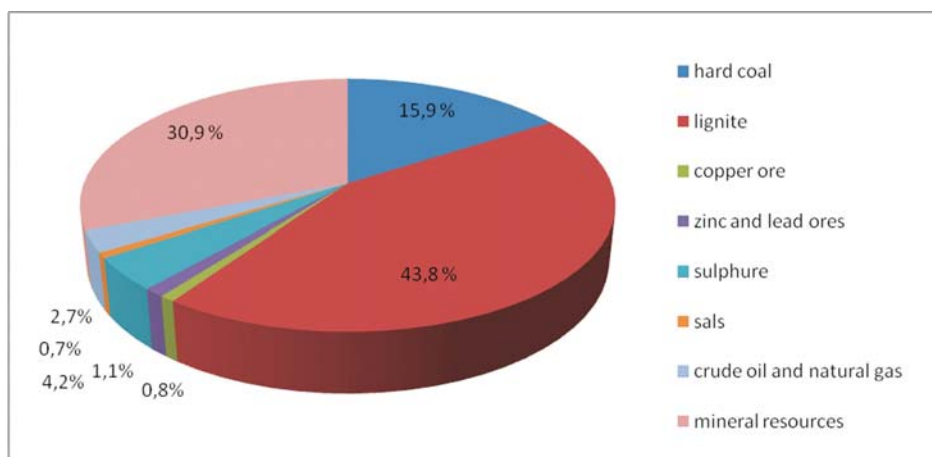


Fig. 2. Share of land surface occupied by particular branches of mining industry in 2012 (prepared by E. Pietrzyk-Sokulska upon GUS 2013)

Rys. 2. Udział powierzchni zajmowanej przez poszczególne rodzaje górnictwa w 2012 r. (oprac. E. Pietrzyk-Sokulska według GUS 2013 r.)



Fig. 3. Opencast pits of rocks (photo E. Pietrzyk-Sokulska) and brown coal (photo K. Krawiec)

Rys. 3. Wyrobiska odkrywkowe kopalin skalnych (fot. E. Pietrzyk-Sokulska) i węgla brunatnego (fot. K. Krawiec)

the utility and natural values thanks to harmonious integration into the landscape (Pietrzyk-Sokulska 2008).

The underground mining method has lower impact on the morphology and landscape compared to the open pit one (Pietrzyk-Sokulska 1995). It is dominated by shafts, ventilation towers, industrial buildings and mining waste dumps. It leads to surface subsidence troughs and the creation of water filled basins (Fig. 4).

So far zero-waste excavation technologies have not yet been developed and implemented in mining. Annually, the mining industry in Poland produces around 50 million Mg of waste, of which waste from the extraction process itself constitutes only 20% while the rest is the waste from the processing. Only a part of the waste is used, mostly for engineering



Fig. 4. Shaft and mining waste dumps (kopalniane wieże 2013)

Rys. 4. Wieża wyciągowa i hałdy odpadów wydobywczych (kopalniane wieże 2013)

and reclamation works. Particular branches of mining industry produce different amounts of waste, which is illustrated in Fig. 5.

The smallest permanent changes in landscape are caused during borehole extraction of liquid raw materials, i.e. crude oil, natural gas, geothermal water. These changes are almost invisible if the extraction is properly conducted and the post-extraction cavities are filled.

The exception is the borehole extraction of solid raw materials e.g. sulfur by the underground melting Frasch method which causes surface subsidence, soil and water pollution that are very difficult to predict and which differ for individual mines (Hajdo et al. 2007). In the case of borehole extraction of salt, only insufficient safeguarding of selected deposit cavities may support the creation of hollows of significant depth and area (e.g. in Barycz, Łęzkowice – Mazurek 2007). Beyond this, the possibility exists for the unforeseen breakdowns of water supplying installations and collecting salt may cause soil salinity. After the decommissioning of such areas, as a result of plants succession or biological reclamation, a new ecosystem with flora typical for the higher salinity environment is created (ecological niche).

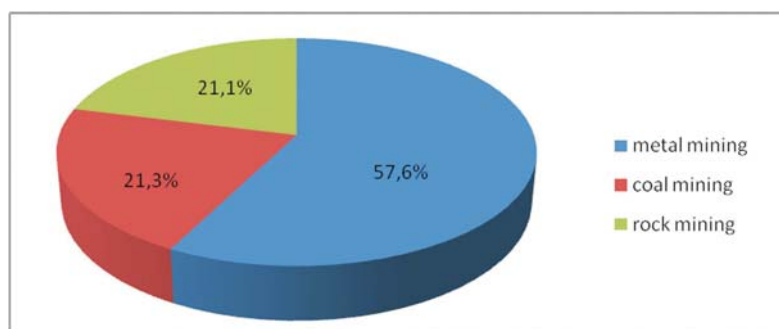


Fig. 5. Structure of waste production in the mining industry (prepared by E. Pietrzyk-Sokulska upon GUS 2013)

Rys. 5. Struktura wytwarzania odpadów w przemyśle wydobywczym (oprac. E. Pietrzyk-Sokulska według GUS 2013)

Opencast and underground mining causes long-lasting changes in water conditions (surface and underground). Changes in network of surface water are related with shifts of watercourse beds, draining of the terrain for mining facilities and pollution by water drained off from mines (Szczepański 2009). Changes in the conditions of underground water are connected with the need of deposits draining (before and during the mining process) that causes creation of depression sinks with a radius of a few kilometers to over a dozen.

Environmental impacts of temporary character and local range may also appear. These take the form of noise emission (the work of machinery, appliances, vehicles and blasting works) and temporary air pollution (within the pits) from mineral dust and gases and also paraseismic tremors with a range of a few hundred meters (depending on the geological structure and the magnitude of tremor). Underground extraction may cause tremors and bumps that may also occur after decommissioning and which are related with the deformation of rock mass and its stabilization.

Mining operations interfere with all components of the environment. The transitional consequences are visible within the biosphere (soil, flora and fauna), hydrosphere (changes in water conditions and quality) and atmosphere (local changes in air quality, temporal increase in noise level, seismic wave and underground tremors), but proper activities conducted during and after mining operations can minimize that impact and even create a new valuable area.

3. Existing myths about the mining industry in Poland

Mining activity has been associated with interference in the environment and its transformation for centuries. Society's perception of the impact of mining on the environment depends on the methods of exploitations. Until the mid-twentieth century the opencast mining method was conducted mainly for industrial minerals. The existing pits were small, so the operation was carried out by hand or by using small cutting drums machines (excavators). Quick development of the mining industry on a mega scale started in the 2nd half of the 20th century, with strong development of open-pits of brown coal and sulfur. For many large-scale mining operation companies began to use explosive materials a much larger area to be transformed. At the end of the 1970s several ecological clubs were created in order to fight the deterioration of the environment and public attention was directed to the activities of heavy industries, including mining. Many associations were comprised primarily of biologists (ecologists later) that promoted conservation and issued numerous publications about the harmful effect of the mining industry on the environment. With this trend in the end of the 20th century there were frequent protests, supported by ecological clubs postulating creation of national parks with a total ban on industrial operations, especially the extraction of minerals. The existing public acceptance for mining operations came to an end. One of the first protests took place in 1993 where Greenpeace activists occupied the drilling platform Petrobaltic near Rozewie where they protested with the slogan

“No drilling, no leakage”. At the same time, in line with the economic changes and restructuring, Polish mining was in stagnation. People protested against closing the mines, particularly the coal mine, and against the loss of jobs. In the first decade of the 21st century, with the increase of demand for raw materials, existing mines were forced to expand, temporarily closed mining fields were forced to reopen or operations in new deposits were begun. Then, once again, social protests against mining intensified (Badera 2010).

Some latest examples are:

1. Intensive protest against exploitation of lignite ore in the area of Legnica (Zielona energetyka... 2015).
2. In the area of Krobia, Poniec and Miejska Górka municipalities since 2011 there has been prospecting for brown coal (339) in accordance with the proper concessions. Opponents of the potential mine development, said that the mine destroys agriculture and local business, diminishes the quality of the environment, and thus the health of residents. These comments were confirmed by several scientists (Protest 2015).
3. Greenpeace Poland, along with the coalition of environmental and local associations, are protesting against the construction of a lignite mine in the village of Gubin under the slogan “Stop pit”. They argue that openpit coal mining, even while maintaining high environmental standards, will be associated with the destruction of a huge area. Representatives of PGE Gubin showed that high level of technology and environmental awareness will minimize the damage resulting from mining activities and that the space occupied in the first stage of the 1,500 hectares of agricultural land and forest (target 2,500 hectares) will be gradually reclaimed and will create on these areas with new use-values, often higher than before the operation. Moreover, it was underlined that in areas with active mining work there is no unemployment, but there is growth of the entrepreneurial population, especially SMEs, and higher infrastructure, etc. (Brodna 2014).

It is surprising that the protests are occurring most frequently in areas where previously society was strongly associated with mining and the development of these areas depended on the condition of the mining industry. In such areas the community formed over many years (sometimes centuries) in a unique mining culture with related customs, architecture, art, etc. They forget about these achievements and about the importance of mining to the development of the region. In Poland there are also some areas where the mining industry is welcomed by local society as it can create a lot of jobs, provide opportunities for advancement to the younger generation and economic development for the region. Reconciling these two social attitudes is a major challenge for the mining industry. It must continue to improve production technologies, collision-free environment and zero-waste, so that the public understands that without raw materials it would be not possible to develop other industries.

4. Activities of the mining industry towards minimization of pressure on the environment

A contractor undertaking mining activity is obliged to identify and describe the potential impact on the environment and has to obtain several permits. This is regulated by specific legal rules and depends on volume, type and phase of extraction and the area on which the activity is being conducted. Commencement of mining activity requires preparation of a geological report and projection of deposit development (PZZ) and a report about the impact on the environment. The aim of this report is to assess the potential impact of mining on the environment and the health of people. It constitutes a base for obtaining the decision on environmental conditions and permit for mining project implementation. The report also reviews important elements of area management, from the point of view of proper performance of mining works and action for the minimization of impact on the environment. Before the beginning of mining operations it is also necessary to obtain several additional documents i.e. permit for the production of waste, program of management of extraction waste and for emission of gases and dust into the air, water management legal permit for supply and sewage disposal. These documents have to be updated during the period of mining activity. Decommissioning of extraction plants has to be conducted in accordance with the mine closure program that also involves decisions on the direction of reclamation and takes into account results of public consultations.

Mining as a cause of environment transformation undertakes actions aimed at the minimization of these changes and when they are irreversible, it tries to compensate effects and repair the damage.

The minimization of environmental impact of mining can be also done by:

- ◆ thorough and rational deposits exploitation,
- ◆ minimization of raw materials use per final production unit,
- ◆ multiple use of products made out of raw materials and use of raw materials in some of the production processes (e.g. foundry sands in casting),
- ◆ management of mining and processing waste by means of recovery and recycling,
- ◆ substitution of raw materials.

4.1. Rationality of raw materials use

Raw materials resources are exhaustible and non-renewable as they were formed during different geological processes in a specific time. An exception are deposits which are currently being formed. Complexity and rationality in the use of deposits in Poland is obliged in accordance with legal rules ([Ustawa Prawo Ochrony Środowiska... 2001](#)).

Accompanying raw materials existing in the overburden and its intergrowths may be utilized for eliminating the need of new deposits use i.e. rock masses stripped in opencast mines and dumped that may be used economically. As a result, the land area used for their storage undergoes the reclamation process. This procedure enables the saving of resources

in different, undeveloped deposits thus resulting in aiding the protection of areas likely to be used for other purposes. The above actions extend the operating time of already developed deposits, which is visible especially in mining of rock and metallic ores. Metallic ores are often accompanied by many by and co-products, but they are not recovered due to technological or economic reasons (Jarosiński et al. 2013). New innovative technological solutions for complex processing of ore are needed to recover the maximum volume of metals from the ores. Opportunity lies among the biological processing of metal extraction from low-grade ores, waste, mining water as well as from polluted soil and sediments. Thus, in the nearest future, a rapid development in new branches of mining e.g. biomining and phytomining, may occur as well as extraction of metals using plants which accumulate specific elements in biomass (Anderson et al. 1999).

Complexity in using resources in deposits is important for environmental protection as it allows for a diminishing number of mines. Often, in difficult geological and mining conditions or when the mining process is fully mechanized, the best parts of deposits are mined out, while those of worse quality are left. There is also a loss of valuable parts of the deposit when, during extraction, the deposits are used contrary to their natural purpose, e.g. dimension stones extracted by the method of blasting are used as aggregate instead of being used as valuable architectural material. It is also connected with market conditions.

The reuse and multiple use of minerals allows for savings in mineral resources e.g. reuse of glass containers or repeated use of foundry sands in casting. A secondary source for minerals may be the mining and processing waste accumulated in landfills (Niec and Uberman 1995; Niec 1999). Their recovery may save the mineral resources, but it is often difficult due to technological and economic circumstances. It would be recommended to conduct selective dumping during current mining operations, as that would strongly facilitate recovery of valuable minerals using proper technologies in the future. In order to achieve this goal, changes in legal regulations, incentives for entrepreneurs and development of new mining and processing methods are necessary (circular economy).

A certain volume of minerals may be saved by minimization of their use per final production unit. An example would be the increase in efficiency of a power plant decreases the use of coal at the same time as it reduces the emission of CO₂. Another example may be the substitution of copper cables with fiber-optic cables resulting in a decrease in demand for copper and the saving of documented resources for the future.

Another environment-friendly action enabling savings on primary minerals is recycling, however, not every material can undergo such a process while the current technology level (Jarosiński 2012). The chance for broader use of recycling is the development of innovative technologies and creation of companies engaged in recovery of minerals by processing the ever bigger volumes of different waste. According to the Chief Inspectorate of Environmental Protection (CIEP) in Poland every citizen generates about 12 kg of electronic waste annually, of which over 4 kg are recovered which gives about 150,000 tons per year. Most of the waste collected is transferred to recycling processing plants where recovery occurs among other rare metals (gold, silver, palladium etc.). A new form of mining is being

created, the so called urban mining, that can be an alternative for traditional mining and for the acquisition of scarce mineral resources.

Some expectations for diminishing the dependency on non-renewable resources are aroused by new technologies in the field of substitution. In Poland this process is mostly connected with energy resources e.g. substituting petrol with biofuels or coal with renewable energy sources. It has to be taken into account that not all products made out of mineral resources may be substituted. The substitution depends not only on technological possibilities, but also on the prices of resources (e.g. copper, aluminum) and their availability in international markets (e.g. rare earth elements from waste).

4.2. Reclamation and adaptation of post-mining areas

Minimization of environmental transformations (Pietrzyk-Sokulska 2004) caused by mining activity is consistent with the applicable law (Ustawa z dnia 27 września 2013). Mines minimize, among others, the results of deposit draining that causes depression sink. This minimization is achieved by building a network of water intakes and conduits which prevent limitations in water supply for households (Kasztelewicz 2010). Each mine is also obliged to have a special fund for liquidation. It is also obliged for the systematic reclamation of the decommissioned area. The results of mining activities, including reclamation and management of mining areas for each sector, are illustrated in Fig. 6. The share of reclaimed and managed area compared to the total area is still very low.

The direction of reclamation most commonly applied in the case of brown coal mines (Kasztelewicz and Szwed 2010) is the agricultural direction (more than 50%), forestation

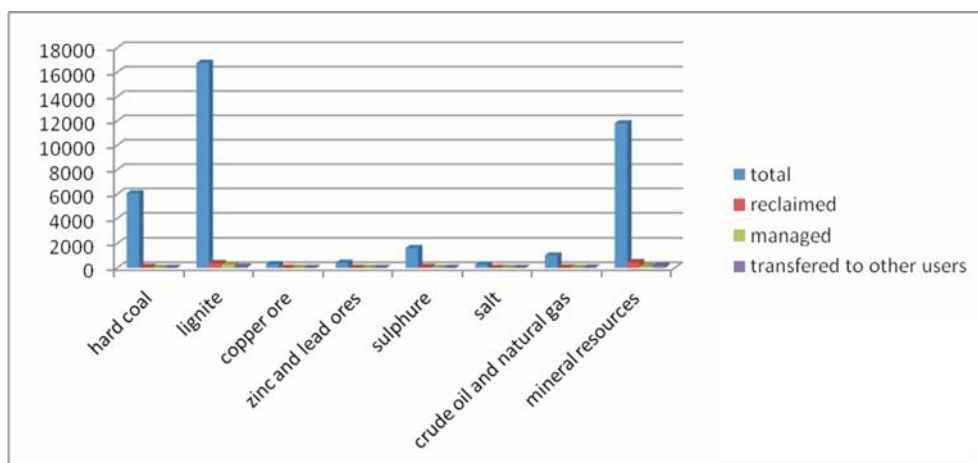


Fig. 6. The structure of management of areas occupied by different branches of mining industry in 2012 [ha] (prepared by E. Pietrzyk-Sokulska upon Ochrona środowiska 2013)

Rys. 6. Struktura użytkowania terenów zajętych przez różne sektory górnictwa w 2012 r. (oprac. E. Pietrzyk-Sokulska na podstawie Ochrona środowiska 2013)

(17–96%), water recreation (9–26%), and other (1–9%). Reconstruction of the former function of the specific area is usually impossible and in such case reclamation is designed in accordance with local conditions and public needs (Uberman and Ostreęga 2012).

There are many good experiences for post-mining land management. One of the first was H. Bednarski's Park (Park im. H. Bednarskiego) in Cracow, created in the years 1896–1912 in the place of Jurassic limestone quarries operating from the Medieval Ages. In the 1950–1960's on the hard coal waste dumps and subsidence in Chorzów, gen. J. Ziętek's Voivodeship Park of Culture and Recreation (Wojewódzki Park Kultury i Wypoczynku im. gen. J. Ziętka) – the biggest in Europe (640 ha) was created. In 1971 Kadzielnia pit in Kielce (formerly a limestone quarry) was adapted for recreational purposes (amphitheater and park) and as a site of abiotic (geological phenomena) environment protection. In the recent years large former mining sites undergo reclamation and adaptation in the recreational and sports direction (e.g. skiing areas – Góra Kamieńsk near Bełchatów, water reservoirs – Zakrzówek, Piaseczno, Machów). Some of the pits were adapted as mausoleums (among others Góra św. Anny – Fig. 7) or museums (e.g. Gross-Rosen Museum – Fig. 8).



Fig. 7. Góra Św. Anny – amphitheater (Góra św. Anny 2011)

Rys. 7. Góra Św. Anny z mauzoleum i amfiteatrem (Góra św. Anny 2011)



Fig. 8. Gross-Rosen Museum (Muzeum 2014)

Rys. 8. Muzeum Gross Rosen (Muzeum 2014)

Some of the closed mines are classified amongst the most valuable cultural heritage sites (among others, the List of UNESCO World Cultural and Natural Heritage Sites – Wieliczka and recently also Bochnia). Other post-mining areas gave rise to creation of tourist routes of industrial heritage (Black Trout Adit in Tarnowskie Mountains, hard coal mine Guido in Zabrze or gold mine in Złoty Stok). Many other await the commencement or finalization of reclamation and adaptation.

In many pits, especially after the extraction of compact rock raw materials, unique ecological niches were created as a result of plant succession (Nieć, Pietrzyk-Sokulska et. al 2008), rich in species non-occurring in other areas (e.g. basalt croppings in Lower Silesia Region) in which birds of prey (e.g. Liban quarry) or European Mouflons (e.g. Barcin-Piechcin pit – Nieć and Radwanek 2014) settle in. Often these sites are natural enclaves in the vicinity of urbanized areas.

4.3. Extractive industry activities for local communities and economic growth

There are many social and economic benefits connected with mining activities that have direct results for socio-economic standing of regions. Companies, for use the environment, have to pay fees e.g. with hard coal extraction volume of 6–7 mln Mg per year, the extraction charge is 15 mln zloty of which 60% supplies the community budget and 40% the account of the National Fund for Environmental Protection and Water Management. Another compensation are high real estate taxes paid by the extraction industry, more than 1.5 mln zloty for mines with annual coal extraction of 6–7 mln Mg. More significant social benefits include, among others:

- ◆ creation of a significant amount of work places for a long period of time (starting with investment, through exploitation to the closure),
- ◆ decommissioning and adaptation of post-mining areas, not only in the extraction industry, but also in mining related services (trade, transport etc.) thus stimulating local people,
- ◆ possibilities for career advancement and lifelong learning connected with higher income (increase in the standard of living),
- ◆ maintenance of positive balance of migration as a result of influx (or the fact of not leaving) of young people interested in work in the extraction industry;
- ◆ development of identity and social bonds via creation of new cultural values and post-mining heritage.

The most significant economic benefits include (Uberman and Naworyta 2012):

- ◆ higher possibilities for economic development of mining regions due to significant, annual incomes to local budget from taxes and financial charges,
- ◆ higher possibilities for investments in e.g. community facilities, sport, recreation infrastructure and culture (higher standard of living),

- ◆ possibilities for development of geo- and eco-tourism on the basis of reclaimed and developed for this purpose post-mining sites that generate increase in communes' and citizens' incomes.

Reliable information about mining companies' activities in the field of environmental protection, and planned investments can have impact on mining acceptance by local communities. In recent years, alongside the introduction of the corporate social responsibility (CSR) strategy, a lot of mining companies not only identify and publish information about impact on environment and workers' health but also define and quantify their reduction goals. Good examples are records from CSR reports of Polish extraction companies, e.g.:

- ◆ KGHM Polska Miedź SA – spent on pro-ecological investments (nearly 180 million zloty in 2012) and about goals concerning energy saving and increasing energy efficiency. Also other solutions when it comes to waste management, purchasing energy from renewable resources or minimization of odors are also described (KGHM 2013).
- ◆ Katowicki Holding Węglowy (Coal Holding of Katowice) focuses (among others) on reduction of environment pollution by minimizing methane emissions. This process involves the transfer of gaseous mixture from the mining of methane that supplies gas turbine installations with electric energy generators and gas boilers (e.g. in 2011 using this method, emission of methane to the atmosphere was reduced by ca. 7.0 million m³, while in 2012 the reduction amounted to 7.8 million m³; in Murcki-Staszic mine in 2011 reduction of methane to the atmosphere amounted to 1.8 million m³, while in 2012 to 2.5 million m³). Moreover, investments in branches of ZEC S.A. in Wieczorek and Wujek mines (Ruch Śląsk) are also conducted. These include construction of installations for methane combustion and methane drainage plants (KHK 2014).
- ◆ Cemex – reduction of SO₂ and NO_x, use of recycled water or use of alternative fuels (combustion in cement furnaces in temperature reaching 2000°C is one of the safest and at the same time most ecological ways of their utilization); rising of ecological awareness amongst workers and engaging them in initiatives for the environment. These are main topics and goals in the CSR activities (CEMEX 2013).

Summary

By supplying minerals the mining industry is one of the basic factors determining socio-economic growth. Extraction of minerals causes transformation within the environment, but since its activities are necessary, a compromise and balance between increasing economy and social needs and environmental protection has to be reached. Such compromise is possible by taking action in line with the idea of sustainable development.

The mining industry in Poland is very active and has significant impact on economic growth in many branches. Extraction of raw minerals via mining operations is connected

with (of course alongside undeniable benefits) interference in specific portions of the environment. Despite technical and technological progress, collision-free methods of raw materials extraction have not yet been developed and implemented. Thus, both in global and Polish mining some researches are still being conducted on the methods for elimination, or at least minimization, of environmental impacts. Attention is paid not only to the repair of damage and transformations resulting from extraction of raw materials, but also to the possibilities for acquiring other utility values created by decommissioned mines for the society.

Based on the abovementioned information, the future of mining may be divided into two stages. In the first one, traditional (up-to-date) methods of raw materials extraction will dominate but the efficiency of exploitation will increase (this is connected with new technologies of extraction); in accordance with sustainable growth, stable supply of minerals will be supported by new technologies characterized by minimal use of minerals and application of recycling and substitution. In the second stage, the focus is on the extraction of resources that occurred in ocean beds.

This does not mean, however, that their non-renewable status will result in future generations feeling shortage, and in the worst case scenario a total resource depletion; everything is determined by the progress of technology that may make our civilization totally independent when it comes to non-renewable natural resources. The progress in technologies, especially the pro-environmental ones, in both stages will contribute to minimizing the pressure of the mining industry on the environment. By this time, the currently operating mining industry will repair the environmental damage using the knowledge and up-to-date experience. The rise in awareness of communities from mining regions when it comes to the role of mining for the economy will enable the development of compromise in the topic of the future of mining.

A very important factor in the further progress of mining is the relationship with the local community and the idea of building a positive image of mining in the public opinion. Negative perception of the activities conducted by mining companies formed in the second half of the 20th c. when movements and actions for the protection of the environment were intensified and when the evaluation processes of impacts of the extraction industry (not in all cases truthful) increased. This was connected, on one hand, with obsolete methods of extraction, not respecting work safety regulations, casualties (including fatalities) and with the restructuring of industry and introduction of the free-market economy by the end of the 20th c. These actions hindered the development of mining which was followed by a drastic fall in work places and numerous social protests. Today, the Polish mining industry faces new chances connected with the rational management of resources and pro-environmental (ecological) activities along with actions that involve the idea of CSR and which are aimed at local communities.

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WPLYW GÓRNICTWA NA ŚRODOWISKO W POLSCE – MITY I RZECZYWISTOŚĆ

Słowa kluczowe

górnictwo, presja na środowisko, działania naprawcze, CSR

Streszczenie

Górnictwo wiąże się zawsze z ingerencją w środowisko, zwłaszcza w krajobraz, hydrosferę i atmosferę. Wzrost w ostatnich latach wymogów, dotyczących standardów jego jakości, miał wpływ na podejmowanie przez górnictwo szeregu działań zmierzających do minimalizacji wpływu eksploatacji, eksploatacji, jak i wstępnego przetwarzania oraz wykorzystania wydobytych kopalin i odpadów. Ponadto przedsiębiorstwa górnicze, często poprzez procesy rekultywacji, a następnie odpowiednio wybrane kierunki adaptacji terenów zajętych pod wyrobiska i towarzyszącą im infrastrukturę, rekompensują dokonane w środowisku przekształcenia. Powstałe w ten sposób nowe tereny cechują, w wielu przypadkach, wyższe walory niż te sprzed rozpoczęcia działalności górniczej. Problemem pozostaje szczypanie nieodnawialnych zasobów kopalin, które można minimalizować dzięki prowadzeniu racjonalnej gospodarki zasobami, ale także efektywnym zużyciem, odzyskiem i recyklingiem oraz stosowaniem substytutów surowców mineralnych. Będzie to miało wpływ nie tylko na przedłużenie żywotności działających zakładów wydobywczych, ale ograniczy także powierzchnię terenów zajmowanych pod eksploatację nowych złóż, wpływając w konsekwencji na poprawę jakości środowiska.

W artykule zwrócono uwagę na zmiany zachodzące w branży górniczej, wskazano szanse i zagrożenia wynikające z dalszego jej rozwoju w Polsce. Pokazano także działania branży dla minimalizacji presji na środowisko oraz stosowane metody naprawy nieuniknionych przekształceń komponentów środowiska.

THE IMPACT OF MINING ON THE ENVIRONMENT IN POLAND – MYTHS AND REALITY

Key words

mining, environmental impact, reclamation, CSR

Abstract

Mining is always connected with interference in the environment, especially with the landscape, hydrosphere and atmosphere. The increasing requirements of environmental standards in Europe influence actions taken by the mining industry, which leads to minimization of impact during exploration, exploitation, processing and use of raw materials and waste. Moreover, mining companies often compensate the environment transformations via the processes of reclamation and adequately chosen directions of further adaptation.

New post-mining areas are characterized, in many cases, by higher values than before the commencement of mining works. The problem is still the depletion of non-renewable raw materials.

This can be minimized by rational resource management and also by the effective use, recovery, recycling and substituting of minerals. These actions will have an impact not only on the extension of the operation of existing plants, but will also diminish the areas needed for extraction of new deposits.

In the paper, the transformations taking place in the mining industry in Poland, as well as myths and threats connected with its further development were pointed out. The actions by this industrial branch which lead to minimization of the pressure on the environment and the applied reclamation were also shown.

