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Productivity and economic effectiveness of young black locust tree stands on afforested sulphur opencast mine sites

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Abstract

The correct selection of the species composition of afforestation in relation to the habitat conditions has a decisive impact on the effects of forest reclamation. In most of the reclaimed forestry areas in Poland, the stands enter the pre-logging period, and it is possible to assess the first economic and production effects of reclamation. The assessment was made based on the analysis of the size of the harvested wood during the intermediate cutting on the heap of the former 'Piaseczno' opencast sulphur mine located in southern Poland and managed by the State Forests. At this stage of development, *Robinia pseudoacacia* played a large role in obtaining a good income from the sale of intermediate cutting wood and economic effects. The obtained results may be important in the context of indicating alternative directions for reclamation and afforestation of post-mining areas, e.g., for plantation purposes.

Key words

reclamation, black locust, forest production, ecosystem services

Introduction

The area of reclaimed and developed land in Poland in 2021 amounted to approximately 2800 ha, including over 500 ha reclaimed for forestry. In turn, the total area of land requiring reclamation in Poland is over 62,000 ha (Local Data Bank 2022). Land reclaimed for forestry is the largest share among reclamation approaches (approximately 40%) (Krzaklewski 2017) and is one of the most environmentally effective methods of managing post-industrial areas (Pietrzykowski 2015). Since 2005, the areas that have been reclaimed for forestry are not large and cover several hundred hectares per year on the national balance of forest area (Local Data Bank 2022). On the one hand, post-mining areas reclaimed for forestry purposes do not have a large share of the overall forest area in Poland, which amounts to over 9 million ha; on the other hand, afforestation of post-mining areas contributes to the expansion of forest resources. However, the level of difficulty in managing post-industrial objects is completely different in these areas than that in natural or commercial forests, and it is a challenge (Pietrzykowski et al. 2012; Pietrzykowski 2015).

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In Poland, legislation imposes the obligation of reclamation on the perpetrator(s) of degradation – in this case, the mining industry. According to the Act on the Protection of Agricultural and Forest Land (Act 1995), reclamation covers the restoration of the utility or natural values of degraded areas through technical and agrotechnical measures aimed at restoring soil and building the necessary hydrotechnical infrastructure and roads (Act 1995). Due to such provisions and their very broad interpretation, reclamation may end at the stage of agrotechnical treatments, and the introduction of woody vegetation may constitute a separate stage (Act 1995). The stage of afforestation (biological reclamation) and further land management may be carried out by the State Forests National Forest Holding (PGL LP), to which the land was transferred. The stage of management (introducing trees in an appropriately selected species composition) of the transferred land is preceded by the aforementioned biological reclamation carried out by the enterprise that contributed to the degradation of the land (Krzaklewski and Pietrzykowski 2007; Pietrzykowski and Krzaklewski 2014). The general scheme of action does not cover all the details and difficulties of biological remediation. The fundamental issue is the correct diagnosis of habitats and the selection of species composition for stands, which affect the long–term natural and economic effects of reclamation.

In most cases, the evaluation of the effectiveness of reclamation refers to ecological aspects, including the rate of development of soil properties, the rate of soil organic matter accumulation, the succession of vascular plant communities, the growth reaction and nutritional status of trees, and the stability of stands (Pietrzykowski et al. 2010, Pietrzykowski 2014). For these reasons, there is still a lack of data on the expenditure incurred by the administration of the State Forests National Forest Holding for forest management in reclaimed areas and the profits resulting from the production of wood raw materials (Pietrzykowski et al. 2012). The assessment and modelling of the productivity of habitats, as well as the analysis of the economic effects of reclamation, have been the subject of research and practical interest relatively recently. This is because the oldest stands in reclaimed areas, mostly in Poland, are entering the intermediate cutting period (50–60 years; Krzaklewski 2017).

The economic effectiveness of the reclamation process depends on many factors, including the costs of developing the post-mining area, the facilities located on its premises, and the costs of reclamation treatments. To determine the final economic result of reclamation, as with any economic undertaking, the length of the payback period and the profitability of the investment must be taken into account (Ostręga and Uberman 2010). In the case of forest reclamation, greater financial outlays are incurred in the technical and biological phases (appropriate terrain relief and its preparation through agrotechnical measures to introduce afforestation). The appropriate quality of planting material and the correct selection of species for the habitat conditions improve the economic effect of reclamation through higher investment profitability and return on costs in terms of using the stands. The aforementioned profitability will result mainly from the increased mass of the stand and its quality (Pietrzykowski and Krzaklewski 2014). When estimating the costs of reclamation for forestry, it should be remembered that the costs borne by the entity obliged to the reclamation of the degraded areas end when the land is taken over by the state forest areas. The most important and immeasurable benefit of forest reclamation is the protective and soil-forming function of stands (Pietrzykowski 2014). However, the income from the production of the raw material should also be taken into account from the perspective of pre-cutting and final harvesting (Pietrzykowski 2014). In sustainable forest management, the production of wood raw material, in addition to the ecological and sociocultural functions, constitutes an equal function of the forest and builds its economic pillar (Bielak et al. 2015).

This study aimed to assess the economic effectiveness of forestry-based reclamation based on the productivity and magnitude of the intermediate cutting of stands placed on reclaimed post-mining land, specifically on a dump established on the 'Piaseczno' sulphur mine (Tarnobrzeg region). The performed assessment may indicate possible long-term prospects for the use of this type of land in the context of the discussion undertaken on the cultivation of plantations of fast-growing trees, especially black locust (*Robinia pseudoacacia* L.) in reclaimed areas.

Material and methods

Research object

The research area was a reclaimed and reforested external dump on the former sulphur mine 'Piaseczno' located in southern Poland in the Vistula valley (N 50 33.622; E 21 34.185). The site is conical in shape, with an area of 120 ha and a height of up to 40 m, and was created as a result of the mining of sulphur using the opencast method during 1961–1971 (Węgorek 2009; Pietrzykowski et al. 2010).

The spoil heap mainly consists of Neogene clays of the Krakowiec formation, loose Quaternary sands, and a mixture of Quaternary sands and Neogene clays (Węgorek 2009; Woś and Pietrzykowski 2020). In addition, the dump was shaped without maintaining the postulates of appropriate selection and management of overburdened rocks, as there were no clear legal regulations in this regard at that time. This sometimes resulted in the occurrence of landslides and surface run-off, as well as a significant acreage of clay soils (Neogene clays of the Krakowiec formation) present at the top of the dump, characterized by unfavourable air and water conditions from the point of view of the environment (Węgorek 2000; Pietrzykowski et al. 2010). In this region, the average annual air temperature and precipitation during 1990–2019 were 8.9°C and 570 mm, respectively. The length of the growing season in this area is 212 days (Woś and Pietrzykowski 2020).

In the studied area of the 'Piaseczno' dump, initially – i.e., during the second Management Plan (FMP; 2nd revision) in 1980–1989 – 15 forest divisions were designated. The spatial arrangement and diagnosis of habitats changed in the subsequent economic periods (1992–2001 and 2002–2012), and finally, 23 surveys located in four divisions of the Zawidza Forest District were designated (221, 222, 223, 224), belonging to the Staszów Forest Inspectorate, Regional Direction of State Forest in Radom.

Currently, in the area of the reclaimed 'Piaseczno' dump, four types of forest habitat have been distinguished (Forest Management Plan 2012–2021): 28.5 ha of fresh mixed forest, 32.5 ha of wet mixed forest, 71 ha of fresh forest, and 5.5 ha of riparian forest. Currently, the stands are in the third age class (40–60 years) and consist of a fairly wide (for post-industrial areas) spectrum of selected species, among which black locust (*Robinia pseudoacacia* L., 30–50 years old) has a significant share.

Methods

The analysis of the economic effects of forestry-based reclamation presented in this article includes the species composition of stands, the growing stock [total volume (m^3)] of stands, the amount of timber harvested, and profits from the sale of wood raw material in the reclaimed dump. These data were sourced from the available documentation kept by the State Forests National Forest Holding, including stand maps; Forest Management Plans (FMP) of the Staszów Forest Inspectorate for the economic periods 1992–2001, 2002–2011, and 2012–2021; the SILP base; and the costs of timber harvesting in the Staszów Forest Inspectorate during 2006–2016. Due to the black locust having the highest share of the species composition in the last economic period (2012–2021), the value of wood was analysed solely based on this species. Based on the analysis of the black locust wood prices applicable in the Staszów Forest Inspectorate during 2016–2017 to determine the value of the harvested wood during 2006–2016 and the assessment of the economic effects of reclamation, the price for 1 m^3 of black locust wood was adopted following the average selling price of wood, calculated according to the average price of wood obtained by forest districts for the first three quarters of a given year according to Statistics Poland. Profitability (a measure of the benefits obtained from a given investment or business activity) has been calculated using the return on investment (ROI; ROI = profit from wood sales/costs of farming and forest management).

Results

The current species composition in the studied dump differs from that established and introduced during the afforestation phase. According to the Forest Management Plan (FMP) for 1992–2011, oak (*Quercus* spp.) had the largest share of the species composition (24%). Black locust and Scots pine (*Pinus sylvestris* L.) had a similarly high share (19% and 18%, respectively) (Tab. 1). Birch (*Betula pendula* Roth), poplar (*Populus* spp.), and black alder [*Alnus glutinosa* (L.) Gaertn] had a lower share, from 9 to 11% each (Tab. 1) (FMP

1992–2001). According to the last FMP (2012–2021), the species composition was dominated by black locust, constituting 32% of the species composition, whose share increased by 13% compared to the first FMP (Tab. 1). An equally high change was recorded in the case of oaks (*Quercus* spp.), whose share has decreased from 24 to 12% (Tab. 1). The remaining species, including pine, maintained similar percentages to the baseline values (first FMP, Tab. 1).

Table 1. Changes in species composition in the 'Piaseczno' dump

Species	FMP 1992–2001	FMP 2002–2011	FMP 2012–2021	Changes in the percentage share of species in 1992–2021
Quercus spp.	24%	26%	12%	–12%
Robinia pseudoacacia L.	19%	14%	32%	13%
Pinus sylvestris L.	18%	21%	20%	2%
Betula pendula Roth	11%	6%	7%	–4%
Populus spp.	11%	9%	5%	–6%
Alnus glutinosa L. Gaertn	9%	9%	13%	4%
Larix decidua Mill	n.d.	6%	6%	n.d
Other	7%	9%	6%	–1%

n.d. – no data available; FMP – forest management plan.

The total amount of the growing stock in the 'Piaseczno' dump was 19,871 m^3 (Tab. 2). Black locust had the largest share (6,430 m^3, or 32.36%). The growing stock of pine was 3,885 m^3 (20.05% of the share of stands), with 2,555 m^3 (13.19%) for alder and 2,317 m^3 (12%) for oak (FMP 2012–2021).

Scots pine was one of the most numerous species in the stands in the 'Piaseczno' dump (Tab. 1). It is a species that is very often and successfully used as a pioneer species in reclamation in Poland and throughout Central and Eastern Europe (Pietrzykowski 2014). Comparing the growing stock of merchantable timber of the two most abundant species, i.e., black locust and pine, it can be concluded that in the 'Piaseczno' dump during 2012–2021 (Tab. 2), pine was characterized by almost two times less growing stock of merchantable timber (3,885 m^3) than black locust (6,430 m^3). The comparison of data on the growing stock of other trees introduced into the dump based on the FMP for 2012–2021 (Tab. 2) shows that the growing stock of larch (1,120 m^3), which plays the role of a production species in forests, was almost six times smaller than that of black locust (Tab. 2). Comparing the growing stock of black locust to the remaining production species introduced in the 'Piaseczno' dump, a large disproportion was found in both the percentage share and the growing stock of the merchantable timber. In the case of oak, the growing stock of merchantable timber was almost six times smaller than that of black locust, and in the last FMP (2012–2021), a significant decrease in its share was recorded.

Table 2. Merchantable timber of growing stock for species occurring on the 'Piaseczno' dump (according to FMP 2012–2021)

Species	Total volume [m^3] (growing stock)
Robinia pseudoacacia	6430
Pinus sylvestris	3885
Alnus sp.	2555
Quercus sp.	2317
Betula pendula	1381
Larix decidua	1120
Populus tremula	1005
Populus sp.	420
Acer pseudoplatanus	145
Fagus sylvatica	10
Others	486

During 1992–2014, a total of 5,262.06 m^3 of wood raw material was harvested at the dump site (Tab. 3). Poplar had the largest share of the commercial thinning (1,443.43 m^3, or 27.43%), followed by pine (966.40 m^3, or 18.37%), birch (915.33 m^3, or 17.39%), and black locust (730.49 m^3, or 13.88%) (Tab. 3). The commercial thinning volume during 2012–2014 (5th revision) was similar to that recorded during 2002–2011 (4th revision, Forest Management Plan 2002–2011). When analysing the share of harvested wood of these species in individual revisions (1992–2001, 2002–2011, 2012–2014), black locust showed the greatest increase in the share of commercial thinning. The high percentage share of black locust at the end of the 5th revision (Forest Management Plan for 2012–2021) was also expressed by a high percentage share in the commercial thinning of wood

raw material during the remaining revisions. During the 3rd revision (Forest Management Plan for 1992–2001), the share of black locust was 11.13% (29.90 m^3), while during the 4th revision (Forest Management Plan for 2002–2011), it was 7.56% (215.55 m^3) (Tab. 3). When carrying out the 5th revision (Forest Management Plan for 2012–2021), the share of black locust in harvesting was 22.50% (485.04 m^3; Tab. 3).

In the last three-year period, the share of black locust harvested was more than twice as high as that during 1992–2011. The income related to the sale of black locust wood during 2006–2016 amounted to PLN 122,858.03, while the profit was PLN 84,352.97 (Tab. 4), giving an ROI profitability ratio of 2.19, i.e., a more than twofold ROI.

In the case of black locust, mainly timber classified as S2a was obtained. The medium-sized timber were as it follows length 1.0–3.0 m, minimum upper diameter 7 cm, maximum lower diameter 35 cm without bark, permissible one-sided curvature up to 8 cm/1 m or multi-sided curvature equal to half the one-sided curvature, with soft rot unacceptable (Ordinance No. 51 2019), accounting for 88.48% of the black locust harvest. Timber S4 was also harvested with medium-sized timber, length 1.0–3.0 m, minimum upper diameter 5 cm, one-sided and two-sided curvature allowed, soft rot allowed up to 50% of the forehead surfaces (Ordinance No. 51 2019), constituting 11.42%; and large-sized WC wood (large-sized wood), class C, upper diameter from 18 cm, length 2.5–14.0 m, healthy knots up to 10 cm in diameter and decayed up to 8 cm allowed, nodules, roses, frontal cracks allowed, frontal-lateral and frost: 1 fracture permissible, 4 cm/m curvature permissible, internal and diffuse rot permissible up to 1/3 of the felt diameter, external rot permissible up to 1/4 of the circumference or 1/10 of the diameter (Ordinance No. 51 2019), constituting 0.1% of the black locust timber harvest.

Table 3. Commercial thinning in individual revisions and total for the distinguished species in the 'Piaseczno' dump

Species	Revision 3rd (1992–2001)		Revision 4th (2002–2011)		Revision 5th (2012–2014)		Total commercial thinning (1992–2014)	
	commercial thinning							
	m^3	%	m^3	%	m^3	%	m^3	%
Robinia pseudoacacia	29.90	11.13	215.55	7.56	485.04	22.50	730.49	13.88
Betula pendula	7.02	2.61	472.03	16.56	436.28	20.24	915.33	17.39
Fagus sylvatica	0.00	0.00	0.84	0.03	0.00	0.00	0.84	0.02
Quercus spp.	9.75	3.63	101.10	3.55	156.39	7.26	267.24	5.08
Fraxinus excelsior	10.40	3.87	14.33	0.50	51.44	2.39	76.17	1.45
Larix decidua	19.15	7.13	121.23	4.25	107.78	5.00	248.16	4.72
Alnus spp.	2.60	0.97	3.86	0.14	31.37	1.46	37.83	0.72
Populus tremula	90.42	33.65	140.69	4.94	28.02	1.30	259.13	4.92
Pinus sylvestris	60.04	22.35	655.50	23.00	250.86	11.64	966.40	18.37
Populus spp.	0.65	0.24	1080.95	37.93	361.83	16.79	1443.43	27.43
Other coniferous	5.00	1.86	4.00	0.14	12.25	0.57	21.25	0.40
Other deciduous	33.75	12.56	24.49	0.86	157.78	7.32	216.02	4.11
Carpinus spp.	n.d	n.d	0.84	0.03	1.68	0.08	2.52	0.05
Acer pseudoplatanus	n.d	n.d	0.00	0.00	44.88	2.08	44.88	0.85
Ulmus spp.	n.d	n.d	0.00	0.00	1.40	0.06	1.40	0.03
Salix spp.	n.d	n.d	12.34	0.43	18.63	0.86	30.97	0.59
TOTAL	268.68		2847.75		2145.63		5262.06	

n.d – no data available.

Table 4. Costs and profits [PLN] of black locust harvesting in the Staszów Forest Inspectorate during 2006–2016 according to the Wood Price List of the Staszów Forest District

Years		2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Thinning in wood class	s2	33.80	5.82	0.00	28.86	0.00	65.52	253.89	0.00	0.00	0.00	0.00
	s2k	0.00	0.00	0.00	0.00	0.00	0.00	0.00	186.25	0.00	0.00	22.51
	s2d	0.00	0.00	0.00	0.00	0.00	0.00	0.00	17.70	0.00	0.00	0.00
	s4	0.00	0.00	0.00	0.00	3.25	0.00	6.19	15.55	10.92	0.00	43.36
	wd	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.70
Thinning in individual years [m^3]		33.80	5.82	0.00	28.86	3.25	65.52	260.08	219.50	10.92	0.00	66.57
The price of thinning and extraction [m^3][a]		44.00	39.50	55.00	45.00	43.50	45.00	52.00	69.40	47.00	47.00	47.00
Average selling price of wood [PLN][b]		133.70	147.28	152.53	136.54	154.65	186.68	186.42	171.05	188.85	191.77	191.01
Costs of commercial thinning and extraction in individual years [PLN]		1487.20	229.89	0.00	1298.70	141.38	2948.40	13 524.16	15 233.30	513.24	0.00	3128.79
Income from the sale of wood in particular years [PLN]		4519.06	857.17	0.00	3940.54	502.61	12 231.27	48 484.11	37 545.48	2062.24	0.00	12 715.54
Profit [PLN]		3031.86	627.28	0.00	2641.84	361.24	9282.87	34 959.95	22 312.18	1549.00	0.00	9586.75
Total cost of commercial thinning and extraction during 2006–2016 [PLN][c]							38505.06					
Total profit of wood selling during 2006–2016 [PLN][c]							122858.03					
Total profit from wood selling during 2006–2016[c]							84352.97					

[a] The price of commercial thinning and extraction in Staszów Forest Inspectorate (SILP data) during 2006–2016.
[b] The average price of wood sale calculated according to the average price of wood obtained by forest inspectorates for the first three-quarters [m^3].
[c] According to the data obtained from Staszów Forest Inspectorate.

Discussion

Among the many ecosystem functions and services performed by restored forest ecosystems in the course of reclamation in post-mining areas, most attention is paid to the restoration of biodiversity, carbon sequestration, landscape functions, and soil and water protection (Pietrzykowski and Krzaklewski 2007). Perhaps too little attention is paid to the production functions and the possibility of using biomass and wood to obtain economic benefits (Pietrzykowski et al. 2009; Pietrzykowski and Socha 2011). It should be emphasized that the process of ecosystem restoration is long and difficult, and the costs of carrying out maintenance and protection works are high. Therefore, the species composition of the reclaimed and afforested areas should be planned to ensure – in addition to adapting to the habitat and caring for biodiversity – the future reimbursement of costs or even economic profit. The protective and social functions of such ecosystems are of primary importance, but the production functions should be equally important, which meets the postulate of multifunctionality of forest management (Act 1995).

In the area of the studied dump, the black locust was characterized by the fastest increase of growing stock among the species introduced there. Changes in the percentage share of individual species are the result of forest management and the different growth rates of given species. The great increase in the percentage of black locust may be due to the tree's fast growth. A very large increase in the share of black locust in the yield is related to the development phase that the stand enters as well as the rela-

tively fast increase in biomass of this species (Kraszkiewicz and Szpryngiel 2009). The culminating volume increase is at the age of 20 years. On the contrary, the highest intensity of the average annual increase is observed when the tree reaches the age of 35–40 years (Jaworski 2011), i.e., the age at which the species in question was at the time of the research. Oaks, in which there was a decrease in the share of species composition, are more demanding in terms of the fertility of the habitat; oaks were introduced into patches with the graining of Neogene clays and, to a lesser extent, mixtures of Quaternary sands and Neogene clays (Skawina 1974). The tree species introduced to the heap were characterized by different growth dynamics and their culminations. Oaks, as species that grow more slowly than the others, may 'lose' their share of the species composition. In addition, black locusts can quickly increase the area of stands in the gaps of poorly growing stands through their root sprouts. A significant increase in black locust may also result from favouring the species that grows best during cuts. Black locust is characterized by good growth and high volume increment. In addition, black locust is an expansive species (a widely spread species). It prefers poorer habitats, and optimal conditions for the growth and development of black locust are found in fresh mixed forests, but it can occur in a wider spectrum, avoiding wet and shaded habitats (Danielewicz et al. 2018). However, it should also be remembered that in the reclamation of post-industrial areas towards forestry, we introduce vegetation to soilless areas where, due to the chemical and physical properties of the object, the selection of species is limited. Black locust performs two important functions on post-industrial facilities, namely, anti-erosion and phytomelioration. The anti-erosion function of this species is due to the extensive root system that the tree produces. For this reason, it was very often introduced to post-mining facilities that were barren (Krzaklewski 2017). In addition, the organic matter collected under black locust is characterized by a high content of nitrogen in a form assimilable by plants (Wanic and Pająk 2012), which is important from the point of view of restoring forest ecosystems. Thus, black locust was introduced to forest areas and is now present in large numbers in tree stands. Therefore, it is justified to estimate the value it can bring as a raw material. Also, the groups of assortments obtained give support to the conclusion that it will become one of the most important species, improving the economic effects of reclamation in the analysed dump. The suitability of black locust to improve the economic calculation related to reclamation was evidenced by the high prices of black locust wood in 2016 according to the retail price list in the Staszów Forest Inspectorate (in PLN – current currency in Poland), i.e., PLN 319.80 for WC, PLN 209.10 for S2a, and PLN 140.40 for stacked wood S4. In the case of S2a, the price of black locust is the same as that of oak, while in the case of S4 assortment, the price of black locust is approximately PLN 3 lower than that of oak.

Due to economic reasons and the ever-growing demand for wood, black locust should return to the planned reforestation systems in post-industrial areas, especially in the case of planning alternatives to the forest, i.e., the plantation. Until now, black locust introduced in reclaimed areas played a phytomeliorative role, ensuring the strengthening of slopes (Krzaklewski 2017). In the state forests, it is treated rather reluctantly due to its foreign origin (introduced species) and expansive character (widespread species). In forestry, the species is considered a nuisance plant that hinders the regeneration of the forest after cutting stands with its participation or in the vicinity of the place from which it penetrates the clearing areas and inhibits the development of native forest species cultivation Therefore, its presence in or introduction to tree stands should be monitored. Despite the high technical qualities of its wood, good incremental possibilities, low habitat requirements, easy adaptation to transformed habitats, low sensitivity to industrial pollution, and prospects for application in the energy sector, it is not very popular in afforestation in Poland (Woś et al. 2020). Krzaklewski et al. (2018) indicated that black locust plantations can be successfully used as an alternative method of reclamation and development of soilless post-mining areas, thanks to which the possibility of intensive production of scarce wood raw materials can be ensured. These authors showed that in the case of an energetic variety, after 5 years of growth, it is possible to obtain 3.5 tonnes/ha/year (dry mass) of the average annual black locust wood increment (Krzaklewski et al. 2018). The use of this species in practice is currently limited to the preservation of slopes in reclamation activities and the use of urban greenery in park plantings and along avenues

(Tałałaj and Węgorek 1996). Black locust plantations established on clay soils can be an alternative to energy plantations of other species of trees and shrubs (Kraszkiewicz 2013). Black locust wood also has very high heating values, comparable to oak wood (Kraszkiewicz and Szpryngiel 2009).

Conclusions

The condition for obtaining good economic effects of reclamation through afforestation of post-mining areas is, first of all, the appropriate selection of the species composition of afforestation to the habitat conditions. However, black locust growing stock comprises the largest share of the total volume of wood (merchantable timber) among individual species at the dump site at present. Often, as demonstrated by the Forest Management Plan analysis of the 'Piaseczno' dump, habitat conditions may be subject to changes related to moisture content and the dynamics of soil-forming processes, and probably also to the changing approach of practitioners to the diagnosis of habitats in these areas.

Although the habitats in the dump were created in degraded post-mining areas, their production possibilities, especially in the case of the introduction of black locust, are promising. Despite its anti-erosion and slope protection roles, thanks to its strong root system and nitrogen supply to the soil, black locust is a species that is avoided in commercial forests due to its foreign origin. However, it should be used in the restoration of post-mining areas, especially in planning plantations of fast-growing trees. This species should, as far as possible, return to the sets of planned afforestation in post-industrial areas, especially in the case of planning alternatives to the forest, i.e., reclamation, or in the case of replenishment in the planting of slopes and shelves of dumps and pits.

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