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Directions of the reclamation and development of wasteland

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Summary. In the publication, the issues associated with land use and reclamation were presented. Causes of land degradation resulting in the creation of wasteland and directions of its reclamation were characterized. When choosing the direction of restoration, the development plan objectives have been taken into account, as well as the local needs and protection of the environment. The forest or agricultural directions are the commonest and the complete or partial reconstruction of the soil profile is the basis of reclamation.

In the last decades vast agricultural areas have been excluded from use. They were allocated mainly for housing estates, industrial areas, roads and communications paths, mining areas or water reservoir sites. Simultaneously, thanks to reclamation and the following development, a great deal of the downgraded part has been restored for agricultural use.

Key words: reclamation, land use, wasteland, decline, devastation, agriculture, soil, land.

INTRODUCTION

Life of the man is inseparable from using the environment, which also involves exploitation of the needed raw materials. Such activity can affect positively or negatively the environment, and in many cases it leaves a permanent track. The destroyed or vandalized surface of the earth requires a thought-over and effective reclamation and the following development. One of the legal documents concerned is the Reclamation Act on the Protection of Agricultural and Forest Areas, which resolves the principles of protection of agricultural and forest lands as well as the reclamation and improvement of the utility of ground.

The process of reclamation consists in the restoration of the utility of ground which has been downgraded or vandalized as a result of human activity or natural disasters, through performing technical, biological or agrotechnical treatment. We rank the ground degraded by the industry and mining, landfill sites, slag heaps among areas requiring reclamation and the like [10,11,18]. Reclaimed ground should be subjected to rational development consisting in the realization of the sequence of treatments which will enable to use this ground to agricultural, forest, or other purposes.

The reclamation and development are interrelated. The direction of reclamation has a considerable influence on the direction of development and depends on: demographic conditions, the structure of using the surrounding ground, costs of individual tasks, land development plan on which the reclaimed area lies and needs of changes in the structure of using the area [13].

In order to expand cities, build motorways and new factories, new areas are needed. Therefore, the change is inevitable from using agricultural lands to other functional purposes. According to the statistical yearbook in Poland in the years 2000 – 2009, 23 thousand ha of agricultural lands were turned off to nonagricultural destinations, including 15 thousand ha of farmland [2]. In order to stop this rush one should reclassify areas in the well-conceived way and, if possible, conduct the rehabilitation in agricultural direction.

PROTECTION OF LAND

The protection of ground consists in reducing activities affecting the environment and downgrading or vandalizing the areas in question.

Agricultural and forest areas constitute a crucial element in the functioning of environment, therefore their appropriate protection is important. In the light of the act from 3 February, 1995 on the protection of agricultural and forest areas, the protection of agricultural areas consists in:

– limiting their allocation to non-agricultural or non-forest units,

– preventing the degradation processes and devastation of agricultural land as well as damage in agricultural production occurring as a result of non-agricultural activities and of movements of the earth masses,
– reclaiming and developing land towards agricultural purposes,
– keeping peat bogs and small ponds,
– limiting changes of the natural shape of the earth areas.

Similarly, the protection of forest areas consists in:

– limiting their allocation to non-forest or non-agricultural units,
– preventing degradation processes and devastation of forest lands as well as the damage in tree stands and forest production resulting from non-forest activity and movements of the earth masses,
– restoring the utility of ground which lost the character of forest land as a result of non-forest activity,
– improving their utility as well as preventing or lowering their productivity,
– minimizing the changes of natural forming of the earth area.

The level of soil protection is dependent on two factors, the origins and class. The highest classes and organic soils deserve top protection levels [3].

THE DECLINE AND DEVASTATION OF THE SOIL ENVIRONMENT

The industrialization and urbanization are the main causes of soil degradation causing the increase of wasteland. The destructive character of this devastation is obvious, the effects are most often irreparable, and the adverse influence is unquestioned. The decline of soil is caused by many factors, and the most important are: the building development and changes in using ground, mining exploitation of raw materials, waste disposal, industrial and automotive environmental pollution, use of chemicals in farming and forest, water and wind erosion, inappropriate land reclamation [17].

With its big interference in the environment, mining is the branch of industry which is most often matched up. It results from the specificity of the mining industry both underground, above the ground and to a large degree opencast. It is an undeniable fact that in Poland over 60% of all wasteland is the effect of activity of coal mining and the mining of raw materials [1]. The area of land occupied by the mining engineering is decreasing and in 2008 it was over 36 thousand [2] ha. Until recently, they still left the degraded areas to themselves without any corrective actions, hoping that the nature alone would restore a particular area. It contributed to the creation of the opinion that mining was highly harmful to the environment. At present, restoration works are being conducted not only after the completed use but also while the use is lasting.

Nevertheless, wasteland is coming into existence for natural reasons and it includes; bogs, sand dunes, areas with disadvantageous land features on which conditions for inhabiting are insufficient. Such wasteland, incurred for natural reasons, should be protected, since in spite of the lack of utility it usually has a considerable natural value. In the years 2000 - 2010 wasteland constituted 1.6% of the area of the country [2].

Every owner of land, including farmlands and ground reclaimed to agricultural destinations, is obliged to the counteraction of soil decline. If a suspicion exists about the possibility of the appearance of erosion or of mass movements the afforestation rate can be ordered to the owner of the ground by way of a decision requiring the afforesting, planting bushes on the ground or arranging permanent grassland on it. Also, the duty of keeping the technical efficiency of devices in the state preventing erosion and of devices of detailed land reclamation lies with the landholder on which the devices are staying.

The basic forms of soil degradation include: erosion, acidity, making barren, alkalization, salinity, breach of balance between nutrients, environmental pollution of soil with toxic elements.

Erosion of soil is the process of soil cover decay which in a significant way influences the sculpture of the earth's crust. It can be triggered by water, wind or, in special cases, gravity. For its straining depends on the terrain, properties of topcoat of the lithosphere, climatic conditions, flora and the way of using ground [1]. The dense flora constitutes the cover of soil, influences its properties, increases the water retention, shapes the local microclimate and influences the accumulation of nutrients. The liquidation of flora in order to increase the cultivated area increases the erosion processes to a considerable degree. It is caused by the long-lasting or periodic denudation of soil and performance of treatments aerating the soil. The sandiest soils are exposed to erosion and weakly clayed. They are characterized by great permeability and low content of functional constituents. Agricultural use of sandy ground causes a sequence of disadvantageous changes such as: increased outflow of rain waters, scouring fertilizer elements, which in consequence results in fertility decrease. Finally, the lowered profitability of cultivation causes cease of the agricultural use and appearance of wasteland. In Poland, 27.6% of the cultivated soil is potentially threatened with wind erosion, including 17.3 in the weak degree, 9.3% in the average degree and 1% in the strong degree. 27.5% of agricultural and forest areas are endangered with surface water erosion, and17.5% with ravine erosion [2].

Acidification of soil is an enormous problem all over the country. It is caused by air pollution, applying mineral fertilizers for a long stretch of time, activity of bacteria, decomposition of humus and storage of sour and acidic waste in landfills. Under natural conditions, soils are characterized by high acidity caused by some sedimentary rocks [12]. As a result of soil acidification a sequence of disadvantageous changes occurs: nutrients are scoured, the concentration of toxic metals and other adverse factors in the soil grows, roots of plants are damaged. The effective but also long-term method of neutralization of acid soils is liming. In order to neutralize the compact

soil to the reaction being neutral for a majority of plants, even several dozen years are needed. According to the statistical yearbook in the year 2009 the area of soil requiring liming in different degrees reached 72%. These results were received after examining 3635 thousand ha of the area.

Making the soil barren consists in the drop of nutrients. It is most often caused be applying the monoculture i.e. the cultivation of one kind of soil plants with about the same requirements in the same area for a few years. As a result, the reduction in content of nutrients which can assimilate in the soil causes the dwarfing of plants. In the organic cultivation, fertilizing with manure and mineral fertilizers is the best-known way of soil enrichment. At present, a research on fly ashes applicability to this purpose is being conducted [16].

Another adverse factor is upsetting the balance between nutrients. With every collected crop there comes a whole range of nutrients, especially microelements. In order to supplement them, mineral fertilizers which in contrast with natural fertilizers do not have all the essential microelements are more and more often applied. This gap upsets the balance between nutrients in the soil causing the sequence of disadvantageous changes.

Alkalization of soil is another disadvantageous occurrence. Alkalization can be caused by cement waste, waste from calcareous, smelly chemical plants, landfill ashes and slags, sewers and urbanized areas. As a result of the alkalization of the soil a concentration of nitrates is growing. It causes delayed plant ripening, their weakening and the associated reduction of their resistance to vermin and illnesses.

Salting the soil is the process of salts accumulation in the soil profile as a result of natural weather conditions or improper irrigation [5]. It is triggered by water-soluble salts, mainly sulphates, chlorides, sodium carbonates. It adversely affects the flora to a great extent since it hampers or completely stops the consumption of water through the root. At the setting of 0.3% and concentration of 0.5% dying out of plants starts taking place [5]. Withering of leaves or dying of roadside trees is the most frequent manifestation of salinity as the effect of exaggerated application of salt in winter in an attempt at the liquidation of black ice. The exaggerated salinity also causes erosion by knocking deep-sea waters, containing waste disposal NaCl off to rivers, which because of the great solubility easily make it out to soil environment and waters. Since the concentration of salt is dependent on the amount of water in soil, salinity is not a permanent phenomenon.

Another danger is environmental pollution of soil with toxic elements. The toxic effect of a substance can result in greater concentration of components of poisonous character. To the most dangerous ones belong heavy metals, herbicides, petroleum products, WWA.

Heavy metals pass through the entire food chain and gradually accumulate in it. The toxicity of heavy metals results from the degree of the contamination of the environment and the biochemical role they fulfill in metabolic processes. The environmentally most hazardous ones are: cadmium, lead, mercury, zinc, copper, chromium and arsenic. These elements enter mainly through dusts emitted from the combined heat and power plants and factories and falling down into the soil. In trace amounts they have a stimulating effect on the growth of plants, however in higher quantities they lead to their dying out [6,14].

Soil often gets contaminated with petroleum and its products, especially in places gas and petroleum obtainment, surroundings of refinery and as a result of the breakdown while storing fuels. Soil pollution with petroleum-derived products adversely affects the crop production.

At present in soils increased contents of long-lasting organic pollutants are recognized, and the frequently observed pollutant is WWA. These compounds come from natural and anthropogenic processes.

Applying herbicides in too large doses, at wrong weather conditions and at incorrect development phases can cause plant damaging.

The process of soil self-cleaning is the longest with reference to long-lasting components. It depends, among others, on the kind of pollutant, the degree of contamination, and the kind of soil.

We distinguish three main methods of soil cleaning to:
- extraction and separation of pollutants from soil with the help of water solutions,
- thermal processing consisting in the burning of pollutants or treatment with infrared radiation,
- biodegradation [5].

Fig. 1. Opencast mine of the lignite coal Rusko-Jaroszów [A. Kowalska]

DIRECTIONS OF RECLAMATION AND DEVELOPMENT

Reclamation not always means restoring ground to its original condition but according to the principle of the forming of diversified environmental conditions can be conducted in other, more desired directions [7]. Degraded areas are often characterized by peculiar properties which, through appropriate actions, can become more attractive and benefit a lot. Therefore, there is no ready standard of behavior with this type of areas, but one should carry out

a thorough analysis of all the factors. At first, one should determine the current functions of the area performed before the decline, to recognize the character and scale of ground degradation in order to determine the appropriate functions of the area intended for reclamation. Here are the main factors on which the choice of direction of the reclamation depends:

Landscape features. Especially vertical shaping enjoys a considerable influence on the direction of reclamation. Technical and economic aspects of the performance of works depend on the gradient. A steep slope predisposes degraded areas to direction of the reclamation in which the terrain has a lower significance or for which varied vertical landscape features are necessary.

The area of devastated ground and the kind of surroundings. Small sizes are predisposed to the direction of reclamation in accordance with the kind of surrounding ground. If the surrounding ground is being used in agricultural or forest way, the direction of reclamation should be identical in order to keep the spatial structure of the use. In the vicinity of the building land, recreational or cultural directions are recommended [4,10].

Water relationships. Apart from vertical landscape features, from economic reasons, water conditions have a considerable influence on the direction of reclamation. On heavily watered areas, water direction is proper if necessary, i.e. when the conditions make it a right, natural direction.

Coating with tree flora and greenery. Direction of reclamation should be selected in such a way as to integrate the existing flora. However, the flora does not condition the specific direction of reclamation. It participates, however, in creating the biologically active layer of soil needed in reclamation, mainly in agricultural or forest directions.

The type of soil has a considerable influence on the direction of reclamation, particularly when a layer of biologically active soil is essential. On sandy soil, planting the coniferous forest is recommended; sandy, clay, dust and argillaceous soils can be reclaimed in agricultural direction.

It is possible to reclaim a degraded area in a few directions. The most often chosen directions are forest and agricultural ones. In 2009 they amounted to 93% of the whole reclaimed ground [2].

Agricultural direction. The reclamation involves devastated areas which stay in the agricultural category of arable land and are laid for the use as e.g. pastures. Works are focused on the improvement in the biological properties of active soil or its reconstruction, but also on the improvement in water relationships and landscape features.

Forest direction. In forest direction laying the ground for the arboriculture is the purpose of reclamation. Reclamation works consist in landscape features improvement, creating the layer of soil and regulating water relationships.

Fishing direction. If the reclaimed area has a proper shape, lowering the permeable bottom and the possibility of keeping the essential water level can be used to form fish ponds. Reclamation works consist mainly in the proper forming of the bottom, forming edges and ensuring the essential water level. For example post-mining excavations can be used, incurred after extracting sands and gravels, which are usually characterized by the highest level of waters.

Recreational direction. It is one of more expensive directions on account of a lot of works needed in order to get a safe and attractive area. In a majority of cases a body of water for recreational purposes is involved.

In order to allow the degraded area to serve people, one should form the bottom of the container, its edges, ensure the appropriate level and quality of water, as well as prepare the grounds for pedestrians, build car parks and roads. In case of the allocation for pedestrian areas, forming the terrain, regulating water conditions and producing the layer of biologically active soil are included in the scope of works.

Land improvement direction. We distinguish two subtypes: hydro-drainage and phyto-drainage. In the first case a small pond serving as a small retention container is created, in the second, afforesting mid-field [1].

Infrastructure direction. As a result of reclamation in the direction of infrastructure, devastated areas are converted into economic, housing, building and other types. The works focus mainly on the proper landscape features, draining and preparing access roads. If the area is to be developed in this way it must fulfill a number of conditions such as: endurance of ground, appropriate terrain as well as appropriate water conditions [1].

The essential system of the marking of directions introduced to the reclamation in the PN-G- 07800 norm, 2002 has been supplemented and extended. Apart from trends, also detailed directions were set, which it is possible to survey in order to get all sorts combinations. Such solution was suggested by U. Kaźmierczak and J. Malewski and mentioned in the work by P. Kasprzyk [7].

Table 2. General and specific reclamation directions by Kaźmierczak [1,9]

Trend of the reclamation	Detailed direction of the reclamation	Trend of the reclamation	Detailed direction of the reclamation
Agricultural	cultivations	Natural	nature reserve
	breeding		landscape park
Forest	economy		area of protected landscape
	protection		species protection
	recreation		natural feature of historic importance

Water	buildings	Natural	documentary position of geological features
	recreation		ecological use
Economic	the housing industry		natural-landscape team
	industry		the green belt
	services		

For areas with a large surface, wider general and detailed directions of the reclamation and development were drawn up. Cultural direction in which the artistic, teaching and contemplative initiative is contained is a novelty.

Table 3. General and specific directions of reclamation and development of terrain-space components [8]

Agricultural	breeding: of animals, poultry, fish
	cultivations: arable land, orchards, meadows, pastures, home-grown gardens
Forest	protection
	economic
	recreation: tourist routes, couples, walking-bicycle paths, health, forest paths promotional complexes
Water	recreation: bathing beaches, water sports
	economic: holding containers, containers of the drinking water
Natural	forms of protection depending on natural values
Economic	the housing industry, campuses, garages
	industry
	services: incubators, magazines, shops, wholesale companies, car parks, sports facilities and the like
	landfill sites
Cultural	teaching: thematic tracks, laboratories
	contemplative
	artistic: museums, exhibitions, showrooms and concert, stages, amphitheatres and the like

METHODS OF THE RECLAMATION OF DEGRADED AND VANDALIZED AREAS

The reclamation consists in sending or restoring the degraded or vandalised utility or natural ground through due forming of the terrain, regulating water conditions, reconstructing the soil, improvement of the physical and chemical properties. The technique of the reclamation of degraded or vandalised areas depends very much on many factors resulting both from the character of reclaimed ground and from the scope of works essential for the set direction of rehabilitation. We distinguish three phases of reclamation of degraded areas: preparatory, technical and biological.

In the preparatory phase the recognition of determinants takes place, consideration of the correctness of performing the reclamation, establishment of the direction of reclamation and development, drawing up and estimate of the technical documentation.

They fall within the scope of the technical phase of reclamation: forming of the relief of the reclaimed area, regulation of water conditions (including the structure of necessary facilities and hydro-technical devices), neutralization of toxic pollutants in the ground, fertilizing works, complete or partial reconstruction of the soil profile and the building of necessary infrastructure [8,15].

The biological phase consists in improving the physical and chemical biological properties of ground and waters, the technical and biological structure of hillsides of heaps and escarpments of excavations, implementing the flora, reconstructing biological conditions and protecting against the sheet erosion of the reclaimed areas as well as storing water in the post-mining holes intended to become bodies of water [1]. The biological reclamation also includes agrotechnical treatments such as: mechanical cultivation of ground, mineral fertilizing, inserting carious blends, mainly papilionaceous and digestive ones.

The role of flora in the process of the reclamation is significant and relies on the protection of areas against industrial pollutants, stabilization of loosely-knit soil-grown works and protection against water erosion and air. Flora also plays an important role in processes of soil formation.

CONCLUSIONS

According to the Polish constitution and the Act on the protection of agricultural and forest lands every citizen is obliged to look after the natural environment, including ground. However, human activity is connected with interference in the environment and its decline. Deterioration of the state of biologically active layer of soil results from acidification, getting barren, alkalization, salinity, upsetting the balance between nutrients and environmental pollution of soil with toxic elements. A number of developed and tested techniques enabling to obtain optimal conditions for the life of plants and animals exists which, applied during the process of reclamation, can bring notable benefits to the areas in question. We are singling out some of the directions of reclamation. In Poland, agricultural and forest direction is the commonest. There are some main factors on which the choice of reclamation direction depends: landscape relief, area and kind of devastated ground as well as the kind of surroundings, forming the coverage with tree flora and greenery, water conditions or type of works in the degraded area.

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KIERUNKI REKULTYWACJI I ZAGOSPODAROWANIA NIEUŻYTKÓW

S t r e s z c z e n i e . W publikacji przedstawiono zagadnienia związane z rekultywacją i zagospodarowaniem terenów zdegradowanych. Scharakteryzowano przyczyny degradacji gruntów prowadzące do powstania nieużytków oraz kierunki ich rekultywacji. Przy wyborze kierunku rekultywacji bierze się pod uwagę założenia planu zagospodarowania przestrzennego, potrzeby lokalne oraz zasady ochrony środowiska. Najczęściej wybierane są kierunki rolny i leśny. Istotą przeprowadzenia rekultywacji w tych kierunkach jest całkowite lub częściowe odtworzenie profilu glebowego.

Przez ostatnie dziesięciolecia wyłączonych z użytkowania zostało wiele gruntów rolnych. Przeznaczone były głównie na tereny osiedlowe, przemysłowe, pod drogi i szlaki komunikacyjne, pod użytki kopalne oraz pod zbiorniki wodne. Jednocześnie dzięki rekultywacji i następującemu po niej zagospodarowaniu udało się przywrócić część zdegradowanych, głównie przez przemysł, gruntów pod użytkowanie rolne.

S ł o w a k l u c z o w e : rekultywacja, zagospodarowanie, nieużytki, degradacja, dewastacja, rolnictwo, gleba, grunt.