



ANNEX 3

Kozłowa Góra Reservoir (PA2.2)

SET-UP OF PILOT-SPECIFIC MANAGEMENT PRACTICES

D.T2.1.2 Transnational case review of best management practices in pilot actions

BEST MANAGEMENT PRACTICES REPORT IN PILOT ACTION

“KOZŁOWA GÓRA RESERVOIR ”

FINAL VERSION

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Introduction

In this report best management practices are presented on the level of Pilot Action Kozłowa Góra Reservoir, regarding potential conflicts of interest between land use management and water protection.

The aim of this report is to provide the review of best practices regarding different types of land use (agriculture, grassland, forestry) respectively vegetation cover (wetland), aiming at water protection and mitigating floods in the Pilot Action.

For this, first of all human activities have to be identified, which are posing risk to water quality and quantity; flooding and consecutive to water management. Finally, review of best management practices in the Pilot Action is presented.

The purpose of the report is to review the activities within the best practices regarding water management in the area of the Brynica river sub-basin upstream the Kozłowa Góra dam. According to the PROLINE-CE project structure, this area has been classified as Plain area with agriculture as a main form of land use.

The currently applied best practices have been identified on the basis of study analysis considering the currently applicable legal acts and standards. The so called best practices were divided according to the forms of land use and vegetation type.

1. Land use, drinking water and flood protection in the Pilot Action

The Pilot Action area is situated in the central part of Silesia Voivodeship (Figure 1). It covers the area of 193.93 km² within the boundaries of the following districts: tarnogórski, będziński, myszkowski and lubliniecki. It is situated outside the territory of the Upper Silesia Conurbation and encompasses communes which are primarily of a rural or urban-rural nature. Administratively, it belongs to 10 communes, amongst which only one commune, i.e. Ożarówice, lies entirely within the confines of the sub-basin. The area of the other communes located within the boundaries of the sub-basin changes from 0.4% of the total area of Tarnowskie Góry to approx. 73% of the Świerklaniec commune. There is also a different share of the communes within the total area of the sub-basin - from 0.17% (Tarnowskie Góry) to 23.46% (Ożarówice) (Table 1).

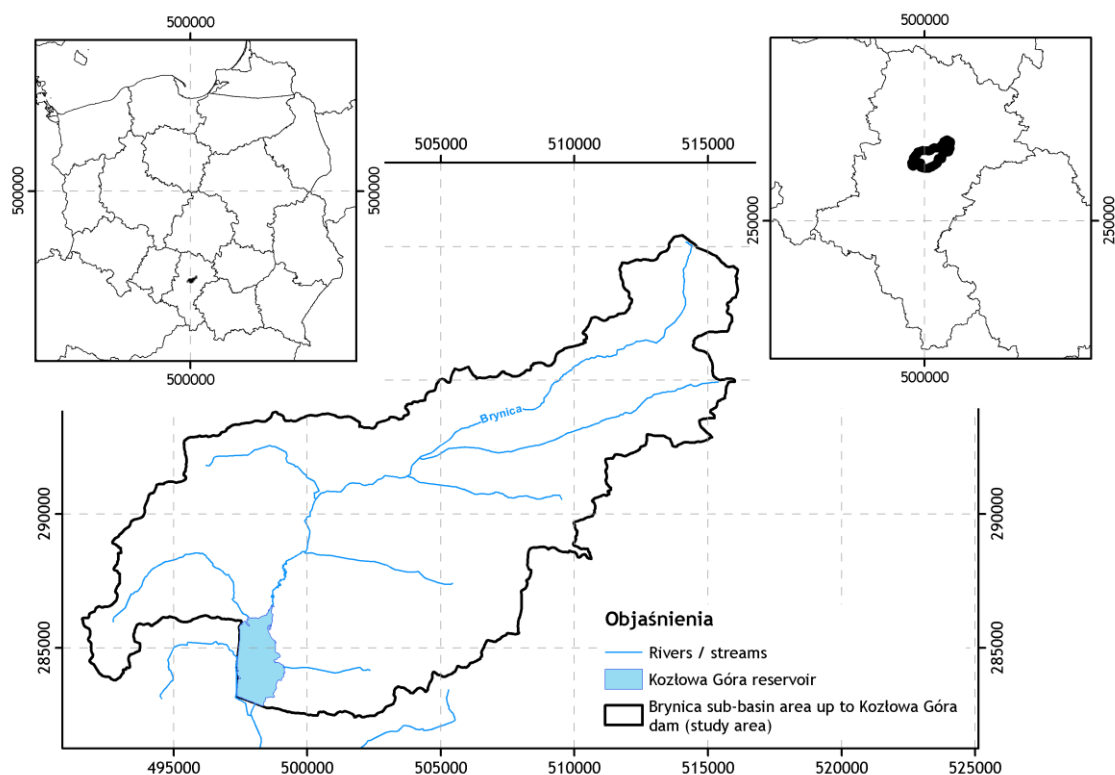


Figure 1. Location of Kozłowa Góra reservoir and Brynica River sub-basin upstream the Kozłowa Góra dam administration map of Poland.

Table 1. The share of the communes' area within the Brynica River sub-basin upstream the Kozłowa Góra dam

County	Commune	Area within the sub-basin	Percentage share within the sub-basin
		[km ²]	[%]
tarnogórski	Miasteczko Śląskie	26.50	13.66
	Ożarowice	45.49	23.46
	Świerklaniec	32.72	16.87
	Radzionków	0.80	0.41
	Tarnowskie Góry	0.34	0.17
będziński	Siewierz	26.44	13.64
	Bobrowniki	20.67	10.66
	Mierzęcice	13.82	7.13
myszkowski	Koziegłowy	21.66	11.17
lubliniecki	Woźniki	5.48	2.83

1.1. Land use

The description of the spatial management in the sub-basin in question was prepared on the basis of the CORINE Land Cover 2012 map analysis (Figure 2) as well as the data from environmental protection programmes and implementation reports for the particular communes.

The largest part of the sub-basin is covered by forest areas - 47.8% of the land area, including forests - 46%. The remaining surface (1.8%) is covered by forest areas in the process of changes (forest nurseries, tree clearance) (Figure 3). There is a wide belt of forests in the western, northern and eastern parts of the sub-basin. Large forest areas also extend east of the Kozłowa Góra Reservoir. Forest areas have definitely dominated the right-side part of the Brynica River sub-basin. In the dominant part the area, the forests are administered by the Świerklaniec Forest Inspectorate, with only the eastern part being under the Siewierz Forest Inspectorate. They are part of the Forest Protective Belt of the Upper Silesian Industrial Region (GOP). The forests are dominated by coniferous trees - nearly 74%. The share of mixed and deciduous forests is considerably smaller, i.e. 20% and 6% respectively. The tree species composition is markedly dominated by the pine (70 - 80%).

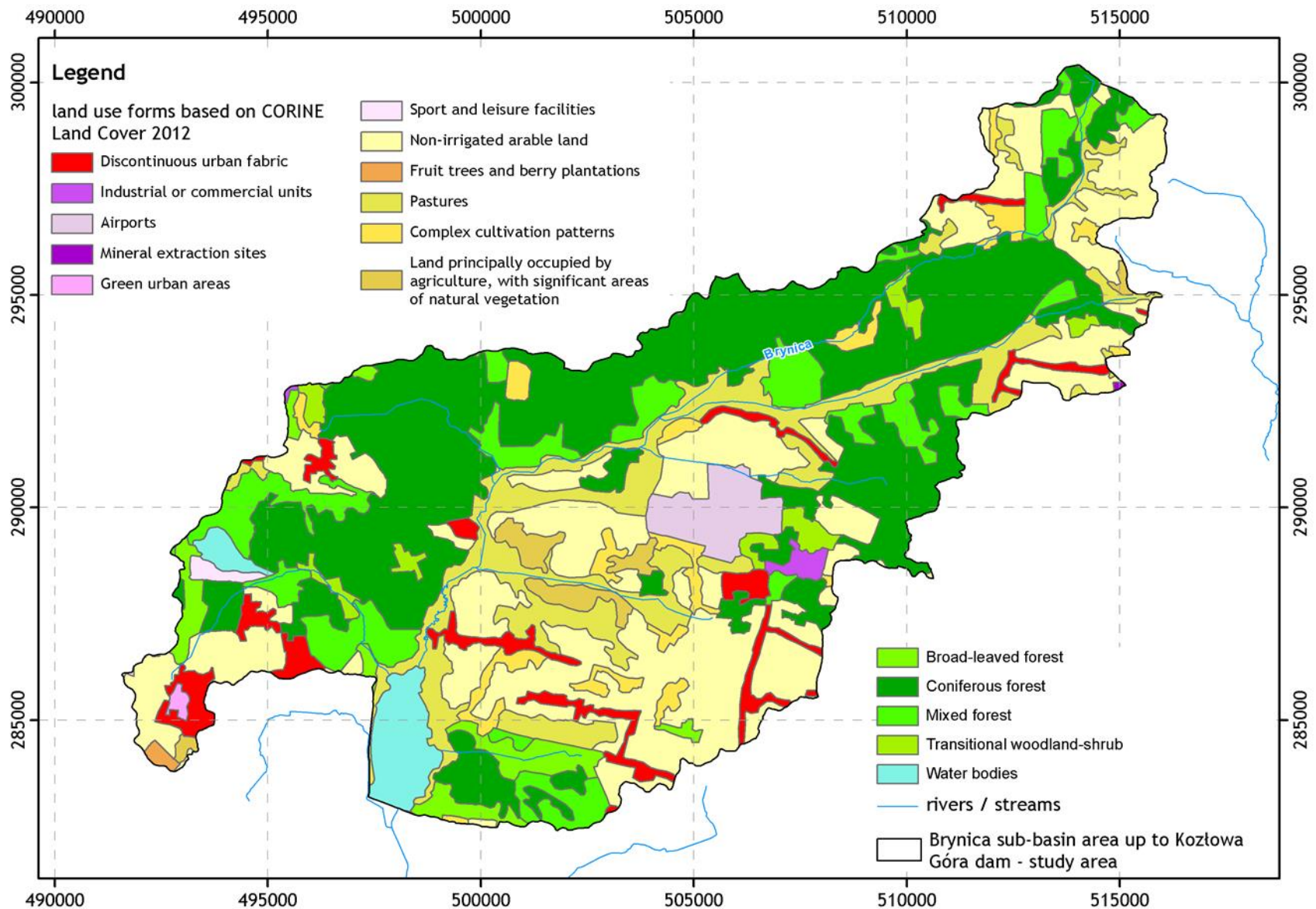


Figure 2. The land-use forms within the Brynica River sub-basin area, upstream the Kozłowa Góra dam (based on CORINE Land Cover 2012).

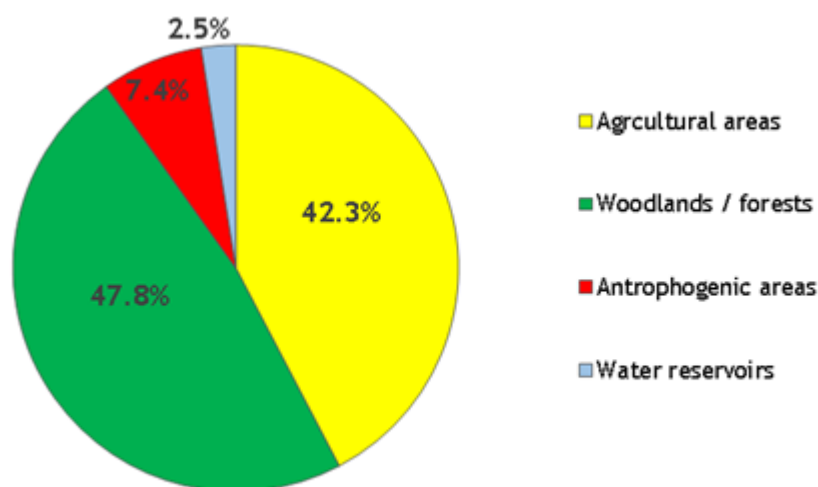


Figure 3. The main forms of land use in the sub-basin of the Brynica River sub-basin upstream the Kozłowa Góra dam

Agricultural lands cover the area of 82 km². This constitutes 42.3% of the total sub-basin area. They include arable lands, areas occupied by permanent crops (orchards and plantations), meadows and pastures as well as areas of mixed farming. Agricultural lands usually occur in the central and north east part of the sub-basin, in the area of the Ożarówice, Mierzęcice, Bobrowniki, Siewierz and Koziegłowy communes. Arable lands under regular tillage make up more than half of these areas (60.3%) (Figure 4). Meadows and pastures have a considerably smaller share - 28%, while the smallest share is demonstrated by orchards and plantations, occupying merely 0.35% of the agricultural land area.

Regions occupied mostly by agriculture with a large share of natural plants and allotment cultivation, which together make up the so-called areas of mixed farming, cover respectively: 3.6 and 7.8% of the agricultural areas within the sub-basin.

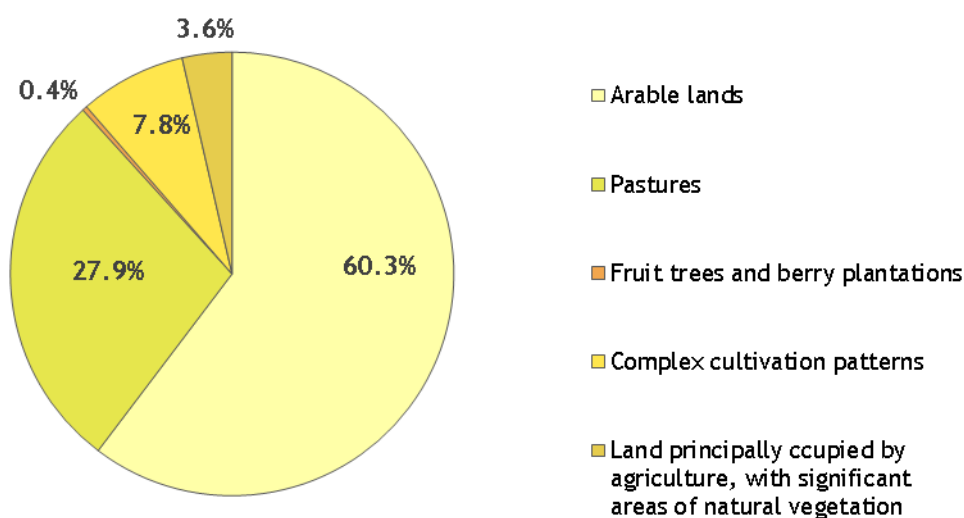


Figure 4. The agricultural land use structure in the Brynica River sub-basin upstream the Kozłowa Góra dam

Due to the dominant nature of the communes making up the sub-basin, anthropogenic regions constitute a small percentage of this area, with merely 7% (Figure 3Error! Reference source not found.). More than a half of the surface (58.7%) is covered by residential buildings (Figure 5). The largest built-up areas located in the western part of the region include the villages (sołectwa) in the Tarnogórski district, namely: Świerklaniec, Nakło, Nowe Chechło and Miasteczko Śląskie. These areas are characterised by condensed single-family residential housing and location of basic service facilities. Furthermore, in the central part of the area, in the Mierzęcice commune, there is a typically urban housing estate along with infrastructure (the Mierzęcice Osiedle village). It constitutes an autonomous urban entity arising out of the revitalisation of the remnants of the former military unit. In this area, thanks to the direct vicinity of the airport, there are several hotels as well as hotel & catering companies. The remaining villages are of typical rural nature with buildings located along a single street.

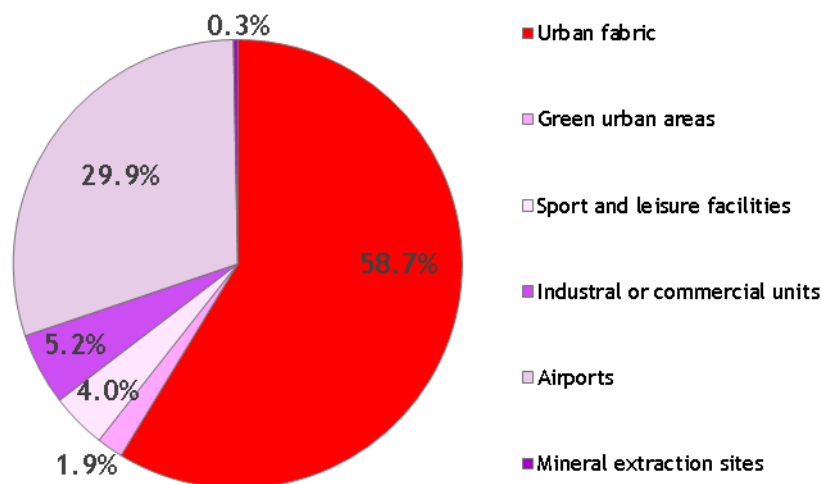


Figure 5. The structure of using the anthropogenic regions in the area of the Brynica River sub-basin upstream the Kozłowa Góra dam.

Urban green and relaxation areas constitute less than 6% of the anthropogenic areas, including sports and recreation grounds with a 4.0% share. They encompass, amongst others, the centres at the Nakło-Chechło artificial lake which offer weekend or holiday recreational activities for the local inhabitants. Green areas, such as parks and squares, constitute merely 1.9% of the total sub-basin area (e.g. the Świerklaniec Park and the manor park in Nakło Śląskie).

The anthropogenic regions include industrial, commercial and traffic areas. Industrial and commercial buildings occupy 5.2% of the anthropogenic areas. It consists of buildings related to the transportation activities as well as the scrap trade and processing sector in the central part of Mierzęcice, and just outside the sub-basin - industrial sites of the Huta Cynku “Miasteczko Śląskie” zinc smelter. A considerable share in the surface of the anthropogenic areas, reaching as much as 29.9%, is held by the territory of the Katowice International Airport in Pyrzowice. It is located in the area of two communes, namely Ożarówice and Mierzęcice. In the southern part, which is more developed, there is a complex of three passenger terminals, cargo, ramps and car parks, as well as the administration buildings and hangars. The central part consists of the runway with its navigational facilities and taxiways. In the northern part - which is the least developed region - there is the approach radar and the patrol road around the fencing of the airport. These are the airport’s back-up lands for investments.

Within the sub - basin area, there is a complex system of road infrastructure. In the southern part of the area runs a section of the A1 motorway with the “Pyrzowice” interchange and of the S1 expressway linking the airport in Pyrzowice with the Upper Silesian Agglomeration. There is the west - east national road no. 78 spanning Chałupki-Gliwice-Zawiercie-Chmielnik, while the easternmost part of the sub-basin is intersected by the national road no. 1 Zwardoń - Częstochowa - Łódź - Gdańsk. Moreover, the road network includes provincial roads: 913 (an alternative route to the S1 road), the provincial road no. 912, 908 running in the westernmost part of the sub-basin and the system of local roads.

In the middle part of the area, there is the eastbound railway line no. 182: Tarnowskie Góry - Zawiercie, open only for freight traffic from Zawiercie to Siewierz. It is currently planned for revitalisation and reconstruction. It is intended to become part of a fast railway link connecting Katowice with the Pyrzowice airport and Zawiercie. In the south-westernmost part of the sub-basin runs a section of the coal trunk-line: Gdynia - Herby Nowe - Tarnowskie Góry - Chorzów Batory, which links Upper Silesia with the Baltic coast. Right at the western border of the sub-basin, there is one of the largest marshalling yard in Europe, the length of which amounts to a few kilometres from the station in Miasteczko Śląskie to the station in Tarnowskie Góry.

Mines, post - mining pits and construction sites represent nearly 0.3% of the anthropogenic regions. At the borderland of the sub-basin, in its eastern part, there is a working of the “Brudzowice” dolomite mine of the Górnicze Zakłady Dolomitowe S.A. [Dolomite Mining Works, Joint-Stock Company] seated in Siewierz.

East of Żyglin, by the road leading to the Brynica River, there is a private limestone quarry covering an area of several hectares. Across the entire sub-basin area, there are numerous small sites of active or abandoned aggregate exploitation. Moreover, in the central part of the sub-basin, among Pyrzowice, Zendek and the Polski Las farmstead, there are ongoing works related to the construction of another section of the A1 Pyrzowice-Częstochowa motorway.

Water areas consist of inland waterways, which are composed of watercourses and reservoirs. The former group includes the Brynica River along with its tributaries: Trzonia, Czeczówka, Potok Ożarówicki and the tributary from Żyglin, while the latter - the Kozłowa Góra Reservoir and the Chechło-Nakło Reservoir formed in a former sand excavation site. In total, they represent 2.5% of the area of the sub-basin in question.

According to land use forms in the Pilot Action area several types of the potential sources of pollution can be observed.

1.1.1. Point sources of pollution

The point sources of pollution include (Figure 6):

- **Industrial plants** – in the area of interest, there are 18 plants that pose a potential hazard to the groundwater. They are small enterprises operating in woodworking, food and automotive industries. The plants are located in the southern and south-east part of the area of interest and are not hazardous to the environment;
- **Livestock farms** – 10 farms have been identified in the area of interest, which can potentially threaten the quality of waters. They are mainly poultry farms. The farms are located in the following communes: Miasteczko Śląskie, Świerklaniec, Ożarowice, Mierzęcice and Bobrowniki;
- **Service stations and fuel storage** facilities – in the area of interest, there are 9 objects where distribution and storage of liquid fuels take place. In the event of a breakdown or incorrect operation, these objects pose a major hazard to the condition of the water environment. Uncontrolled or emergency spillage of oil derivatives may permanently contaminate the water environment. The service stations and fuel storage facilities are located in bigger towns in the southern part of the investigated area, near major communication routes;
- **Landfills** – there are no landfills of municipal, industrial or hazardous waste in the area of interest. However, one of the waste management issues is illegal waste disposal in the so called “open dumps”. They can be found most often in post-mining excavation sites (sand, gravel, clay), by rivers and streams, in terrain depressions, forests and along the field roads. In accordance with the imposed obligations, the communes remove open dumps on an ongoing basis;
- **Sewage treatment plants and sewage discharge** – in the area of interest, there are 2 sewage treatment plants. One of them is the biggest and most advanced sewage treatment plant in Ożarowice opened in 2016. It is a mechanical-biological sewage treatment facility with the maximum capacity of 2,500 m³/d. It serves the communes of Mierzęcice and Ożarowice.

In the area of the Brynica River sub-basin upstream the Kozłowa Góra dam, 14 sewage discharge points have been identified. The municipal wastewater constitutes 30% of all discharge, a similar volume is industrial wastewater. The other discharge include mainly stormwater. The direct receivers of the discharge are: the Cieczówka stream, the Świerklaniecki ditch and the Brynica River. The annual discharge volumes oscillate around 730,000 m³ of municipal waste and 330 m³ of industrial waste. Domestic and sanitary sewage is disposed into septic tanks or directly into

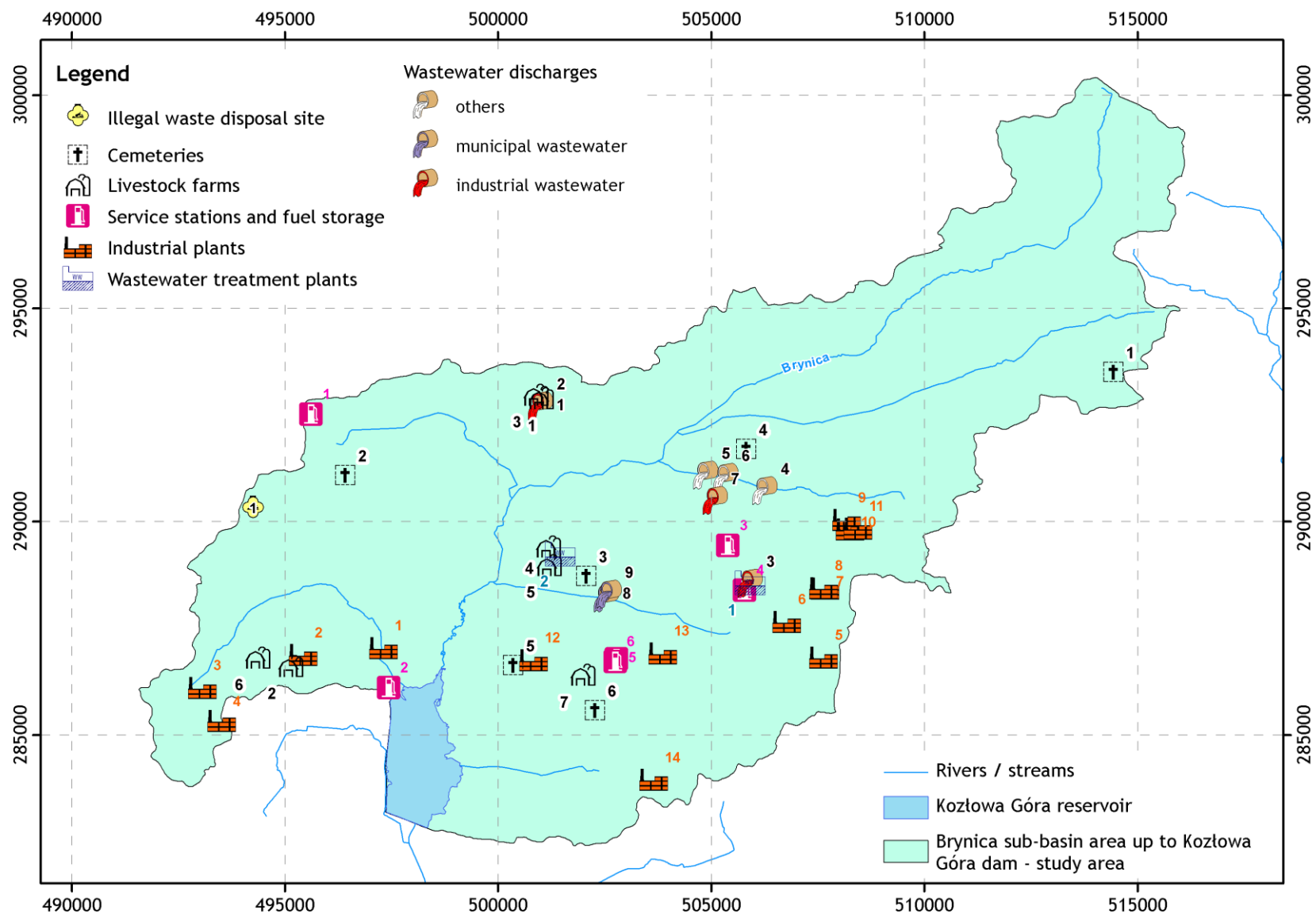


Figure 6. Location of potential point sources of pollution in the study area.

the ditches and streams. Leaking septic tanks and illegal sewage system outlets pose a major threat to the quality of the ground- and surface waters. The sewage is the source of the pollutants identified as BOD, COD, ammonium nitrogen and phosphates. Stormwater from the roads, squares and service stations contaminate the waters mainly with oil derivatives that are washed away from the surface.

1.1.2. Linear sources of pollution (Figure 77)

— **Communication routes** — some major communication roads run through the area of interest, namely: Pyrzowice-Piekary section of A1 motorway, Pyrzowice-Cieszyn section of S1 expressway, Tarnowskie Góry-Siewierz section of national road No. 78 and provincial roads No. 908, 912 and 913. Construction of S11 expressway Koszalin-Pyrzowice is also planned. Save for the seasonally operating cargo line from Tarnowskie Góry to Zawiercie, there are no operating railway routes. The launch of a railway connection between Katowice and Pyrzowice Airport is planned in the near future. The communication routes are the potential sources of pollution with: oil derivatives, fuel combustion and tyre wear products, chemical substances spilled on roads in the winter (salt and other). Additionally, there is a threat of release, spread or spillage of transported toxic substances (chemicals, paints, diluents etc.) due to a breakdown or a road accident.

— **Surface water (rivers, streams)** — the waters in the main surface streams in the area of interest are in a bad condition, classified as grade II and III water purity and are the source of groundwater pollution. The poor condition of the waters results from exceeding the levels of such elements as: boron, aluminum, copper, phenols, cadmium and its compounds. The streams are polluted with domestic and agricultural wastewater as well as sewage from the plants located in the towns through which the streams flow.

1.1.3. Nonpoint sources of pollution

— **Agricultural areas** — mineral fertilizers, slurry and plant protection products used in a wrong time or in excessive doses may be washed away from the soil by rainwater and transported into the surface streams and groundwater;

— **Urban areas** — many towns and villages are not connected to a sewage system (e.g. part of Bobrowniki and Mierzęcice communes). Wastewater from the unsewered areas are discharged directly into the soil or collected in septic tanks which are then emptied into the fields,

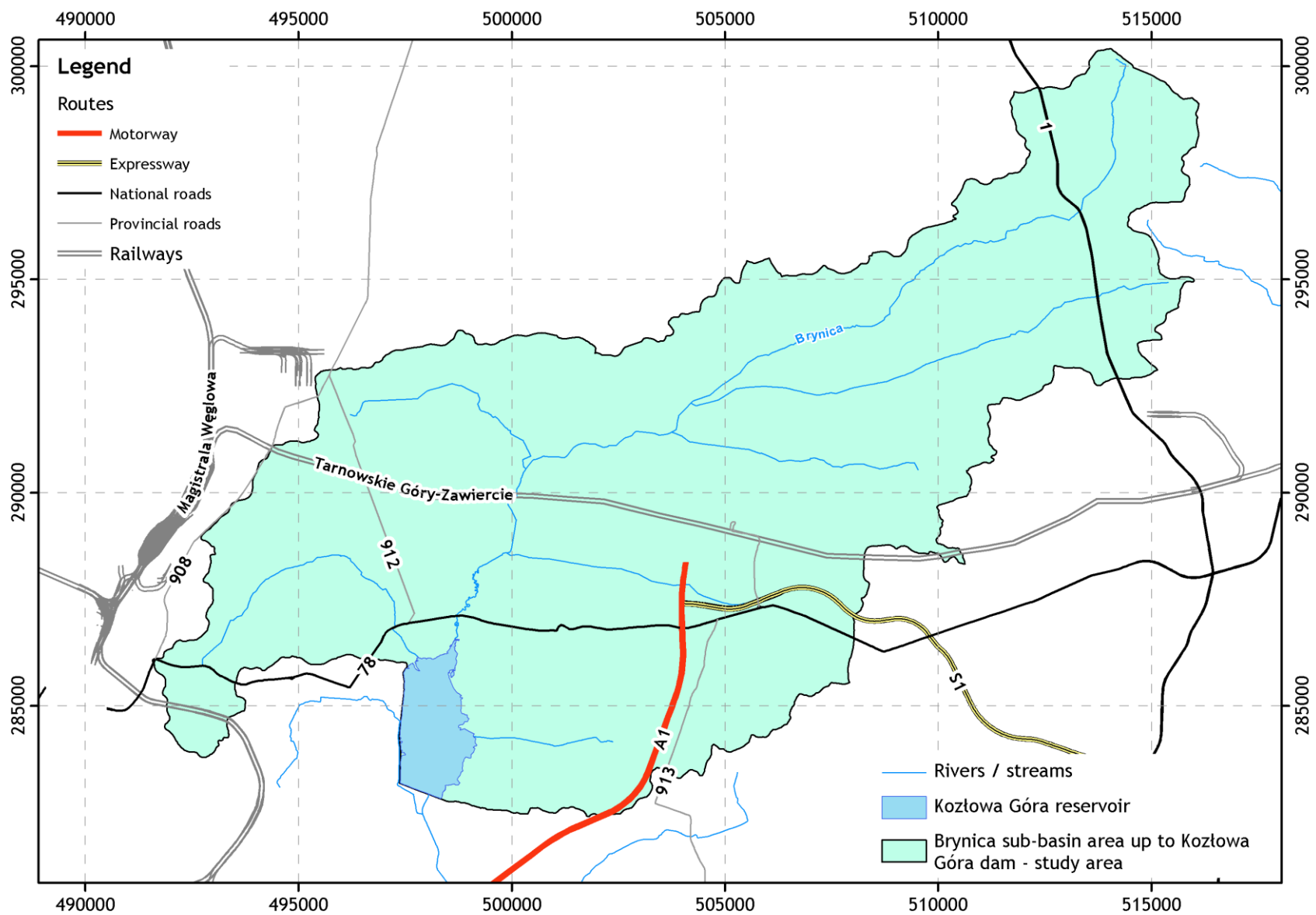


Figure 7. Location of potential linear sources of pollution in the study area.

meadows or ditches. In the rural areas which prevail in the described area, the additional pollution source are barns and livestock farms, as most of them are not protected from absorption of the slurry into the ground;

– **Gas and dust emissions** – as for the type of emissions, industrial and uncontrolled emission takes place in the area of interest. Industrial emission is linked to the local industrial plants. However, as the area of interest lacks large gas and dust emitters such as power plants, heat and power plants or smelters, the most significant is the local emission and the so called low emission sources. Emission of dust and harmful gases from private heating stoves and local boiler houses is a particular nuisance during the heating season, when the largest amounts of pollutants, mainly from carbon burning, are released into the air. The communes fight the problem of low emission by: replacing the old-fashioned coal boilers, building and upgrading the heating networks, changing fuels used for heating (from carbon to gas, oil or electricity) and thermal modernization of buildings.

Road transport is the source of uncontrolled emission in the area of interest. Road traffic causes a high concentration of carbon monoxide, nitrogen oxides and volatile hydrocarbons along the main communication routes.

1.1.4. Others

In the central part of the investigated area, in the commune of Ożarówice, the Katowice International Airport in Pyrzowice is located. The object emits noise at a very high level and may pose an oil derivatives spill threat, which can cause permanent contamination of the ground- and surface waters.

1.2. Drinking water protection

On the Pilot Action area (Kozłowa Góra reservoir and Brynica River sub-basin upstream the Kozłowa Góra dam) there is no drinking water protection zones concerning surface water.

2. Best Management Practices

2.1. Forest

The study analyses did not allow to identify the best practices implemented for these types of land use in the area of the Brynica river sub-basin upstream the Kozłowa Góra dam. In Poland, there are no regulation and policy concerning woodland management facing water resources protection. Polish woodlands' authorities - State Forest agency and Regional Offices of State Forest, have started Small Retention Programme to improve flood/drought mitigation in woodlands ecosystems. Still, we are waiting for guidelines.

2.2. Agriculture and Grasslands

The list of the so called best practices in water protection in agricultural areas located within the Brynica river sub-basin upstream the Kozłowa Góra dam, was developed based primarily on the Codes of Good Agricultural Practices (Duer et al., 2004), and the activities outlined in the Regulation of the Council of Ministers of 18th October 2016 on the Water management plan for the Vistula river basin.

ACTIVITY	DESCRIPTION	ADVANTAGES	CHALLENGES
Construction of new and expansion of existing sites for the storage of solid and liquid natural fertilisers.	All liquid and solid natural fertilisers and waste produced on the farm should be stored in special tight containers or on plates located at appropriate distance from buildings and farm borders in line with the requirements of construction law, in particular away from a well that is a source of water for people and animals. Containers for liquid manure and no-outflow containers should have an impermeable bottom and walls and a sealed lid with an entrance opening and a ventilation opening.	Enhance and preserve water supply ESS	Educating / persuading the society to apply the activity/ making them interested in implementation of the activity, monitoring of activity application process, enforcement of the policy or regulations

Education agricultural professionals on good agricultural practices and providing them with specialist consultations.	Implementation of a program aimed at limiting of nitrogen outflow from agricultural sources.	Enhance and preserve water supply ESS	Educating / persuading the society to apply the activity/ making them interested in implementation of the activity, monitoring of activity application process, enforcement of the policy or regulations
Control of agricultural sources of pollution and implementation of duties of agricultural professionals.	Implementation of a program aimed at limiting of nitrogen outflow from agricultural sources.	Enhance and preserve water supply ESS	Educating / persuading the society to apply the activity/ making them interested in implementation of the activity, monitoring of activity application process, enforcement of the policy or regulations
Limiting fertilisation on wet, flooded, frozen, or snow covered soil.	Fertilisers may not be used on flooded, snow covered, or frozen soil.	Enhance and preserve water supply ESS	Educating / persuading the society to apply the activity/ making them interested in implementation of the activity, monitoring of activity application process, enforcement of the

			policy or regulations
Observing the storage conditions for natural fertilisers and handling of leachates.	Manure may be collected, fermented, and stored in animal houses or on dung plates with side walls. Floors of animal houses and dung plates should be protected against leakage to the ground and equipped with systems draining leakage to septic containers for dung and manure water. Manure may not be stored in field vents.	Enhance and preserve water supply ESS	Educating / persuading the society to apply the activity/ making them interested in implementation of the activity, monitoring of activity application process, enforcement of the policy or regulations
Compliance with the requirements for storage of mineral fertilisers.	Mineral fertilisers should be stored in their original packaging in closed storage or at least under a roof. The height of the stacks of fertiliser packages containing ammonium nitrate and ammonium fertilisers may not exceed 4 bags. Fertilisers supplied without package should be stored in storage or under a roof. Liquid fertilisers should be stored in original packaging or in tightly sealed containers intended for this role. Containers should be situated on a sealed plate with a capacity corresponding to the container capacity.	Enhance and preserve water supply ESS	Educating / persuading the society to apply the activity/ making them interested in implementation of the activity, monitoring of activity application process, enforcement of the policy or regulations
Compliance with fertilisation requirements	Natural and mineral fertilisers should be used in such a way and at such times so as to limit the risk of dislocation of the	Enhance and preserve water supply ESS	Educating / persuading the society to apply the activity/

	contained components (nitrogen and phosphorus in particular) into surface water and groundwater. Use of fertilisers may not cause a risk to human and animal health.		making them interested in implementation of the activity, monitoring of activity application process, enforcement of the policy or regulations
Use of proper fertilisation method in the vicinity of watercourses	Natural fertilisers should not be used within a distance of 20 m from water protection zones, reservoir edges and watercourses, swimming zones in surface waters, and coastal zones. Natural fertilisers in liquid form may be use if the groundwater level is below 1.2 m.	Enhance and preserve water supply ESS	Educating / persuading the society to apply the activity/ making them interested in implementation of the activity, monitoring of activity application process, enforcement of the policy or regulations
Inventory of groundwater intakes used for agricultural irrigation (concerning wells), control of water use from these intakes.	Creation of a database of wells used for agricultural irrigation, preparation of an annual report from measurements of each intake with a transfer to a proper authority to issue a water permit and Regional Water Management Board in order to account for the data in water and economic balance.	Enhance and preserve water supply ESS	Educating / persuading the society to apply the activity/ making them interested in implementation of the activity, monitoring of activity application process, enforcement of the policy or regulations

Obligation to dispose of dead animals at special disposal sites.	Dead animals left on the farm may cause water pollution. With the exception of individual poultry and small domestic animals, they may not be buried or stored w manure or compost pit. Dead animals must be immediately delivered to special disposal sites, preferably with a specialist transport vehicle.	Enhance and preserve water supply ESS	Educating / persuading the society to apply the activity/ making them interested in implementation of the activity, monitoring of activity application process, enforcement of the policy or regulations
Limiting the amount of liquid manure produced on the farm.	Efforts should be made to reduce the amount of liquid manure produced on the farm by minimising as much as possible the amount of water used to clean animal houses and limiting leakage from drinking water dispensers. Waste from domestic sanitation facilities should not be disposed in the liquid manure storage.	Enhance and preserve water supply ESS	Educating / persuading the society to apply the activity/ making them interested in implementation of the activity, monitoring of activity application process, enforcement of the policy or regulations
Proper disposal of silage juices.	Silage juices contain significant amounts of minerals, including nitrogen compounds. The outflow of juice to the surface waters results in their pollution and depletes the water of oxygen. Juices collected in wells should be poured in the fields or meadows from which the vegetative mass for silage came from.	Enhance and preserve water supply ESS	Educating / persuading the society to apply the activity/ making them interested in implementation of the activity, monitoring of activity application process, enforcement of the

			policy or regulations
Obligation to collect sewage in sealed containers in areas without sewage network.	Farms with individual water intakes should have a sealed container for temporary collection of liquid waste. The container should be equipped with a sealed lid with a lockable opening for waste removal. No-outflow containers should be emptied by slurry spreaders, and the contents delivered to the nearest sewage treatment plant.	Enhance and preserve water supply ESS	Educating / persuading the society to apply the activity/ making them interested in implementation of the activity, monitoring of activity application process, enforcement of the policy or regulations
Obligation to connect to a collective sewage network or to have a household waste treatment plant in areas with sewage network.	Farms equipped with a water supply line use much more water than farms using their own wells, which results in the increasing amount of waste water. These farms should be connected to a collective sewage network or have a household sewage treatment plant. Sewage should not be discharged directly in the surface waters or spilled into the fields.	Enhance and preserve water supply ESS	Educating / persuading the society to apply the activity/ making them interested in implementation of the activity, monitoring of activity application process, enforcement of the policy or regulations

Proper cleaning of agricultural machinery and equipment.	Machine and agricultural equipment washers should be constructed in a manner that prevents the penetration of harmful substances into the groundwater. The optimal solution is to construct a washer on a biological substrate with thickness of at least 50 cm, consisting of 50% of cut straw, 25% of high peat, and 25% of soil; with a 10 cm thick gravel drainage layer underneath. The surface of the substrate where the structure (ramp) protecting from damage from other equipment is located, should be planted with grass.	Enhance and preserve water supply ESS	Educating / persuading the society to apply the activity/ making them interested in implementation of the activity, monitoring of activity application process, enforcement of the policy or regulations
Compliance with the rules governing the use of chemical plant protection products in order to protect water resources from pollution.	The decision to use chemical plant protection products and the choice of the most appropriate one should be taken very carefully. Before use of the product, the instructions should be read carefully and understood. Products without original label - instructions of use - should never be used. Chemical plant protection products may be used with ground equipment, in the fields located at least 5 m from public roads and at least 20 m from buildings, allotments, apiaries, herbal plantations, nature reserves and parks, surface water coastal lines, and water protection zones.	Enhance and preserve water supply ESS	Educating / persuading the society to apply the activity/ making them interested in implementation of the activity, monitoring of activity application process, enforcement of the policy or regulations

Use of proper crop rotation.	Properly developed crop rotation limits the amount of mineral nitrogen leached from the soil during autumn and winter periods. On plains, ca. 60% of arable land, and on in areas with erosion risk at least 75% of arable land should be kept under plant cover throughout the year.	Enhance and preserve water supply ESS	Educating / persuading the society to apply the activity/ making them interested in implementation of the activity, monitoring of activity application process, enforcement of the policy or regulations
Compliance with the rules governing the proper grazing of animals.	Animals should not be grazed when the soil is excessively wet and after mid-October, as fertiliser components from faeces may seep into groundwater. In sheep grazing loose herding should be used, allocating 2-3 m2 of surface for 1 animal per day. Sheep should not be grazed in water intake areas, near watercourses and steep slopes.	Enhance and preserve water supply ESS	Educating / persuading the society to apply the activity/ making them interested in implementation of the activity, monitoring of activity application process, enforcement of the policy or regulations
Renewal of degraded grasslands.	Permanent grasslands with degraded sward should be renewed. The main way of renewal is reseeding, possibly with partial destruction of the old turf and the improvement or change of use and fertilisation methods.	Enhance and preserve water supply ESS	Educating / persuading the society to apply the activity/ making them interested in implementation of the activity, monitoring of activity application process, enforcement of the

			policy or regulations
Use of buffer strips along watercourses and lakes.	Permanent grasslands, located in the immediate vicinity of surface waters, in addition to their production functions must also protect these waters, forming buffer zones between arable land and waters. Particular care is needed in case of grasslands on muck and organic soils, which can easily degrade.	Enhance and preserve water supply ESS	Educating / persuading the society to apply the activity/ making them interested in implementation of the activity, monitoring of activity application process, enforcement of the policy or regulations

2.3. Urban and industrial areas

The list of the so called best practices in water protection in urban and industrial areas located within the Brynica River sub-basin upstream the Kozłowa Góra dam, was developed based on the activities outlined in the Regulation of the Council of Ministers on 18th October 2016 on the Water management plan for the Vistula river basin.

ACTIVITY	DESCRIPTION	ADVANTAGES	CHALLENGES
Optimisation of water consumption by limiting intake or construction of small retention reservoirs.	Limiting groundwater intake in areas of possible ascension and ingress of saline waters to a level enabling preservation of designated chemical composition of drinking water.	Enhance and preserve water supply ESS	Educating / persuading the society/ professionals to apply the activity/ making them interested in implementation of the activity, monitoring of

			activity application process, enforcement of the policy or regulations
Implementation of system tasks of waste management included in the waste management plans.	Modernisation/closure of municipal waste landfill /landfill monitoring.	Enhance and preserve water supply ESS	Educating / persuading the society/ professionals to apply the activity/ making them interested in implementation of the activity, monitoring of activity application process, enforcement of the policy or regulations
Annual reports concerning the measurement of groundwater use by the owner/user of the intake.	Preparation of a report on the volume of groundwater inflows to mining excavations and scale of their use on site and transfer of the report to the authority responsible for issuing the permit /preparation of annual report and survey of conducted measurements for each intake, including each of well and the transfer of the report to the authority responsible for issuing the permit.	Enhance and preserve water supply ESS	Educating / persuading the society/ professionals to apply the activity/ making them interested in implementation of the activity, monitoring of activity application process, enforcement of the policy or regulations
Optimisation of water consumption by the use of mining drainage water and surface	Development of an analysis concerning proper use of good quality water, e.g. water from mining drainage for municipal purposes.	Enhance and preserve water supply ESS	Educating / persuading the society/ professionals to apply the activity/ making them interested in

water.			implementation of the activity, monitoring of activity application process, enforcement of the policy or regulations
Optimisation of water consumption by national management of water intended for consumption.	Taking measures aimed at rational water management, including selective capture of good quality water in order to use it (depending on their suitability for drinking or e.g. for replenishing of water circuits in mechanical coal processing, for fire protection pipelines etc.)/limiting saline waters dumping after pumping them to the surface.	Enhance and preserve water supply ESS	Educating / persuading the society/ professionals to apply the activity/ making them interested in implementation of the activity, monitoring of activity application process, enforcement of the policy or regulations
Annual transfer of data on the status of excavation no longer exploited (conducted drainage, reclamation status, monitoring) by the mining plant director.	Preparation of an annual report concerning the amount of drainage, quality of drained water, manner of its use/monitoring of groundwater from reclaimed open mine and abandoned mining plant.	Enhance and preserve water supply ESS	Educating / persuading the society/ professionals to apply the activity/ making them interested in implementation of the activity, monitoring of activity application process, enforcement of the policy or regulations

Annual transfer of data on the scale of drainage and the range of depression crater by people who manage the plants conducting drainages on regional and local scale (deep and open mines).	Preparation of a report concerning the size of inflows to the excavation and the range of depression crater along with impact assessment.	Enhance and preserve water supply ESS	Educating / persuading the society/ professionals to apply the activity/ making them interested in implementation of the activity, monitoring of activity application process, enforcement of the policy or regulations
Reclamation of open mines in a manner limiting the risk towards the quality of groundwater.	Prohibition of reclamation with materials posing a risk to surface water and groundwater.	Enhance and preserve water supply ESS	Educating / persuading the society/ professionals to apply the activity/ making them interested in implementation of the activity, monitoring of activity application process, enforcement of the policy or regulations
Construction of individual sewage treatment systems.	Construction of individual sewage treatment systems.	Enhance and preserve water supply ESS	Educating / persuading the society/ professionals to apply the activity/ making them interested in implementation of the activity, monitoring of

			activity application process, enforcement of the policy or regulations
Construction of a new or modernisation of already present sewage treatment plant.	Construction of a new or modernisation of already present sewage treatment plant.	Enhance and preserve water supply ESS	Educating / persuading the society/ professionals to apply the activity/ making them interested in implementation of the activity, monitoring of activity application process, enforcement of the policy or regulations
Construction of new no-outflow reservoirs and overhauling existing ones.	Construction of new no-outflow reservoirs and overhauling existing ones.	Enhance and preserve water supply ESS	Educating / persuading the society/ professionals to apply the activity/ making them interested in implementation of the activity, monitoring of activity application process, enforcement of the policy or regulations
Construction or modernisation of sewage network.	Construction or modernisation of sewage network.	Enhance and preserve water supply ESS	Educating / persuading the society/ professionals to apply the activity/ making them interested in implementation of

			the activity, monitoring of activity application process, enforcement of the policy or regulations
Obligation to regularly dispose of liquid waste.	Obligation to regularly dispose of liquid waste.	Enhance and preserve water supply ESS	Educating / persuading the society/ professionals to apply the activity/ making them interested in implementation of the activity, monitoring of activity application process, enforcement of the policy or regulations
Closure of the obsolete sewage treatment plants.	Closure of the obsolete sewage treatment plants.	Enhance and preserve water supply ESS	Educating / persuading the society/ professionals to apply the activity/ making them interested in implementation of the activity, monitoring of activity application process, enforcement of the policy or regulations
Searching and documenting alternative sources of drinking water.	Construction of dispersed groundwater intakes (including a water supply system) within groundwater body (GWB)/water transfer from neighbouring GWB.	Enhance and preserve water supply ESS	Educating / persuading the society/ professionals to apply the activity/ making them

			interested in implementation of the activity, monitoring of activity application process, enforcement of the policy or regulations
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2.4. Flood mitigation

The list of the so called best practices in flood protection within that Brynica river sub-basin, upstream the Kozłowa Góra dam, was developed based on Instrukcja utrzymania i eksploatacji. Zbiornik wodny Kozłowa Góra w Wymysłowie (Maintaining and operating instruction. Kozłowa Góra reservoir in Wymysłów) and according to the guidelines of the Water Law Act of 18th July 2001 (Journal of Laws No. 115, item 1229).

ACTIVITY	DESCRIPTION	ADVANTAGES	CHALLENGES
Functioning of the Kozłowa Góra reservoir	Location of the Kozłowa Góra reservoir that serves, among others, as flood protection. The reservoir is operated according to strictly determined procedures that include actions in case of a flood.	Flood mitigation	Cost of operating of the reservoir, conflict between water supply and flood mitigation functions of the reservoir
Determination of actions in the event of a flood in the Kozłowa Góra reservoir	So called “rigid” water management instructions in the Kozłowa Góra dam reservoir have been developed. They provide instructions for actions in case of a flood.	Flood mitigation	Cost of operating of the reservoir, conflict between water supply and flood mitigation functions of the reservoir

Activity of the Flood Protection Coordination and Information Center (OKI, Ośrodek Koordynacyjno - Informacyjny Ochrony Przeciwpowodziowej) operating by the Regional Office for Water Management (RZGW) in Gliwice	The goal of OKI activities is to collect, process and share information regarding flood protection.	Flood mitigation	Reaction time for endanger of flood event, data exchange between OKI and reservoir management
Hydrological and meteorological forecasting and warning	All the activities that provide information on the current and anticipated hydrological and meteorological conditions, in particular on the observed or anticipated course of hazardous meteorological or hydrological phenomena, such as floods.	Flood mitigation	Reaction time for endanger of flood event, data exchange between authorities/ responsables and reservoir management
Preservation of levees	Levees, located along the riverbanks, separate the flood hazard areas from the neighbouring territories, thus mitigating the effects of floods.	Flood mitigation	Educating the society of the role of levees, enforcement of the policy or regulations

3. Conclusions

In Poland there is a number of best practices, included in national strategies and legislation, in order to minimise the negative impact of agriculture and industry which should be applied but the implementation level is hard to evaluate.

Sustainable management of the sub-basin area constitutes a significant challenge, especially in urban and agricultural areas. The latter requires cultivation and use of various fertilisers and may have a negative impact on water quality. Development of industrial plants and road networks increases the potential for polluting the waters. All activities in the reservoir sub-basin area should be focused on monitoring, planning, and management (Gunkel G., do Carmo Sobral M., 2007).

The monitoring aspect should include the collection of data on water availability, water requirements, and water quality, but also the monitoring of the level of the groundwater table. Moreover, new monitoring points should be created for a representative assessment of water and soil quality in areas where existing networks are poorly constructed and hydrological databases should be developed using modelling and spatial analysis. A good management in the sub-basin should also include the development of predictive tools. Such models may provide knowledge concerning water quality and valuable information on water management.

Planning should include two stages related to diagnostics of the actual situation and definition of future activities. Plans should primarily include information about financial and economic instruments (Tortajada C. and Contreras-Moreno N., 2005).

Management should be based on the construction and maintenance of water. In general, for different forms of water use, the principle of rational water management should be used by all new users, and a runoff from urbanised sub-basins should be used and treated with modern purification technologies. In relation to already existing water users, the pursuit of rational water use should be achieved through the ability to verify water permits and regulation of system of water use charges.

The Kozłowa Góra Pilot Action is a great example of a conflict area, where reservoir administration and authorities have to balance between two main function of the reservoir: flood mitigation and water supply.

However, the biggest challenge is cooperating with society. It seems that education the society how their activities, like agriculture, inappropriate waste water management etc., may impact, both, water quality and quantity, and enforcement of regulation and policy concerning best practices could be a milestone in preserving drinking water resources.

4. References

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