Remediation of post-lignite mining land by cultivation of industrial hemp

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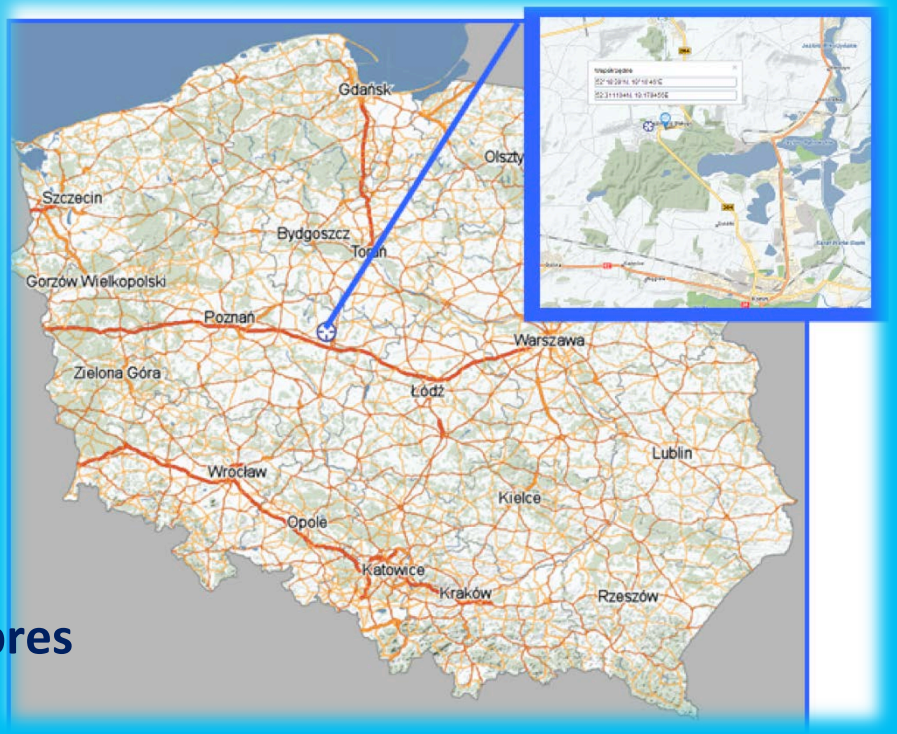
Life+ is the only financial instrument of the European Union that concentrates exclusively on co-financed project in environmental protection. Its main goal is support to the process of implementation of common environmental protection regulations and identification and promotion of new solutions for environmental protection.

The project **„Remediation Method of Degraded Land by Cultivation of Industrial Hemp in The Region of Lignite Mine Konin”**, led by Institute of Natural Fibres and Medicinal Plants in Poznań, started on 01. October 2012.



DURATION: Start: 01/10/2012
End: 30/09/2018

PROJECT LOCATION:
Kazimierz Biskupi

PROJECT'S IMPLEMENTORS:

Project Coordinator: Institute of Natural Fibres & Medicinal Plants

Associated Beneficiary(ies): Cooperative Agricultural Farmers in Kazimierz Biskupi

Lignite mining in Poland covers approximately **16 000 ha** while the area of land degraded as a result of open mining activity is over **67 000 ha** (GUS).

Annual output of lignite mining is about **60 million tons.** This amount covers 35% of electricity produced in Poland.

For comparison, the global production of lignite is **880 million ton.** The biggest producers are Germany –175 million tons, Russia –83 million tons, Australia – 175 million tons, Greece – 63 million tons, Poland – 83 million tons and Turkey – 57 million tons.

Mining of lignite in Poland is conducted by open mining method. This is connected with vast negative transformations in natural environment.

Lowering the water level causes drying of watercourses, ponds and falling of water in lakes and wells. Also areas adjacent to the excavation site get dry.

After drying, the overburden, i.e. the layer with a thickness of several tens of meters of rock material, including the infrastructure, vegetation and soil is removed. This is followed by coal mining. When mining is terminated, a dead excavation is left, that, as the mining is progressing following the deposit, is being filled with the overburden material.

The surface is leveled but the top layer misses the fully developed soil layer as the content of humus is traces only.

Remediation of degraded land in the area of Kazimierz Biskupi is conducted by cultivation of industrial hemp and alfa-alfa.

Industrial hemp are the plants producing big amounts of biomass.

Besides hemp the alfa-alfa will be used in the Project. As plant belonging to *Papillionaceae* family is able to live in symbiosis with *Rhizobium* bacteria which can fix nitrogen from the atmosphere.

Objectives of the project:

1. Accelerated agricultural remediation of post mining areas

Accelerated agricultural remediation will be conducted on the area of 25 ha on post mining areas left after closing of lignite strip mine (LSM Konin) in Kazimierz Biskupi, wielkpolskie district. Time of remediation implementation – 6 years.

2. Development of a novel, environmentally sound technology of hemp straw processing.

3. Dissemination of the degraded land remediation model and a novel, environmentally sound technology of hemp straw processing in Poland and EU.

Besides Poland, lignite is being mined in the following countries of the EU: Germany, Czech Republic, Slovakia, Hungary, Greece, Romania and Slovenia.

There are evidences showing that most of the costs resulting from soil degradation is not born by the direct users but, in many cases, by whole societies and bodies located in considerable distance from the location of the problem.

EXPECTED RESULTS:

1. Model remediation of about 25 ha of post mining land by accelerated innovative method of biological composite.

2. Humus content increase in soil by about 20-50% in 6th year of the project.

3. Yield increase of cultivated crops (hemp from 2 t/ha in 1st year of the project to 5-7 t/ha in 6th year and alfalfa from 1 t/ha in 1st year of the project to 7-10 ton/ha in 6th year.

4. Atmospheric CO_2 absorption increase by plants from 1 t/ha in 1st year of the project to 2 t/ha in 6th year. Use of a free insolation.

5. Creation of favorable habitats for birds and pollinating insects.

The result of the second goal will be development of environmental friendly technology. The technology will be demonstrated to potential interested organizations. It will also be used to train young people getting their professions the environmental friendly processing of agricultural and energy yielding raw materials.

Fibrous hemp is one of the oldest cultivated plants. It is a crop of high biological plasticity. It can grow in different geographical and climatic conditions. Hemp is an annual plant with high yields of dry matter. Stems are high, reaching **3-4 m**. Hemp stems have tube-like shape with a void channel inside.

To prevent such a tall stems from breaking the nature gave the hemp ability to produce long and strong cellulosic fibres creating a strong structure inside the plant. **Long fibres are surrounded by the hemicellulose and lignin polymers.** play the role of truss cross brace and make the whole structure a strong and durable. Additionally the structure is bonded with pectin. Cellulose and accompanying substances content in dry matter of stems is **70-75%.**

Hemp has strong tap root system growing 1,0-1,5 m deep in the soil. Strong root system produces vertical channels in compacted layer of loam and clay when plant senesces.

After mowing and ploughing down into the soil, the hemp plants become the biological scaffold promoting development of soil flora and fauna.

Alfalfa

Another crop that is used in the project is alfalfa which as a plant belonging to *Papilionaceae* family is capable of symbiosis with Rhizobium bacteria which can fix the nitrogen from the atmosphere. Fixed nitrogen is used by the host plant for protein synthesis. The significant surplus of nitrogen is emitted to the soil and can be used by other crops grown together with alfalfa or as succeeding crop in the crop rotation.

Combination of hemp yielding high yield of cellulose which contains carbon, oxygen and hydrogen with alfalfa producing considerable amounts of nitrogen thanks to *Rhizobium* bacteria consists a sort of "**biological composite**". This facilitates quick forming of humus which is one of the main goals of the project.

Preparatory work was conducted comprising removal of bushes weeds and stones which made the preparation of the soil for sowing difficult.

Next the pre-sowing agronomic treatments were conducted namely:
- disc harrow treatment – three times.
- ploughing.
- treatments drying the soil and pre-sowing treatments.

Following field preparation the lime was applied at 6 tons/25 ha followed by mineral fertilizers application (NPK) in accordance with fertilization plan in the first year of the project:

- application of N in the hemp fields at 150 kg N/ha
- application of N in the alfa-alfa fields at 40 kg N/ha
- application of P at 150 kg P2O5/ha
- application of K at 215 kg K /ha

Seeds of alfa-alfa were dressed with nitragine (Rhizobium meliloti) before planting followed by sowing of hemp and alfa-alfa in earlier prepared fields.
Hemp was planted at total area of 12 ha at 42 kg of seeds/ha. while alfa-alfa – on 13 ha at 25 kg/ha.

October 4th, hemp was mowed. Mowing was conducted using a mower pulled by the tractor, equipped with three knives cutting the stem into three sections. This facilitates later plowing the biomass down. Working width of the mower is 4 m and it is able to mow 3-4 ha/h.

The amount of biomass produced per ha of remediated land was determined

	Field 1	Field 2
The amount of biomass produced per ha of remediated land was determined kg/ha	hemp	
	1 818	2 511
	alfalfa	
	843	1 049

October 14th, the mowed biomass was sprayed with a product accelerating decomposition of mowed biomass. The operation was conducted only in the smaller field to investigate its action. The treatment was conducted before plowing at the dose of 60 dm3/ha.

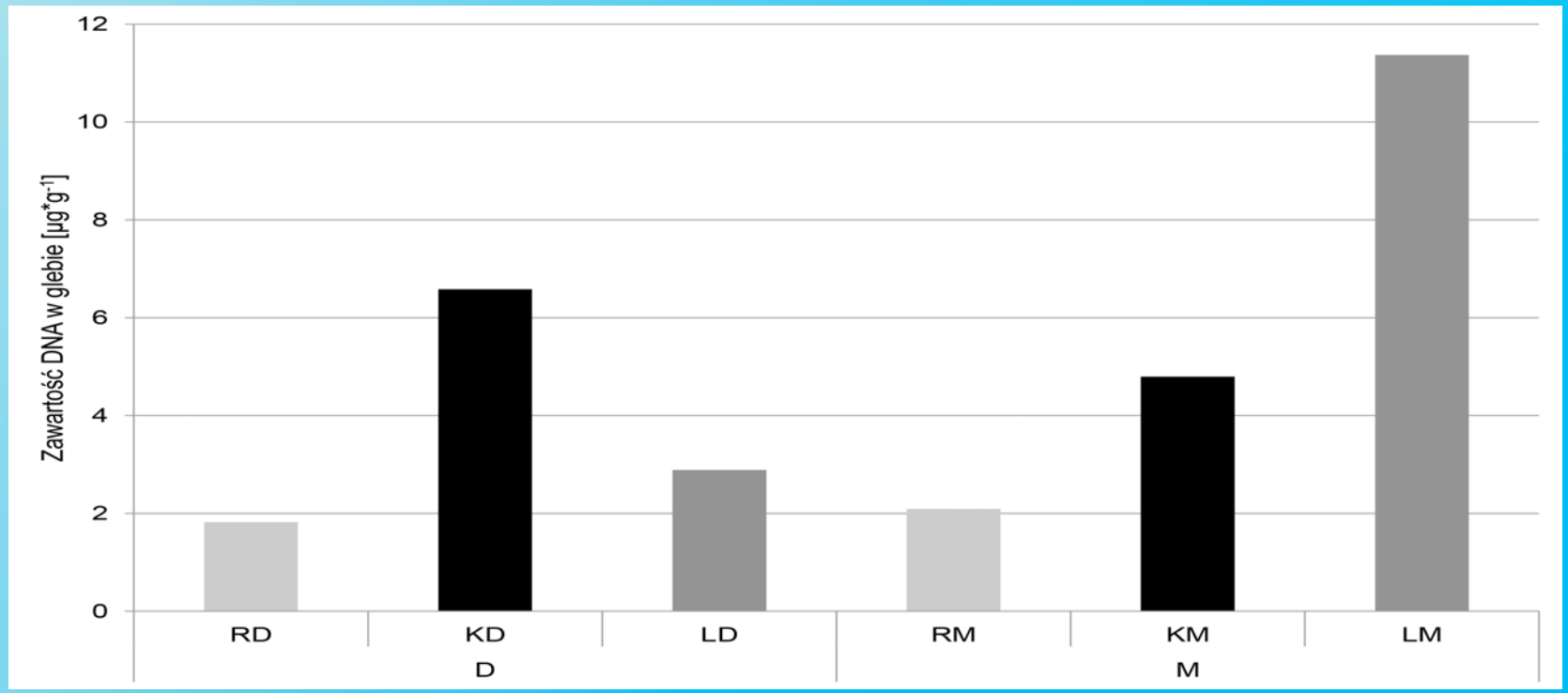
Humus content in the soil after a year of remediation

Field	Sample	Humus level [%]		Humus level changes in 2013-2014 [%]
		January 2013	January 2014	
I	1	1,30	1,91	31
	2	1,51	2,16	30
II	1	1,48	1,77	16
	2	0,76	0,98	22

Soil sampling

The DNA content in the soil depending on the site and grown crop

D – field II, M – field I, RD, RM – control on the site, K – hemp on the site, L – alfalfa on the site.



Spectrometric analysis shows that both sites differed significantly in terms of the content of humus substances. Soil in the field I contained almost three times more humus acids as compared to the field II. However, this higher content is less than 50% of humus compounds in cultivated soils.

Land before reclamation

First year or reclamation

THANK YOU FOR YOUR ATTENTION !!!