Raising the Bio-based Industrial Feedstock in Marginal Lands

Monitoring of Environmental Impact

D4.1.

Date: 31. January 2024

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Funded by the European Union

Technical References

Project Acronym	MarginUp!
Project Title	Raising the bio-based industrial feedstock capacity of Marginal Lands
Grant Number	101082089
Project Coordinator	Philipp Grundmann Leibniz Institute for Agricultural Engineering and Bioeconomy (ATB) Email: marginup@atb-potsdam.de; pgrundmann@atb-potsdam.de
Project Duration	December 2022 – November 2026

Deliverable No.	4.1.
Dissemination level [1]	PU
Work Package	WP4
Task	4.1.
Lead beneficiary	ATLANTIS
Contributing beneficiary (ies)	Use case leaders: CICYTEX, RISE, CLuBE, INOMINE, ATB
Due date of deliverable	31. January 2024
Actual submission date	31. January 2024

[1] PU = Public
PP = Restricted to other programme participants (including the Commission Services)
RE = Restricted to a group specified by the consortium (including the Commission Services)
CO = Confidential, only for members of the consortium (including the Commission Services)

Document history

V	Date	Beneficiary	Author/Reviewer
1	09. January 2024	ATLANTIS	Charalambos Panayiotou, Panagiota Venetsanou
2	10. January 2024	SU	Romain Pirard
3	12. January 2024	ZALF	Michael Glemnitz
4	17. January 2024	ATLANTIS	Charalambos Panayiotou, Panagiota Venetsanou

5	19. January 2024	ZALF	Michael Glemnitz
6	25. January 2024	SU	Romain Pirard
7	29. January 2024	ATLANTIS	Charalambos Panayiotou, Panagiota Venetsanou
8	31. January 2024	ATB	Philipp Grundmann, Thi Huyen Trang Dam

MarginUp! in a nutshell

MarginUp! is developing sustainable and circular value chains to produce bioproducts and biofuels in innovative business models from natural raw materials grown on marginal lands. In the project, climate resilient and biodiversity-friendly non-food crops will be introduced on marginal and low-productivity lands, not competing with food crop production. To further improve biodiversity and environmental benefits, MarginUp! will contribute on understanding which marginal lands are suitable, with regards to the lowest impact for indirect land-use change (ILUC) biomass production. The project will identify good practices for sustainable biomass production and bio-based products that safeguard biodiversity and local ecosystems. All this will be done in close collaboration with land managers, farmers, and stakeholders from the growing bioeconomy industry.

Hence, MarginUp! is expected to provide viable outcomes to ecosystems degraded by e.g. water-stress or desertification due to human activity and/or climate change. The project will also contribute to restoration and stimulation of ecosystems in abandoned mine lands, as well as boosting land yield and health in low productivity marginal lands. Through this innovative approach, MarginUp! will increase farming system resilience, enhance rural areas, and promote stakeholder participation.

MarginUp! is building on learnings from seven use-cases: Five implementations across Europe (Spain, Greece, Sweden, Germany, and Hungary), and two use-cases in Argentina and South Africa, together increasing the replication potential of the project's results. Each use-case considers the current use and properties of its area and proposes crops and crop rotation strategies that promote biodiversity and increase soil productivity according to local requirements of Mediterranean soils in Spain, mining lands in Greece, boreal soils in Sweden, wetlands in Germany, lands exposed to desertification in Hungary, degraded pastures in Argentina, and areas with invasive bush species encroachment in South Africa. The proposed crops create a sustainable supply of resources to foster the development of the bioeconomy businesses at local and regional levels while providing ecosystem benefits and building resilience to climate change.

On this basis, the MarginUp! project will enhance European industrial sustainability, competitiveness, and resource independence, by reducing the environmental footprint, considering biodiversity aspects, enabling climate neutrality and increasing resource efficiency (particularly through upcycling and cascading use of biomass) along different value chains in seven use-cases including enhanced technologies and business models for innovative bio-based products that will lessen EU reliance on fossil-based products.

To stay up to date with MarginUp! project events and reports, follow us on Twitter (@MarginUp_EU), LinkedIn (MarginUp! EU) or visit www.margin-up.eu.

Summary

This report constitutes the first draft of the MarginUp! Monitoring Plan and will serve as the basis and guidance for the project partners. The sampling locations, sampling frequency and parameters are suggested. The guidelines are based on scientific protocols and methods. The soil and water monitoring will be conducted in the beginning and the end of each pilot site. The other parameters under study will be recorded monthly during the pilot implementation.

The investigated parameters will be evaluated prior to the beginning and the end of each pilot. The evaluation of the beginning of the pilot will be referred to as the Baseline of each Use Case and will be compared against the results at the end of the pilot to identify and quantify the impacts caused by the project activities.

Disclaimer

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List of Acronyms

UC	Use case
KPIs	Key Performance Indicators
LCA	LIFE Cycle Assessment
SOM	Soil Organic Matter

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- Environmental Monitoring
- Use Cases
- Sampling
- Chemical analysis

1. Introduction

The main objective the MarginUp! project is to raise the potential for biodiversity enhancement and the production of bio-based industrial feedstocks on marginal lands. The project is coordinated by the Leibniz Institute of Agricultural Engineering and Bioeconomy (ATB) and brings together 29 partners from eight different European countries and two international partners (Argentina and South Africa) from across the agriculture and bio-economy sectors.

MarginUp! will develop sustainable and circular value chains to produce bio-products and biofuels from natural raw materials grown on marginal lands. By introducing climate resilient and biodiversity-friendly non-food crops on marginal and low-productivity lands, MarginUp! will increase farming system resilience, enhance biodiversity, and promote stakeholder participation.

WP4 concerns the Environmental Impact Assessment of the MarginUp! project. The objectives of WP4 are:

- *To assess the environmental impacts of the new industrial feedstocks*
- *To assess potential environmental and socioeconomic impacts of upscaling and replication of the Margin Up*
- *To verify and demonstrate the environmental and socioeconomic benefits to promote the bio-products and biofuels from natural raw materials grown on marginal lands.*

To monitor the environmental impact of new cropping systems, a list of Environmental Key Performance Indicators (KPIs) has been defined based on anticipated impacts and includes Inputs (Energy / fuel use, water footprint, Fertilisers, and other inputs), Impacts (Soil quality and land degradation risk, biodiversity / ecosystem indicators, water quality of runoff from the pilot areas) and Outputs (Biomass produced, volume and type of waste streams).

This report constitutes the first draft of the MarginUp! Monitoring Plan and will serve as the basis and guidance for the project partners. A monitoring guide for each pilot Use Case is presented. The sampling locations, sampling frequency and parameters of interest are defined.

The monitoring guide is based on widely accepted and used standards and methodologies for data collection, analysis, and interpretation.

The Monitoring results will initially contribute to the assessment of the potential environmental impacts of the Margin up project. Last, but not least, some of the data collected by the Monitoring will be used as input data to the Life Cycle Assessment (LCA).

2. Methodology

This Section describes the methodology suggested for implementation of the Margin up! Monitoring Plan. The aim of the Plan is to investigate environmental parameters regarding soil and water quality, and biodiversity as well as parameters relevant to resource consumption, energy, and waste, such that a holistic picture of the sustainability of the project's activities can be assessed. Selection of parameters and indicators, as well as sampling and analysis methods have been based on widely used standards and protocols. To facilitate the assessment of impacts caused by the pilot activities, the parameters under study will be evaluated prior to the beginning and the end of each pilot. The evaluation of the beginning of the pilot will be referred to as the Baseline of each Use Case and will be compared against the results at the end of the pilot to identify and quantify the impacts caused by the project activities.

2.1. Soil Quality

The chemical and physical conditions of soil are key determinants of soil productivity and environmental quality. Hence, monitoring soil quality is an essential component of soil resource management. In the framework of the MarginUp! Project soil physical and chemical properties relevant to the project activities will be investigated.

Monitoring will be implemented during the pilot implementation period in each of the use case areas. The results will be used for the purpose of assessing positive and negative impacts on soil quality resulting from the pilot activities' implementation. It also should be mentioned that if pilot activities take place in more than one location, the sampling should be conducted at the beginning and end of pilot activities, respectively, at each site.

2.1.1. Sampling

Soil sampling should be performed with a hole auger digger (Figure 1) or similar equipment, at the depths of 10 cm and 50 cm. The sampling points are depicted on Figures 4-10. The final sample will be stored in a clean plastic bag (1 kg) and transported to a chemical certificated laboratory. Each bag should be marked with a unique number to identify the sample. More details about the soil sampling are given in the FAO Operating Procedure for handling and preparation of soil samples for chemical and physical analysis[1].

[1] FAO Operating Procedure for Soil Samples: www.fao.org/3/ca8283en/ca8283en.pdf

Figure 1: The manual hole auger digger

A Sampling Data Form will be filled in during each campaign. The form will include the following information:

- *Number of the sample (same number as marked on the sampling bag.)*
- *Name of person performing the sampling*
- *Sampling date*
- *Sampling location and depth of sampling*
- *Picture of the sampling point*

The Figure below illustrates an indicative data collection Sampling Data Form.

Data Collection Reporting Protocol

Date and time:	
Staff responsible:	
General Description	**Location (Map)**
Equipment used	
Environmental conditions	
Pictures	

Figure 2: The sampling collection form

The following Investigations will be made by a certified chemical laboratory:

2.1.2. Monitoring Parameters

2.1.2.1. Soil Texture

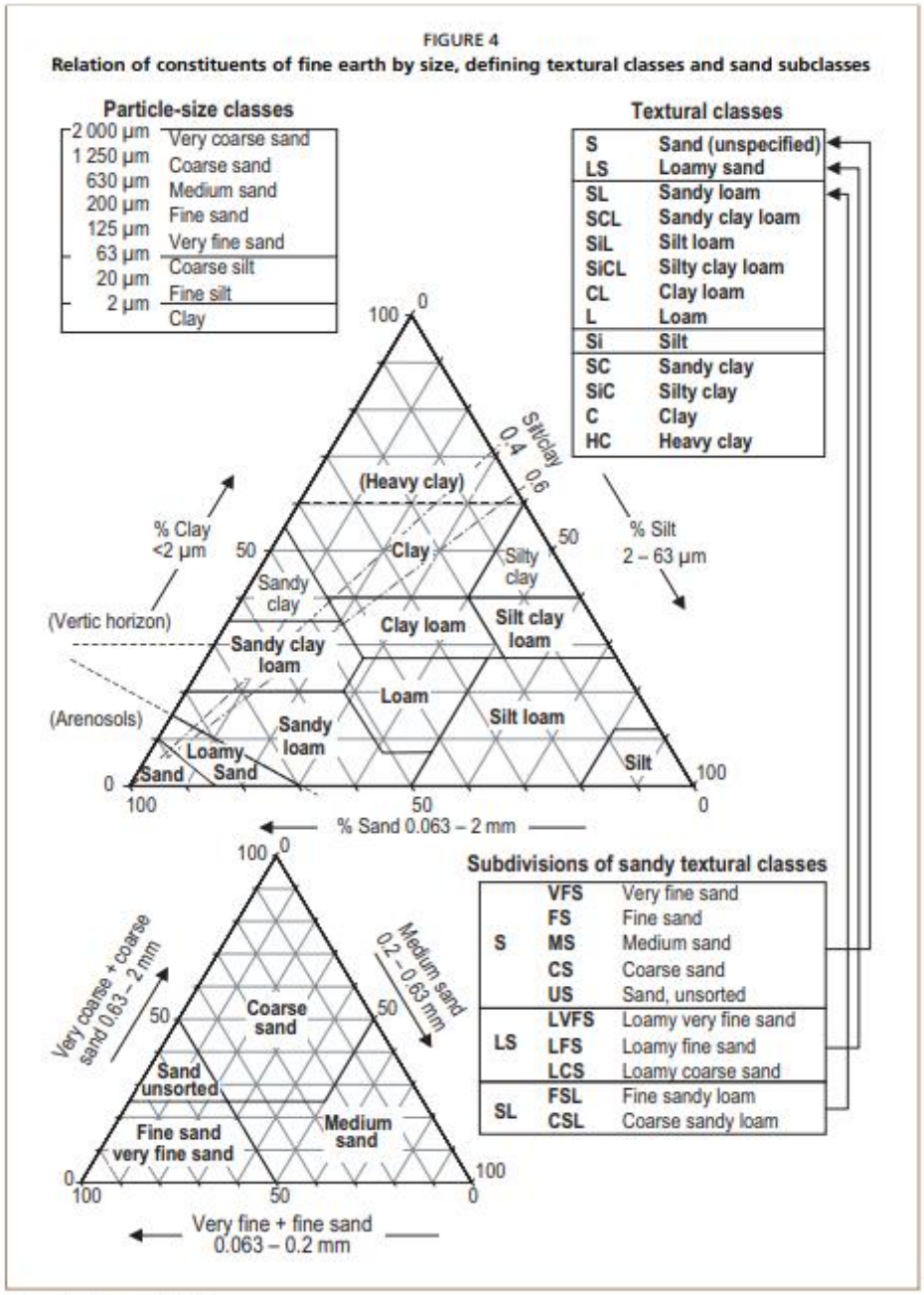
The grain size analysis of soil samples is used for the soil texture classification. The purpose of grain size analysis is to derive the particle size distribution of soils. The analysis is conducted via two techniques. Sieve Grain Size Analysis can determine the particles' size ranging from 0.075 mm to 100 mm. Any categorization of grains larger than 100mm will be conducted visually whereas particles smaller than 0.075 mm can be distributed using the Hydrometer Method. The grain size analysis can provide valuable insights about the soil permeability.

A detailed description of these techniques is given in the report of the FAO titled Guidelines Soil Description2. The soil texture will be analyzed once (at the beginning of each pilot).

Based on the Grain Size analysis results, the texture classes are estimated by the following diagram (Figure 3).

Table 8 in ANNEX I presents the Table with the Grain Size results that should be filled out and submitted.

[2] FAO Guidelines Soil Description: https://www.fao.org/3/a0541e/a0541e.pdf



Source: According to FAO (1990)

Figure 3: The soil texture classes based on FAO[3]

[3] Soil texture classes: https://www.fao.org/3/a0541e/a0541e.pdf

2.1.2.2. Organic Mater

Soil organic matter (SOM) is the organic matter component of soil, consisting of plant and animal detritus at various stages of decomposition, cells and tissues of soil microbes, and substances that soil microbes synthesize. SOM provides numerous benefits to the physical and chemical properties of soil and its capacity to provide regulatory ecosystem services. SOM is especially critical for soil functions and quality.
An indicative field method to estimate the soil organic matter is given [4].
Table 9 in ANNEX I presents the Table with the Grain Size results that should be filled out and submitted (if applicable).

2.1.2.3. Soil Chemistry

Soil chemical analysis should be conducted. Soil chemistry is an important indicator of the ecological conditions. Its purpose is to determine the content of plant nutrients, micronutrients, and other physical characteristics.
The proposed parameters and methods and thresholds for soil chemical analysis measured in certified laboratory are presented in ANNEX II. The soil chemical analysis will be carried out at the beginning and the end of each pilot.

2.2. Water Quality

Water quality monitoring is accomplished by groundwater and surface water sampling. They provide useful information about the hydrological and hydrogeological conditions of the areas of interest.

2.2.1. Groundwater Quality

To evaluate the groundwater quality, groundwater samples will be collected from boreholes which are located within of in the vicinity of the case study areas (at a maximum distance of 1 km from the pilot). The groundwater quality will be investigated at the beginning and end of each pilot site. In the case study areas where there are no boreholes already established, this part of the analysis will be omitted.
Groundwater will be collected using a water sampler or by filling in a container from flowing water (if present). It is suggested that 1.5 liters of water are collected. The samples can be stored in a plastic or glass container (bottle). Each bottle should be marked with a unique number to identify the sample. The bottle should be rinsed with the drilling water before collecting the final sample. It is suggested to keep the samples bottles in an insulated container during their transportation to the laboratory.
The proposed method is based on the United Environmental Protection Agency document (Groundwater Sampling, Operating Procedure[5].
A sample collection form will be filled (Figure 2). It will include the following information:

[4] Soil Organic Matter: https://www.nrcs.usda.gov/sites/default/files/2022-09/Estimated_Soil_Organic_Matter__Field_Method.pdf

[5] USEPA Groundwater sampling Operating Procedure

- *Number of the sample (same number as marked on the bottle)*
- *Name of person performing the sampling*
- *Samling date*
- *Sampling location and depth of borehole*
- *Sampling depth*
- *Picture of the borehole*

ANNEX III contains the proposed parameters and analysis methods. Analysis should be conducted by a certified laboratory.

The following parameters will be measured in situ:

- *pH*
- *Temperature*
- *Conductivity*
- *Turbidity*

2.2.2. Surface Water Quality

Surface water quality assessment focuses on the lakes, or river that are found within or near the pilot case study areas (at a maximum distance of 1 km from the pilot). In the case study areas where there are no lakes or rivers, this part of the analysis will be omitted.

The surface water sampling will be carried out at the beginning and the end of each pilot site.

Surface water will be collected using a water sampler or by filling in a container from flowing water (if present). It is suggested that 1.5 liters of water are collected. The samples can be stored in a plastic or glass container (bottle). Each bottle should be marked with a unique number to identify the sample. The bottle should be rinsed with the drilling water before collecting the final sample. It is suggested to keep the samples bottles in an insulated container during their transportation to the laboratory.

The proposed method is based on the United Environmental Protection Agency document (Surface Water Sampling Operating Procedure)6.

A sample collection form will be filled (Figure 2). The form will include the following information:

- *Number of the sample (same number as marked on the bottle)*
- *Name of person performing the sampling*
- *Samling date*
- *Sampling location*

[6]Surface Water Sampling, Operating Procedure: https://www.epa.gov/sites/default/files/2015-06/documents/Surfacewater-Sampling.pdf

- *Picture of the lake*

ANNEX IV presents the proposed parameters and methods (the partners can also choose another certified method) for the groundwater chemical analysis measured in certified laboratory.

The following parameters will be measured in situ:

- *pH*
- *Temperature*
- *Conductivity*
- *Turbidity*

2.3. Weather Data

To investigate the climate conditions of the Use Cases, the meteorological data will be derived from the closest public weather station to the pilot. Knowing climate conditions at the time of monitoring facilitates the interpretation of results.
The following are suggested:

- *Temperature, rainfall, presence of frost at the day of sampling.*

Monthly data over the period of the pilots will be collected for the following parameters:

- *Number of days with frost*
- *Number of days with precipitation*
- *Mean, maximum, minimum Temperature (ºC)*
- *Rainfall (mm) (maximum, minimum and monthly)*
- *Mean and maximum wind speed (m/sec)*
- *Wind Direction (predominant*

2.4. Land Use Management

The following parameters will be recorded monthly during the pilot implementation:

2.4.1. Resource Consumption

- *Use of fertilizers: name, composition, quantities applied, application dates, application method.*
- *Use of herbicide/pesticides: name, composition, dose, dates of application, BBCH at application (if possible!), which is very useful to identify the phenological development stages of plants and application frequency.*
- *Water management (irrigation): Quantity, application dates, duration of irrigation, irrigation method, method to determine need for irrigation.*

2.4.2. Solid and Hazardous Waste

The following waste streams will be monitored:

- *Agricultural waste: plant residues from agriculture that are not used for human or animal food. Crop residues consist mainly of stems, branches (in pruning), and leaves.*
- *Solid waste materials (plastics, glass, wood, metals, spent consumables, equipment, etc)*
- *Chemicals (pesticides, fertilisers, oils, cleaning materials, etc)*

For each waste stream, the following will be recorded.

- *Quantity (monthly)*
- *Method of storage on site*
- *Method of disposal / management*

2.4.3. Energy

The following will be monitored during the pilot:

- *Monthly fuel consumption by fuel type (petrol, gas, wood, other…) (kg / month)*
- *Monthly electricity consumption (kWhrs)*

2.5. Biodiversity

Biodiversity data will be provided by WP2. More details about the Biodiversity Monitoring are presented in Deliverable D2.3.

Plant coverage will be calculated at the beginning and end of the pilot period utilizing satellite data and pictures. The satellite data will be compared to the respective data from the previous season.

3. Use Case Pilots

The following section provides customized information for each of the MarginUp! Use Case Pilots. More specifically, the locations of monitoring stations are indicated.

As already noted, monitoring will be implemented during the pilot implementation period in each of the use case areas. It also should be mentioned that in case that pilot activities take place in more than one location, baseline and end of project sampling should be conducted at the beginning and end of pilot activities, respectively, at each site.

3.1. Greek Use Case

In the pilot area, is going to installed Intercropping of perennial woody species (e.g., pseudoacacia and poplar) and indigenous herbs. (e.g., camomile, mountain tea, lupin and lavender). Details about Greek pilot's location are provided by CLUBE.
The detailed methodology for Environmental Monitoring Plan is described in Section 2.
The following Table and Figure depict the proposed Greek sampling point locations.

Table 1: The sampling point locations

Coordinates of sampling points	Longitude	Latitude
Sampling Point 1	40°27'09.08''N	21°49'17.99''E
Control Point	64°41'05.56''N	20°32'46.35''E

Two soil samples will be collected. Sampling Point 1 refers to a point inside the pilot. Control point is a point located outside the pilot but will be used to investigate the Margin up! Environmental impacts on the surrounding area.
No presence of drainage network or lakes close to the pilot. In case a borehole is present (at maximum distance of 1 km), please add its location on the Table above.

Figure 4: The sampling points for Greek use case

The proposed parameters for the soil and groundwater monitoring are presented in ANNEX I-III. Monitoring results should be filled out on the Table.

Data on energy consumption, waste material, water use/irrigation, Land use management, weather conditions and biodiversity will be recorded on the Table presented in ANNEX V.

3.2. Swedish Use Case

The concrete plot for Swedish Pilot will be relocated every year since it is an annual crop and part of a multi-annual crop rotation. Details about Swedish pilot's location are provided by RISE. The detailed methodology for Environmental Monitoring Plan is described in Section 2.

The following Table and Figure depict the proposed sampling points locations for the first site of the pilot.

Table 2: The sampling points for the first location

Coordinates of sampling points	Longitude	Latitude
Sampling point 1	64°41'10.64''N	20°32'45.61''E
Control point	64°40'07.90''N	20°32'34.95''E
Sampling Point 2	64°40'58.51''N	20°32'54.07''E

Two soil samples will be collected. Sampling Point 1 refers to a point inside the pilot. Control point is a point located outside the pilot but will be used to investigate the Margin up! Environmental impacts on the surrounding area.

Sampling point 2 refers to the surface water sampling (in case of water flow).

In case a borehole is present (at maximum distance of 1 km), please add its location on the Table above.

Figure 5: The sampling points for Swedish use case (first site)

The following Table and Figure depict the proposed sampling points for the second location of the pilot.

Table 3: The sampling points for the second site

Coordinates of sampling points	Longitude	Latitude
Sampling point A1	65°21'22.16"N	21°22'57.43"E
Sampling point B1	65°21'42.92"N	21°23'15.86"E
Control point	65°21'35.31"N	21°23'3.80"E

Three soil samples will be collected. Sampling Point A1 and B1 refer to points inside the pilots. Control point is a point located outside the pilot but will be used to investigate the Margin up! Environmental impacts on the surrounding area.

In case a borehole is present (at maximum distance of 1 km), please add its location on the Table above.

Figure 6: The sampling points for Swedish use case (second site)

3.3. Hungarian Use Case

The aim of this use case is to develop a new raw material, recipe, and formulation for oyster mushroom substrate. Details about Hungarian pilot's location are provided by INOMINE. The detailed methodology about the Environmental Monitoring Plan is described in Section 2.
The following Table and Figure depict the proposed sampling points locations.

Table 4: The sampling points locations

Coordinates of sampling points	Longitude	Latitude
Control point	64°41'10.64''N	20°32'45.61''E
Sampling point 1	64°40'07.90''N	20°32'34.95''E
Sampling point 2	64°40'58.51''N	20°32'54.07''E

Two soil samples will be collected. Sampling Point 1 refers to a point inside the pilot. Control point is a point located outside the pilot but will be used to investigate the Margin up! Environmental impacts on the surrounding area.

Sampling point 2 refers to the surface water sampling (in case of water flow).

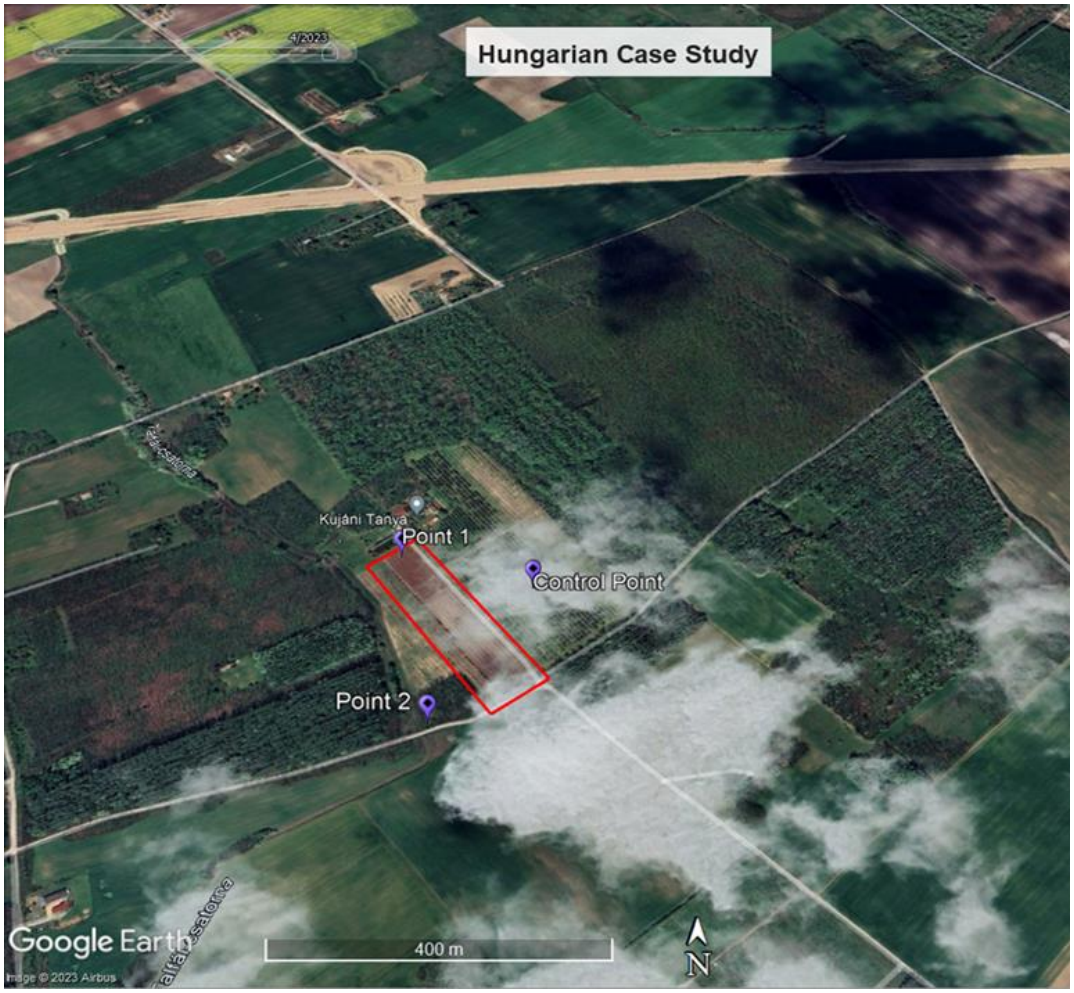


Figure 7: The sampling points for the Hungarian use case

The proposed parameters for the soil and groundwater monitoring are presented in ANNEX I-IV, which they will be measured in certified laboratory. The Tables should be filled out and submitted.

Data on energy consumption, waste material, water use/irrigation, Land use management, weather conditions and biodiversity will be recorded on the Table presented in ANNEX V.

3.4. Spanish Use Case

Details about Spanish pilot's location are provided by CICYTEX. The detailed methodology for Environmental Monitoring Plan is described in Section 2.

The following Tables and Figures depict the proposed sampling points locations at two different sites.

Table 5: The sampling points locations in Vega Ruiz

Coordinates of sampling points	Longitude	Latitude
Control point	64°41'10.64''N	20°32'45.61''W
Sampling point 1	64°40'07.90''N	20°32'34.95''W
Sampling point 2	64°40'58.51''N	20°32'54.07''W

Two soil samples will be collected. Sampling Point 1 refers to a point inside the pilot. Control point is a point located outside the pilot but will be used to investigate the Margin up! Environmental impacts on the surrounding area.

Sampling point 2 refers to the surface water sampling (in case of water flow).

Figure 8: The sampling points for Vega Ruiz

Table 6: The sampling points locations in Las Estufas

Coordinates of sampling points	Longitude	Latitude
Control point	39°58'22.64"N	°31'42.13"W
Point 1	39°58'26.10"N	6°31'35.96"W
Point 2	39°58'25.02"N	31'38.70"W
Point 3	39°58'23.52"N	6°31'33.21"W

Three soil samples will be collected. Points 1 and 2 refer to points inside the pilot. Control point is a point located outside the pilot but will be used to investigate the Margin up! Environmental impacts on the surrounding area.

Point 3 refers to the surface water sampling (in case of water flow).

Figure 9: The sampling points for Las Estufas

The proposed parameters for the soil and groundwater monitoring are presented in ANNEX I-IV, which they will be measured in certified laboratory. The Tables should be filled out and submitted.

Data on energy consumption, waste material, water use/irrigation, Land use management, weather conditions and biodiversity will be recorded on the Table presented in ANNEX V.

3.5. German Use Case

Details about German pilot's location are provided by ATB. The detailed methodology for Environmental Monitoring Plan is described in Section 2.
The following Table and Figure depict the proposed sampling point locations.

Table 7: The sampling points locations of German Use Case

Coordinates of sampling points	Longitude	Latitude
Control point	52°47'22.07"N	12°57'5.33"E
Point 1	52°47'31.28"N	12°57'6.28"E
Point 2 (Water sample)	52°47'44.17"N	12°57'30.73"E

Two soil samples will be collected. Points 1 and 2 refer to points inside the pilot. Control point is a point located outside the pilot but will be used to investigate the Margin up! Environmental impacts on the surrounding area.

Point 3 refers to the surface water sampling (in case of water flow).

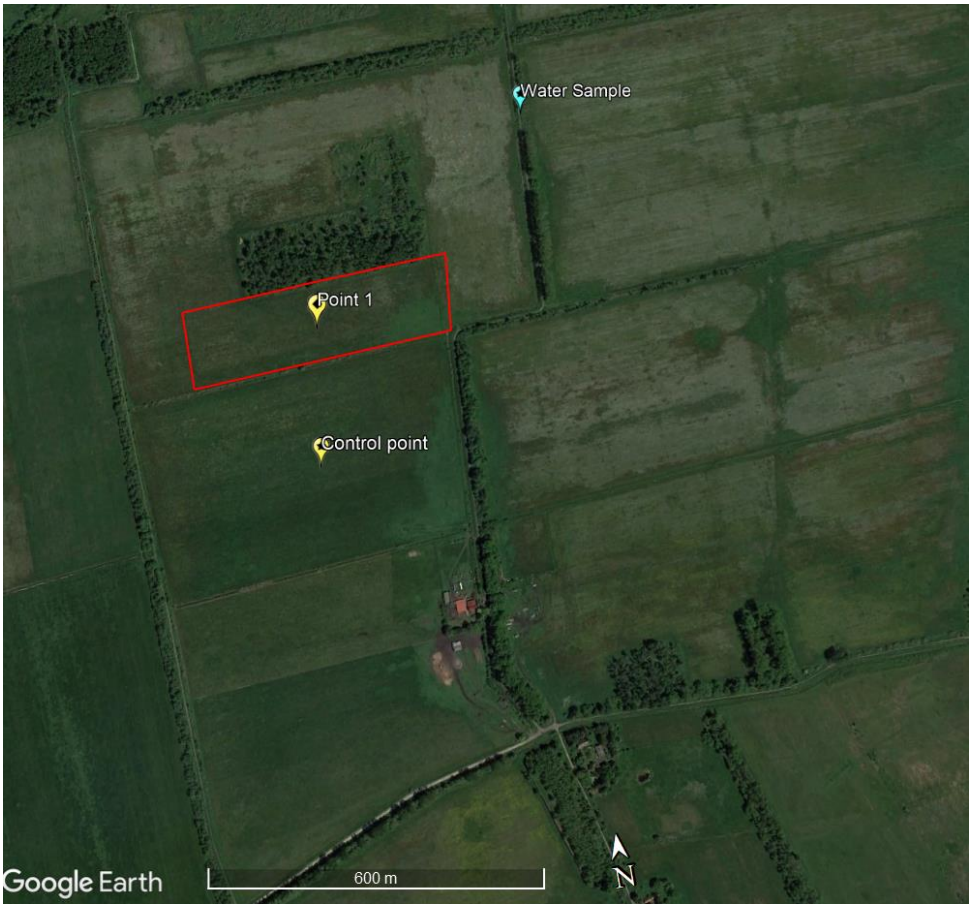


Figure 10: The sampling points for German use case

The proposed parameters for the soil and groundwater monitoring are presented in ANNEX I-IV, which they will be measured in certified laboratory. The Tables should be filled out and submitted.

Data on energy consumption, waste material, water use/irrigation, Land use management, weather conditions and biodiversity will be recorded on the Table presented in ANNEX V.

4. Conclusions

This report deals with a step-by-step guide for the Deliverable WP4.1: Monitoring of Environmental Impact. The sampling locations, sampling frequency and parameters are suggested. The guidelines are based on scientific protocols and methods. The soil and water monitoring will be conducted in the beginning and the end of each pilot site. The other parameters under study will be recorded monthly during the pilot implementation.

The investigated parameters will be evaluated prior to the beginning and the end of each pilot. The evaluation of the beginning of the pilot will be referred to as the Baseline of each Use Case and will be compared against the results at the end of the pilot to identify and quantify the impacts caused by the project activities.

5. References

FAO Guidelines Soil Description: https://www.fao.org/3/a0541e/a0541e.pdf

FAO Operating Procedure for handling and preparation of soil samples for chemical and physical analysis: www.fao.org/3/ca8283en/ca8283en.pdf

Groundwater Sampling, Operating Procedure: https://www.epa.gov/sites/default/files/2015-06/documents/Groundwater-Sampling.pdf

Soil texture classes: https://www.fao.org/3/a0541e/a0541e.pdf

Soil Organic Matter: https://www.nrcs.usda.gov/sites/default/files/2022-09/Estimated_Soil_Organic_Matter__Field_Method.pdf

Surface Water Sampling, Operating Procedure: https://www.epa.gov/sites/default/files/2015-06/documents/Surfacewater-Sampling.pdf

6. Annex

6.1. ANNEX I

Table 8: The Grain Size Analysis Results

Sampling Point unique number	Sand (%)	Silt (%)	Clay (%)	Soil Texture	Notes
					The soil texture will be analysed once

Table 9: The estimated Soil Organic Matter

Sampling Point unique number	Soil Organic Matter

6.2. ANNEX II

The following suggested analysis methods are for indicative purposes. Each laboratory will use appropriate methods based on practices in their country.

Table 10: Parameters for Monitoring of Soil Data

Parameters of Soil	Methods	Concentration	Units	New Dutch Guidelines 2000		Dutch Soil Remediation Circular 2013 criteria (mg/kg DM)	TIME STEPS	NOTES
				Threshold (mg/kg)	Values for Restoration			
Nitrate (NO3)	APHA 4500-NO3			-	-		At the beginning and the end of pilot.	Soil sampling is depicted in Figures 4-10
Chemical Oxygen Demand (COD)	ISO 15705-2002			-	-			
pH	ANNEX 1:5.1			-	-			

Lead (Pb)	EPA 6010 C			85	530	530
Mercury (Hg)	EPA 6010 C			0.3	10	36
Cadmium (Cd)	EPA 6010 C			0.8	12	13
Chromium (Cr)	EPA 6010 C			100	380	-
Zinc (Zn)	EPA 6010 C			140	720	720
Copper (Cu)	EPA 6010 C			-	-	190
Nickel (Ni)	EPA 6010 C			35	210	100
Arsenic (As)	EPA 6010 C			29	55	76
Boron (B)	EPA 6010 C					
Ferrous (Fe)	EPA 6010 C					
Lithium (Li)	EPA 6010 C					
Aluminum (Al)	EPA 6010 C					
Manganese (Mn)	EPA 6010 C					
Potassium (K)	EPA 6010 C					
Sodium (Na)	EPA 6010 C					
Fluorine (F)	ISO 10204-1			500	-	
Total Nitrogen (N)	Kjeldahl					
Total Phospho-rous	EPA 6010 C					

Chlorides (Cl)	APHA 400-Cl					30
Cyanides (CN)	Based on ASTM D2036			1	20	

6.3. ANNEX III

Table 11: Parameters for Monitoring of Groundwater Data

Groundwater Parameter	Method	Concentration	Threshold	Units	TIME STEPS	NOTES
pH	APHA 4500 -H				At the beginning and at the end of pilot.	Sampling from the closest bore-hole (at a maximum distance of 1 km from the pilot)
Conductivity	APHA 2510					
Turbidity	Photometric method					
Odour	APHA2150					
Chlorides (Cl^-)	APHA 5520					
Sulfate (SO_4^-)	ASTM D516					
Nitrate (NO_3^-)	APHA 4500 - NO3					
Phosphate (PO_4^{3-})	APHA 4500 - PO4					
Total Nitrogen (TKN)	MN0831 photometrically					
Ammonium ion (NH_4^+)	ASTM D1426					
Chemical Oxygen Demand (COD)	APHA 5220 D					
Total Organic Carbon (TOC)	APHA 5310					

Biochemical Oxygen Demand (BOD_5)	APHA 5210 D: 2005				
Florine $(F)^-$	ISO 11885: 2009				
Ferrous (Fe)	ISO 11885: 2009				
Cooper (Cu)	ISO 11885: 2009				
Zinc (Zn)	ISO 11885: 2009				
Magnesium (Mg)	ISO 11885: 2009				
Boron (B)	ISO 11885: 2009				
Lead (Pb)	ISO 11885: 2009				
Arsenic(As)	ISO 11885: 2009				
Cadmium (Cd)	ISO 11885: 2009				
Mercury (Hg)	ISO 11885: 2009				
Chromium (Cr)	ISO 11885: 2009				
Nickel (Ni)	ISO 11885: 2009				
Phenol	ISO 6439-2003				
Trichloroethylene	MSZ 1484 -5: 1998				
Tetrachloroethylene	MSZ 1484 - 4: 1998				
Coliforms	ISO 9308 - 2: 2012				
E.coli	ISO 9308 - 2: 2012				

Intestinal enterococci	ISO 7899 - 2: 2000					

6.4. ANNEX IV

Table 12: Parameters for Monitoring of Surface Water Data

Surface Water Parameter	Method	Concentration	Threshold	Units	TIME STEPS	NOTES
pH	APHA 4500-H				At the beginning and the end of pilot.	The surface water sampling is depicted on 7, 8, 9, 10
Chemical Oxygen Demand (COD)	APHA 5220 D					
Biochemical Oxygen Demand (BOD_5)	APHA 5210 - 2005					
Total Suspended Soils (TSS)	APHA 2540 - D					
Total Nitrogen (TN)	Kjeldahl					
N-NH_4	ASTM D1426					
Nitrate (NO_3^-)	APHA 4500 - NO3					
Nitrogen Dioxide (NO_2^-)	APHA 4500 - NO2					
Total Phosphorus, P	ISO 11885: 2009					

Conductivity	APHA 2510				
FOG	APHA 5520				
Chlorides (Cl^-)	APHA 5520				
Ferrus (Fe)	ISO 11885. 2009				
Nickel (Ni)	ISO 11885. 2009				
Borron (B)	ISO 11885. 2009				
Zinc (Zn)	ISO 11885. 2009				
Cooper (Cu)	ISO 11885. 2009				
Lead (Pb)	ISO 11885. 2009				
Arsenic (As)	ISO 11885. 2009				
Mercury (Hg)	ISO 11885. 2009				
Cadmium (Cd)	ISO 11885. 2009				
Chromium (Cr)	ISO 11885. 2009				
Aluminium (Al)	ISO 11885. 2009				
E. coli	ISO 9308 - 2: 2012				
Eggs of intestinal worms	WRC Report No. TT322/08-03/2008				
Storm water volume					

6.5. ANNEX V

*Baseline data responds to at the beginning of the pilot.

**Margin up data will be observed monthly during the pilot period.

Table 13: Environmental Parameters

Organization Name:			
Parameter			
		BASELINE*	**MarginUp!****
Energy	**Units**	**Value**	**Value**
Electricity consumption (WWTP)	KWh		
Fuel consumption by fuel type Fuel 1… Fuel 2… Etc…	Kg		
Waste			
Hazardous waste / by waste stream	Kg		
Organic / agricultural waste	Tons		
Other waste	Tons		
Water			
Total volume of water used	m^3		
Volume of water per acre / year	m^3		
Volume of water per ton of biomass produced	m^3		
Additional direct income generated	m^3		
Additional income streams	m^3		
Land Use Management			
Water consumption	Kg		
Pesticides	Kg/		
Pesticides	Kg /biomass pro-duced		

Fertilisers	Kg/ biomass produced		
Compost / soil enhancers	Kg/		
Compost / soil enhancers	Kg/ biomass produced		
Other inputs (Please specify)	Kg/		
Other inputs (please specify)	Kg/ biomass produced		
Meteorological Data			
Temperature	^{o}C		At the day of sampling and monthly
Rainfall	mm		At the day of sampling and monthly
Number of days with frost			At the day of sampling and monthly
Number of days with precipitation			
Wind speed	m/sec		
Wind direction			
GHG	Tons / biomass produced		The Greenhouse Emissions will be estimated by ATLANTIS based on the provided data
Biodiversity Data			Based on Deliverable 2.3