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Enhancement of sustainable land soil resource management in agriculture - E2SOILAGRI

Final project implementation review (PIR)

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TITLE

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SUMMARY/SAMMENDRAG:

This is the final report for the NIBIO assignment in E2SOILAGRI. The report is a final project implementation review (PIR) assessing implementation results according to the planned results for E2SOILAGRI and the recommendations provided in the mid-term PIR is also be assessed. The review is sub-activity 4.1 in E2SOILAGRI project.

Dette er en avslutningsrapport for NIBIOs bidrag i prosjektet E2SOILAGRI. Rapporten sammenfatter en vurdering av implementeringen som er utført, med kommentarer fra NIBIO. Arbeidet er definert som underaktivitet 4.1 i E2SOILAGRI

COUNTRY: Latvia

GODKJENT /APPROVED	PROSJEKTLEDER /PROJECT LEADER
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Preface

NIBIO is a partner in the project "Enhancement of sustainable land soil resource management in agriculture" (E2SOILAGRI) implemented by the Ministry of Agriculture of the Republic of Latvia and funded under the Norwegian Financial Mechanism Program "Climate Change Mitigation, Adaptation and Environment". The main objective of the project is to improve Latvian soil data for the development and implementation of climate change policies. The project is managed by Latvian authorities. The project period is from February 2021 to January 2024.

NIBIO has an advisory role in the project. NIBIO is owned by the Norwegian Ministry of Agriculture and Food and has a role in contributing to food security and safety, sustainable resource management, innovation, and value creation in Norway. NIBIO is a partner in E2SOILAGRI due to its ongoing soil survey on agricultural land and the experience in making data from the survey easily accessible for Norwegian users, including farmers and agricultural authorities.

The E2SOILAGRI project is supported by Norway through the Norway Grants. The Norway Grants, together with the EEA Grants, represent Norway's contribution towards a green, competitive, and inclusive Europe. Through the Norway Grants and the EEA Grants, Norway contributes to reducing social and economic disparities and to strengthening bilateral relations with beneficiary countries in Central and Southern Europe and the Baltics. Norway cooperates closely with the EU through the Agreement on the European Economic Area (EEA). Together with the other donors, Norway provided €3.3 billion through consecutive grant schemes between 1994 and 2014.

Norway Grants are financed solely by Norway and are available in the countries that joined the EU after 2003. For the period 2014-2021, the Norway Grants amount to €1.25 billion. The E2SOILAGRI benefits from a EUR 1,56 million contribution from Norway Grants.

This report is a final evaluation report from NIBIO as described under activity 4 (Exchange of experience of experts from NIBIO on sustainable management of soil resources), sub-activity 4.1, (Involvement of NIBIO experts into the implementation of the project), task 3, "Perform final evaluation of the project". All Latvian partner institutions were visited in person in early November 2023 to assess the progress and results.

Ås, 08.12.2023

Hildegunn Norheim

Content

Introduction

The project "Enhancement of sustainable land soil resource management in agriculture" E2SOILAGRI is funded by Norway Grants under the Norwegian Financial Mechanism Program "Climate Change Mitigation, Adaptation and Environment" and implemented by Latvian authorities. The project promoter is the Ministry of Agriculture of the Republic of Latvia. Several Latvian public institutions participate in the implementation of the project. The task of conducting a final evaluation of the project was assigned to the Norwegian Institute of Bioeconomy Research through a partnership agreement between Ministry of Agriculture of the Republic of Latvia and the Norwegian Institute of Bioeconomy Research (signed 22.02.2021).

This assignment is described in the partnership agreement:

> *Description: to help project steering group follow up and evaluate project implementation progress it is expected to develop two stage project implementation reviews. Final project implementation review (PIR) will assess project implementation results according to the planed results listed in these ToR. In the same time project implementation according to recommendations provided in the mid-term PIR will be assessed.*
>
> *Final PIR will be carried out in following stages:*
>
> a) *Review of written project progress reports;*
> b) *4 day in country mission to perform stakeholder and project implementation partner interviews;*
> c) *Perform initial finding discussion with representatives from project steering group at the end of in country mission;*
> d) *Prepare and deliver written final PIR report.*

A thorough review of all written project reports has not been done. Some documents have been made available in English for the review team. Other documents were not completed or not translated into English, and it is not possible to review these documents in the time frame for the NIBIO assignment in E2SOILAGRI.

The review team thus emphasizes findings during the in-country mission in the final review. The opinion of the review team is that this is not a critical issue for the final report. It makes sense to concentrate (and limit) the translation effort to documents where English translations will be useful also after the project. Other information was provided during the interviews.

The agenda for the in-country mission is attached in the appendix.

Figure 1 Latvian agricultural landscape (Photo: Geir-H. Strand/NIBIO)

Activity 0: Project management

Activity 0 is implemented by the Ministry of Agriculture (MoA). The activity consists of four tasks:

0.1 Project coordination
0.2 Project Steering Committee
0.3 MoA expert work on implementation of activities
0.4 Translation of project materials from Latvian to English and English to Latvian

The project promoter considers the project management as successful, in all dimensions.

Communication between partners, between project manager and project promoter and between project manager and partners have been regular and partners have been followed up with additional assistance when needed.

Remarks from the review team:

- *All the partners have been asked their opinion regarding the project management and the communication within the project. They are all satisfied with the guidance and assistance they have received.*
- *It's recommended that final versions of documents essential as documentation of the Latvian soil information and soil conditions are translated into English as a preparation for further international cooperation and Latvian involvement in international processes where soil information is a central element.*
- *The purpose of the procedures, data and information system established during E2SOILAGRI is to be elements of a wider Latvian soil information system. The project promoter must ensure that the results of the project are handed over to competent public authorities and that these authorities are given the necessary mandate and resources required to establish and operate a national soil information system[1].*

[1] NIBIO Report 024/2022: Enhancement of sustainable land soil resource management in agriculture - E2SOILAGRI NIBIO Inception report.

Activity 1: Upgrading reliable, country-specific soil information of agricultural land

Activity 1 is implemented by the University of Latvia (Task 1.1 to 1.5) and the Ministry of Agriculture (Task 1.6). The activity consists of six tasks:

1.1 Upgrading of the historical soil information database
1.2 Development of a national soil classification system
1.3 Development of soil mapping methodology on agricultural land
1.4 Mapping of peatland distribution
1.5 Training in soil description and mapping on a scale of 1:10,000 in accordance with the soil classification of Latvia and WRB
1.6 Development of proposals for the improvement of regulatory enactments on soil governance issues

1.1 Upgrading of the historical soil information database

This task is implemented by the University of Latvia (UoL) and consists of two subtasks:

The first objective of this task was to georeference (add digital spatial coordinates to) existing soil profile descriptions. The result is a (digital) list of profiles with coordinates attached. Basic information from the soil profiles (e.g., soil type) is added in the digital list, but the complete profile description remains in a paper-based archive. Cross-reference between the digital list and the paper archive is maintained by a profile identification code. The georeferenced soil profile list will make it easy to a) find profiles for a certain region or soil type in the paper archive; and b) locate a particular profile from the paper archive on digital maps and in the field (using GPS). This service will be valuable in future soil mapping and modelling exercises.

Remarks from the review team:

- *About 480 out of 15 000 existing soil profile descriptions were missing in the archives and are not georeferenced. This is not seen as critical by UoL, neither by the review team. However, the geographical distribution of the lost data should be examined to consider the need for future completion by additional soil profiles to fill gaps in the spatial distribution.*
- *The location of existing historical soil profiles was described with words rather than coordinates. The precision of the positioning of the historical soil profiles will therefore be more uncertain than the positioning of the new soil profiles (where coordinates are obtained by GPS during field work). This uncertainty should be documented in the dataset. If not, the georeferencing will appear to be of the same level of accuracy for old historical and newer soil profiles. Imprecise georeferencing will result in inaccurate resampling and use of older soil profiles. Furthermore, information about the level of accuracy will allow for the ability to filter out unprecise points, if a more detailed dataset should be needed for modelling or other purposes. Information about different levels of accuracy in the georeferencing of soil profiles can be represented as a precision code (e.g. classifying three – or more - different precision levels).*

1.2 Development of a national soil classification system

This task is implemented by the University of Latvia (UoL) and consists of two objectives:

1) Improvement of the Latvian soil classification system, development of description methodology and guidelines (task 1.2.1), and

2) Approbation and final version of Latvian classification system, description methodology and guidelines (task 1.2.2)

The University of Latvia has revised the existing Latvian soil classification system. A draft was developed, and the feasibility of the revised classification system was tested by the University of Latvia.

The Latvian soil classification system contains more information than the World Reference Base for Soil Resources regarding the amount of organic matter in the soil. Four classes are defined in the Latvian soil classification system, whereas the World Reference Base for Soil Resources has three classes. Peat soils are common in Latvia, and this is done to be able to calculate GHG emissions more precisely.

The guidelines for soil description are in progress, but not yet completed.

UoL is working with two documents: one covering the classification system and one for the field guidelines. There are editorial discussions regarding the presentation of the material. The editorial process is still in progress, so no published documents were available for the review team.

Approbation followed by publication of a final version of the Latvian soil classification system is planned to take place in 2023.

Remarks from the review team:

- *The reason for introducing more subgroups for amount of organic matter in the soil is to be able to support more precise calculations of GHG emissions. If all decisions are made according to analytical data from the laboratory, and not "in situ", the number of classes/subgroups can be high. If, on the other hand, the decisions have to be made without analytical data, an increasing number of classes/subgroups to choose from, will result in less standardized decisions. Determining the amount of organic material in the soil is more problematic in some soils than in other. Hence, many classes regarding a given soil property does not necessarily produce more reliable data.*
- *In general, experts will often argue in favor of more detailed (and complex) classification systems, because they are aware of the multitude of variation. The benefits of a more complex classification system may, however, be small compared to the increased cost of using the system. The project motor should therefore assist the experts to find a reasonable balance between complexity and practical applicability of the classification system.*
- *Final versions of the Latvian soil classification system and the Guidelines for soil descriptions have not been published yet. This is an important delivery from the project and necessary for the approbation of the system.*
- *Approbation is planned for the end of 2023 and must be pursued by the project promoter.*

Figure 2 Latvian grass production (Photo: Geir-H. Strand/NIBIO)

1.3 Development of soil mapping methodology on agricultural land

This task is implemented by the University of Latvia (UoL) and consists of six sub-tasks as listed in Table 1:

Table 1. Sub-tasks and status for task 1.3

Sub-task		Status	Responsibility
1.3.1	Development of soil mapping methodology at 1:10 000 scale using Latvian and WRB (2022) soil classification	A draft has been made, final version is not completed	UoL
1.3.2	Soil pit digging, profile description, sampling and analysing, soil type and subtype reference database creation	Completed	UoL
1.3.3	Soil mapping in 2 test areas at 1:10 000 scale	Soil mapping completed. Map construction and comparison is ongoing.	UoL
1.3.4	Guidelines for soil mapping at 1:10 000, 1:50 000, 1:100 000 scale	Partly available as drafts, final versions have not been completed	UoL
1.3.5	Cost evaluation according to different scales and levels of detail	The review team has not been provided with the cost evaluation and is uncertain regarding the status	UoL
1.3.6	Independent expert evaluation on soil mapping methodology	Ongoing	MoA

1.3.1: Development of soil mapping methodology

A soil mapping methodology at 1:10 000 scale using the revised Latvian methodology and the World Reference Base for Soil Resources, including methodology for soil description, classification, and mapping at 1:10 000 scale, is under development by the University of Latvia. In January 2023, it was decided to use the 2022-edition of the World Reference Base for Soil Resources instead of the 2014-edition. This decision caused more work due to reclassification of soils already classified according to the 2014-edition. Nevertheless, it was considered expedient to be able to have a system as updated as possible upon launch.

The drafts have been developed and the implementation is tested by the University of Latvia and SILAVA in other parts of the project. Approbation, followed by publication of a final version of the Latvian soil classification system, a description of the methodology and guidelines for practical use was planned for 2023. Field crew do not yet use a key in the field but follow a methodology guide. Mapping guidelines will among other things describe the connection between land properties.

The definitions for diagnostic horizons, criteria and properties are mainly the same as in World Reference Base for Soil Resources (2022), except for the criteria regarding organic matter of Histosols changed from 20 % to 25 % to match the IPCC definition. In addition, the number of soil groups present in Latvia are less than in the World Reference Base for Soil Resources (2022). Some soil groups have also been combined due to difficulty identifying the soil type by auguring in Latvia.

Remarks from the review team:

- *All definitions used in the Latvian soil mapping methodology which differ from the World Reference Base for Soil Resources (2022) has to be documented and published as part of the Latvian mapping methodology.*
- *A classification key should be developed for use in practical soil mapping. This simplifies the soil mapping and increases the quality of the work.*
- *Classifying soils according to the official World Reference Base for Soil Resources (no matter which edition) is demanding and requires highly skilled personnel. If not, the risk that the data collected are not reliable is high.*
- *The methodology documents should be completed and published. A mandated public authority should assume responsibility for the maintenance of the methodology.*

1.3.2: Soil profiles

Data capture and description of 225 soil profiles have been done. Soil classification is done according to the new Latvian classification system. A (local) database has been created with the descriptions of the 225 soil profiles. The report comparing the new profiles with the historical profiles, including suggestions for improved mapping methodology, has not been completed.

Remarks from the review team:

- *The risk of errors in classifying the soils according to the official World Reference Base for Soil Resources (2022) based on an assumption that all needed observations have been done in the field is high. Highly skilled personnel in the field, being able to do the classification in situ (with the additional help from the analysis afterwards) reduces this risk.*
- *The data and the description of these 225 soil profiles must be transferred to the database which has been created by the SPPS*

1.3.3: Soil mapping in two test areas

Remapping of soils, redescription of selected old soil profiles and description of additional soil profiles has been completed in the two selected administrative areas. These two administrative areas represent the variation found in Latvian agricultural soil conditions. The purpose is manyfold: a) to check the quality of the historical soil profile descriptions; b) to complement the soil profile collection – especially for organic soils; c) provide support for remapping; and d) test the new mapping guidelines.

The activity was mainly planned for 2023. In June, the conditions for soil mapping were demanding due to draught which led to very firm clayey soils. The soil mapping had to stop and was restarted after harvest in August and September. An alternative soil mapping procedure was tested in one of the areas to be able to complete the remapping in a best possible way. In traditional soil mapping, the soil mapper chooses the points for auguring by his/her own decision in order to do the auguring at the most representative points. In the alternative method, which was introduced, a pre-defined grid system (100 m x 100 m) determined where to do the auguring. The soil contours from this grid methodology were made by manual interpolation.

Soil mappers expressed a preference for the grid system, as this made planning easier. UoL will compare the costs and precision of each point selection method within the project. So far, it's estimated that the grid is more precise on clayey soils but it's also more time consuming and therefore more costly. The approach may still be preferable in very flat landscapes where it is difficult for the field crew to select the appropriate positioning of the points.

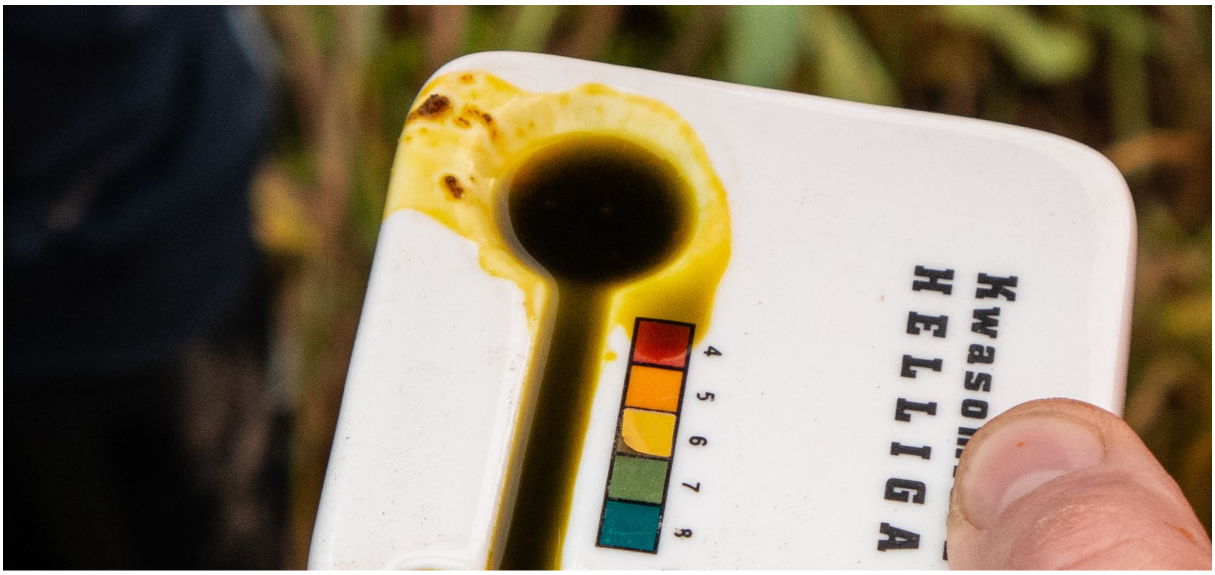

Figure 3 Measurement of pH during soil sampling (Photo: Geir-H. Strand/NIBIO)

New soil maps for the two administrative parishes (Platone and Vecpiebalga) will be created in 2023, using the new mapping instructions and the revised Latvian soil classification system. The results will provide a basis for comparing maps produced according to the old and the new method, as well as estimates for the cost of soil description and mapping according to the new system. The field work is completed, and map construction is in progress. Thereafter, a comparison with the old maps will be done. UoL reports that comparison of historical data regarding Gleysols must be done with precaution due to different definitions in the old and the new system. However, calcareous soils, pH and peat information seem to be described well and still be relevant from the older maps and can be useful in the future.

UoL provides basic soil courses, which introduce students to field work including soil classification. In 2024 the new methodology and guidelines will be included in the course.

Remarks from the review team:

- *The comparison of the two soil mapping methodologies (old Latvian and new Latvian) should be published in an adequate format for Latvian users.*
- *The review team fully supports the University's effort to create a positive spinoff effect by familiarizing students with the new classification system. Students are future users of the maps.*
- *Using labour from the University in the programme for soil mapping can be cost efficient, but the reliability of results can vary depending on availability of professors and students, as well as the students' professionality.*
- *The review team emphasizes the importance of comparing costs between the two point selection methods. It is also important to calculate the exact human resources spent per area, including all factors such as hours, travel, accommodation etc. as well.*
- *Neither mapping guidelines, cost evaluation nor map comparison have been finalised. As of the review team's visit (primo November), UoL has not yet started writing the evaluation report. These are essential and time-consuming parts of the project and should be prioritised.*

1.3.4: Guidelines

The guideline for mapping at scale 1: 10 000 is available as a draft. The review team has not a clear understanding on the status regarding guidelines for scale 1:50 000 and 1:100 000.

Remarks from the review team:

- *The documentation is an essential delivery from the project but is often time-consuming. Measures should be applied to ensure that the task is completed.*

1.3.5: Cost estimations

It's reported that the cost evaluation according to different scales and levels of detail has been done. The review team did not see the results during the visit but has been informed that the task was completed by 1st December 2023.

Remarks from the review team:

- *None.*

1.3.6: Independent cost estimation

Additional funding enabled an additional task for this activity. The project hired an external contractor, the AgroEconomical Institute (AEI), to carry out a cost evaluation of the mapping methodology. AEI is in the process of researching whether the results and scale of the programme and methods developed by UoL are cost appropriate. This complements the programme's own cost estimates. The report by AEI will provide more data and better basis for budgeting future soil mapping programmes. The results will be provided January 15th, 2024.

Remarks from the review team:

- *This is a most reasonable and probably very useful addition to the project. Accurate cost estimates are important for the planning of future mapping activities in the Latvian soil information system.*

1.4 Mapping of peatland distribution

Task 1.4 is implemented by the University of Latvia (UoL).

A methodology for peatland mapping using satellite imagery and artificial intelligence has been developed by UoL and the results look promising. The product is a “probability map” showing the probability of finding peat soils.

A collection of new peat soil profiles has been established. Approximately half of them are redescriptions of existing profiles, the other half are new profiles. The activity was generally seen as the University’s most challenging task but is close to finalization. Among other results, UoL found that 25 % of historically mapped peat soils were not peat at all. Areas of covered crops or fruit orchards etc were the most challenging areas to be predicted by the model. The models give reasonably precise locations of peat soil with 91,67 % calculated accuracy. Farmers responded generally positively when asked for feedback, and said they recognised the results in their own land.

Remarks from the review team:

- *The results from this activity look very promising. The reported accuracy of the model is regarded as high in this context.*
- *According to the knowledge of the review team, the model does not predict the depth of the peat layer, only presence or absence. Future work, if funded, could try to model depth also.*
- *This activity has academic merit and we encourage the scientists involved to publish the method and results in an appropriate international journal*

1.5 Training in soil description and mapping

Task 1.5 is implemented by the University of Latvia.

The curriculum has been developed and the course has been arranged by the University of Latvia. In 2023 two extra seminars were held, one in the spring and one in the summer. The prepared training material will be used by students. Writing guidelines remains, but UoL expects no major challenges.

Remarks from the review team:

- *The training course was held in 2022, when the 2014-edition of the World Reference Base for Soil Resources was still used. A comprehensive training in the 2022-edition of the World Reference Base for Soil Resources may be needed for former students.*
- *The training course should undergo a formal evaluation by the participants with the aim to provide information that allows the University of Latvia to further improve the curriculum. This may have been done, but the review team is not aware of it.*
- *The training course in 2022 lasted for two weeks. The course consisted of lectures on diagnostics and criteria, classification, mapping, the peat model data, GIS, and field work. The content of the course seems adequate but being a fully trained person in both soil description and soil mapping requires more time and experience. If this training course is sufficient for being responsible for both soil description and soil mapping, there is a risk that the quality of the work is poor.*

- *Practice and repeated training will be needed for the participants to maintain and further improve their skills. It is therefore important to follow up the training with practical mapping assignments.*
- *The University of Latvia should consider offering the course on a regular basis.*

1.6 Development of proposals for the improvement of regulatory enactments on soil governance issues

Task 1.6 is implemented by the Ministry of Agriculture (MoA).

The regulatory enactments on soil governance issues have been *developed* by the Ministry of Agriculture (MA), and this activity is thus completed.

MA is responsible for the proposal but the implementation requires participation from other ministries. The required process has been initiated by MA.

SPPS will be named in the regulations as the mandated organization responsible for the classification from 2025 and onwards. Soil mapping is foreseen from 2028 according to regulations.

Remark from the review team:

- *The review team has not seen the draft for the regulatory enactments and would not have the competence to assess it. The review team is generally skeptical about describing the soil survey methodology in regulations because this might impede the process of updating the methodology in the future. However, we understand that there are other aspects specific to Latvian governmental practice that need to be taken into consideration regarding this activity. We still advise the regulatory enactments not to be too detailed nor to link the detailed methodology too strongly to bureaucratic processes.*
- *A general viewpoint from the review team is that the regulatory enactments should provide solid basis for the overall goal (a Latvian soil information system) with its components and provide a mandate for the responsible organization to develop and manage this system.*

Activity 2: Establishment of a national soil carbon monitoring system

Activity 2 is implemented by the State Plant Protection Service (SPPS) and SILAVA. The activity consists of two tasks:

2.1 Establishment of a soil carbon monitoring network on agricultural land
2.2 Establishment of the Soil Carbon Monitoring Database of agricultural land

2.1 Establishment of a soil carbon monitoring network on agricultural land

Task 2.1 is implemented by the State Plant Protection Service (SPPS) and SILAVA.

Two hundred soil carbon monitoring points in agricultural land have been established. 70 % of the sites are in arable land (not grass/orchards/grazing), which is a representative selection regarding land use. The data collection also encompasses economic activity from the farmers who manage the areas where the points are located.

For the soil points, this is mainly done by auguring. If auguring doesn't provide sufficient information, profile digging and description is done. Three classification systems were used: the old Latvian, the new Latvian and the World Reference Base for Soil Resources (probably both the 2014- edition and the 2022-edition due to the fact that it was decided to change into the 2022-edition in the beginning of 2023). The use of three classification system is not considered to be problematic nor difficult by the responsible partner. Histosols are excluded from the monitoring system. The work at each plot took from 1 to 3 hours. The surveyors had training from a soil course at UoL, training in soil classification through E2SOILAGRI and additional help from literature. There was no written field instruction.

Sampling for soil physio-chemical analyses was intended for the end of 2023, but SPPS completed the laboratory analyses in October to give SILAVA more time on the analyses. Soil sample physio-chemical analyses (for 0-10; 10-20 and 20-40 cm depths) were carried out by an accredited laboratory.

Analyzing the data and implementation in GHG Inventory report, together with a scientific report on the results, will be done by SILAVA by the end of 2023. The article is to be submitted by the end of January 2024. The scientific article is not yet ready.

Figure 4 Soil samples (Photo: Geir-H. Strand/NIBIO)

The goal of the soil carbon monitoring network is to have reference data for modelling. SILAVA is using Yasso20 for C stock change modelling. Yasso20 models C stock change probability based on crop rotation data, combined with yield in a specific area and other C input and climate conditions. For pre 1990 input data, the model assumes average values for various produce, mostly taken from local literature. Yield and soil types can vary greatly, and the model is thus very uncertain. The output is a rough estimation of C stock a given year for a given land use type. The results show decrease in C stocks for all plots, and this is assumed to be due to climate change. SILAVA recognizes that the model will not correctly represent field level C stock, and only aim for national level GHG emissions. SILAVA sees the coming scientific article as the baseline for potential further work, if the Latvian government sees a need for field level reporting. Farmers will have to provide more detailed information, like biomass etc., in order to support field level reporting. SILAVA are aware of the farmers' limited capacity for this.

Results regarding C stock have been analyzed, and an article will be published by the end of 2023.

Remarks from the review team:

- *The 200 soil carbon monitoring points that are included in this activity have not been selected for the purpose of being statistically representative for Latvian soils. The data points are needed to calibrate the model and they will provide additional information about the soil types but are not useful for other purposes. Information from the 200 monitoring points should be presented with care in order to avoid incorrect assumptions of statistical representativity for Latvian soils.*
- *Three classification systems were used in the soil carbon monitoring network: the old Latvian, the new Latvian and the World Reference Base for Soil Resources (two editions). The review team underlines the need for highly skilled personnel doing this work. It's demanding to acquire the necessary skills to handle all three systems correctly. Erroneous soil classification in the field will inevitably lead to wrong or unreliable results in later work based on this information.*
- *The article regarding C stocks modelling seems "undeveloped" and a major effort from the involved scientists will be necessary to develop a manuscript suitable for publication.*
- *The impression is that the method of contacting farmers works well, as only a single plot out of 200 was denied sampling by the farmer.*
- *The review team suggests publishing the results from this activity not only as scientific papers, but also as information more accessible for other audiences.*

2.2 Establishment of the Soil Carbon Monitoring Database of agricultural land, which is integrated into the State Crop Monitoring Information System (KUVIS)

Task 2.2 is implemented by the State Plant Protection Service (SPPS) and SILAVA.

A prototype of the Soil Carbon Monitoring Database of agricultural land has been developed and can be integrated into the State Crop Monitoring Information System (KUVIS) together with an agricultural land soil organic carbon monitoring database. Implementation and installation will take place by the end of 2023.

A profile database with all completed profile descriptions has been launched and is managed by SPPS. UoL and SPPS have agreed that UoL is to send data via Excel and photo files to SPPS, while SPPS has the responsibility for entering the data in the database and manage the database.

All raw data is available to SILAVA. Data from the soil descriptions occupies the largest part of the database. This data will be used for the maps of soil classification. Data and database management will be executed by SPPS in the future. All soil projects related to soil mapping in Latvia will use this database onwards, but for now there are only the 201 points from the soil carbon network. In the future it will be extended to include profiles from UoL and other providers. Not all data needs to be "complete". The addition of more data than from the soil C monitoring system is not an activity in E2SOILAGRI.

The database can be filtered by soil types, region, whether the soil information is achieved by auguring or by profile description or by a profile description which is defined as a reference profile (increasing degree of quality), year of data capture etc. But, for the time being, there is no easy way to filter by location, nor soil type. SPPS is working on a mobile app for easier input to the database and for access. SPPS will also make maps for this purpose in the future. SPPS will understand better which functions they need when this is in use.

SPPS has created a documentation of how to use the system. The database includes functions for adding an extensive range of soil data. Five persons at SPPS and three persons at SILAVA have access to changing the content of the database, with various authorization levels. UoL has ownership of the landscape photos connected to the 201 points in the database. All changes to the database are logged.

Remarks from the review team:

- *Technical documentation of the architecture of SPPS's database should be done as documentation for further management and maintenance of the database.*
- *Roles regarding data input and data management for the database should be documented clearly. E.g., who is responsible for changing the classification of a soil type that was done in field, if laboratory analyses indicate the initial classification was wrong.*
- *At some point, the software will be updated, and it is crucial to already have the people on hand who can manage and upgrade the system at this point. This is potentially a source of vulnerability for the project, as loss of knowledge can be detrimental if no one knows how to take over and the routines are not well documented.*
- *Full ownership and responsibility of the database should be placed on only one institution (as recommended in our midterm report).*
- *Photos by UoL are not uploaded to the database because they require too much space. We suggest that this can be solved by referring to a specific photo ID and that they can be saved and accessed externally.*
- *There should be information about which project or sampling regime certain data is connected to in the database.*

Activity 3: GHG emission factors and the national GHG inventory

Activity 3 is implemented by SILAVA. The activity consists of three tasks:

3.1 Test site selection, characterization, GHG measurement equipment installation
3.2 GHG emission (CO_2, CH_4, N_2O) measurements in test sites
3.3 Development of GHG emission factors for organic soil in permanent grassland and implementation in GHG Inventory report

3.1 GHG inventory (including 3.1–3.3)

Test sampling sites were established early in the project and the necessary equipment installed (Task 3.1). Data collection was carried out according to the implementation plan (Task 3.2). The data analysis and calculation of emission factors, and the consequent implementation in the GHG inventory report is soon to be completed.

A scientific publication is being prepared and soon ready for submission. The regression is sometimes poor and with unexpected outliers which point towards bursts of CH_4 emissions. This is not an issue for the publication but an interesting observation to be examined in the future. One hypothesis for the outliers is microbial activity.

Remark from the review team:

- *It seems that this activity is carried out according to plan and the objectives are fulfilled.*

Figure 5 GHG emission measurement site (Photo: Geir-H. Strand/NIBIO)

Activity 4: Cooperation with Norwegian experts

This activity is implemented by NIBIO and will not be assessed in this report. The activity consists of two tasks:

4.1 Involvement of NIBIO specialists in the implementation of the project

4.2 Acquisition of soil mapping experience in Norway

4.1 Involvement in project implementation

NIBIO has delivered an inception report and a mid-term evaluation report, as well as this final Project Implementation Review (PIR)

4.2 Acquisition of soil mapping experience in Norway

A team of Latvian experts visited Norway in 2022.

Activity 5: International participation

Activity 5 is implemented by the Ministry of Agriculture (MA).

5.1 Participation in Europe Soils Partnership

5.2 Participation in UN Framework Convention on Climate Change Conventions

5.3 Participation to EU Land Use and Climate expert seminars

5.1 International activities (5.1 - 5.3)

The three tasks in this activity were merged into one task. Participation has mostly been remote, mainly due to Covid restrictions, but also due to financial reasons. MA will participate at COP28.

It is important to be involved in international networks and processes in order to improve the knowledge of the use of and requirements for soil information in policy development and international conventions. An important part of the E2SOILAGRI project is to generate data for international reporting obligations. Participation in international working groups is important for Latvia and will improve communication with EU and UN organizations.

It is also important to participate in these processes in order to promote Latvian interests. Peat and organic soils are common in Latvia and the definition of these soil types as well as the related measurement and monitoring obligations will affect the country. So will WaterLANDS, the EU Green Deal initiative to upscale the restoration of wetlands including peatlands across Europe[2]. Latvia has a lot of these areas.

Remark from the review team:

- *These international activities are important to build network, promote national interests and ensure that international commitments are in line with the nature of soils and agriculture in Latvia.*

Figure 6 Latvian agricultural field (Photo: Geir-H. Strand/NIBIO)

[2] https://waterlands.eu/

Activity 6: Implementation of publicity measures

Activity 6 is implemented by the Ministry of Agriculture (MA) and partners.

6.1 Conferences and seminars
6.2 Public materials and website
6.3 Scientific publications
6.4 Informative events

6.1 Project conferences/ informative seminars for target groups

This activity was expanded because MA realised farmers needed to be more included. Three seminars have been held. A last seminar is scheduled January 19th in 2024, remotely, when all the final deliverables have been completed. The seminars have been held in each region of Latvia, both farmers and representatives from the municipalities were invited. Municipalities are very relevant due to their responsibilities in spatial planning. They also bring many new and highly relevant questions into the project. Approximately 20 farmers have participated in each seminar. Additionally, in the future it would be reasonable to invite agricultural NGOs to an introduction of the soil classification system. All seminars have been recorded and published on the website.

Remark from the review team:

- *For the final conference, organizers from E2SOILAGRI should take into account that the project has two audiences; a scientific audience related to emission reports, and an agronomic audience related to farmers and advisory systems. The project needs to communicate well with both.*

6.2 Publicity materials and website - activity 6.2

In total, 219 publications have been posted to the website, social media or other communication platforms. This exceeds by far the goal of 100 publications. Physical merch and information material has not been produced as several activities were done remotely, and it was generally seen as unnecessary. One of the remaining publications will be a video, focusing on the results and the successful cooperation between the partners in E2SOILAGRI.

The websites which are used are listed below:

- MoA main page (English): https://www.zm.gov.lv/en/projects/project-enhancement-sustainable-soil-resource-management-agriculture-e2soilagri
- MoA news (English): https://www.zm.gov.lv/en/articles?category%5B717%5D=717
- MoA main page (Latvian translated by Google translate: https://www-zm-gov-lv.translate.goog/lv/projekts/projekts-ilgtspejigas-augsnes-resursu-parvaldibas-uzlabosana-lauksaimnieciba-e2soilagri?_x_tr_sl=lv&_x_tr_tl=en&_x_tr_hl=en&_x_tr_pto=wapp
- MoA news (Latvian translated by Google translate): https://www-zm-gov-lv.translate.goog/lv/jaunumi?category%5B717%5D=717&_x_tr_sl=lv&_x_tr_tl=en&_x_tr_hl=en&_x_tr_pto=wapp&utm_source=https%3A%2F%2Ftranslate.google.com%2F
- SPPS (English): https://www.vaad.gov.lv/en/projects/norway-grants-project-improving-sustainable-soil-resource-management-agriculture
- SPPS (Latvian translated by Google translate): https://www-vaad-gov-lv.translate.goog/lv/projekts/norvegijas-finansu-instrumenta-projekts-ilgtspejigas-augsnes-resursu-parvaldibas-uzlabosana-lauksaimnieciba?_x_tr_sl=lv&_x_tr_tl=en&_x_tr_hl=en&_x_tr_pto=wapp
- Silava (English): https://www.silava.lv/en/research/active-projects/E2SOILAGRI

- Silava (Latvian translated by Google translate): https://www-silava-lv.translate.goog/petnieciba/aktivie-petijumi/E2SOILAGRI?_x_tr_sl=lv&_x_tr_tl=en&_x_tr_hl=en&_x_tr_pto=wapp
- UoL does not have a main website for project, the news are posted together with other project news.

Remark from the review team:

- *Our understanding is that this activity has been successful and well received by the intended audiences. Our experience is that soil information and monitoring of carbon stocks and GHG emissions easily can be made too academic, and that carefully prepared information disseminated to a wider audience is important.*

6.3 Scientific publications

This activity is mostly the responsibility of the partners.

Remark from the review team:

- *The preparation of some of the scientific papers started too late (something we warned against in the mid-term review). The GHG-paper (SILAVA) seems to be on track, but we are more concerned about the papers on the mapping system (UoL) and the in particular the carbon stock monitoring (SILAVA). When scientific work is part of a project (as it is in E2SOILAGRI) the results should be published in peer-reviewed journals in order to a) get a qualified evaluation of the work; and b) make the results available to a wider academic audience and help advance the subject.*

6.4 Informative events and publications in the press

The 200 farmers which participated in the soil carbon monitoring programme received personal thanks and a signed diploma as a recognition for their goodwill. Information will be spread to inhabitants, advisors, farmers etc. through local information channels as well as social media, newsletters, regional municipalities etc. It is also important for agricultural advisors and local agricultural officers to be involved and informed about the activities.

The project group has had discussions on producing thematic maps, such as growth potential, but this is outside the scope of E2SOILAGRI. The first step is making farmers and other users familiar with the new soil maps. The soil classification map will for now be available on the data service Geolatvija[3].

A land management information system will be developed in the future and the hope is that farmers will be provided access easier. As of today, there is a tool produced by UoL that combines data from SPPS (and soil data), Rural Services, Animal data and banking details in order to easily provide farmers connected data, such as GHG balance, pollutants in the future etc.

Remark from the review team:

- *Informative events seem to have been meaningful and successful.*

[3] https://geolatvija.lv/geo/#/

Conclusions

This project final evaluation review summarizes the information obtained during the in-country mission to Latvia in November 2023. The mission took place around three months before the final closing date of the project and some of the deliverables were not yet available. The remaining deliverables can be completed within the project period, but close auditing by the project administration is recommended.

Overall, the E2SOILAGRI project appears successful in meeting both aims and expectations, with good steering and communication between partners. Data capture and development of systems and methodologies worked well, and the results are solid. The project has been carried out according to the activity plan with minor corrections. The review team concludes that the result of E2SOILAGRI so far, and the progress as estimated for the last two months, is in line with the project plan.

The evaluation team has minor concerns regarding the finalization of some of the documentation and scientific papers. Documentation of the various systems and methodologies is important. The project administration and the project promoter may take particular care to follow up these items in the last phase of the project.

The NIBIO interpretation of the situation regarding the Latvian Soil Information System was described in the inception report[4]. E2SOILAGRI was understood as an element in a process aiming to establish a coherent (and official) Latvian soil information system (Figure 7). E2SOILAGRI and other, related activities has brought Latvia to stage T1, with a fairly integrated system.

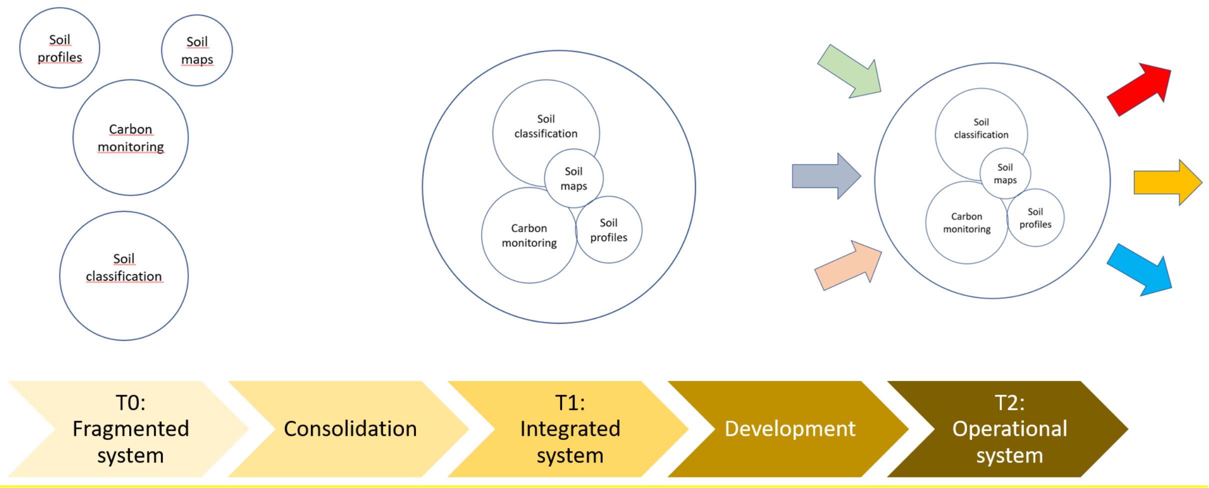

Figure 7 The development of the Latvian soil information system

In order to proceed to a fully operational system (T2), Latvia will improve the regulatory enactments on soil governance issues and mandate a public authority (probably SPPS) to manage the national soil information system. The review team consider this to be a rational plan. It is important that the results provided by E2SOILAGRI in terms of data, methodology, information, and network/cooperation between the participating institutions are transferred to and managed by the mandated public authority in order to consolidate the system and facilitate the next step in the development of the Latvian soil information system.

[4] NIBIO Report 024/2023

References

Strand, G.H. and Svendgård-Stokke, S. 2022a. Enhancement of sustainable land soil resource management in agriculture - E2SOILAGRI. NIBIO Inception report. Nibio Report 024/2022

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World Soil Resources Reports 106. 2014. Food and Agriculture Organization of the United Nations, Rome 2014

Appendix: Agenda for the final evaluation visit to Latvia

Monday, November 6th

11.00	Arrival
14.30-16.30	Interview with Ministry of Agriculture & Project manager Republikas Laukums 2, Rīga (https://goo.gl/maps/dtqNT928o4bg2uvu9)

Tuesday, November 7th

10.00-12.00	Interview with State Plant Protection Service Lielvārdes iela 36, Rīga (https://goo.gl/maps/NsTcggjJ1baXJqoM7)
14.00-16.00	Interview with Latvian State Forest Research Institute Silava Rīgas iela 111, Salaspils (https://goo.gl/maps/21NXnpzsfv5gJrVy5)

Wednesday, November 8th

09.30-12.30	Interview with University of Latvia Jelgavas iela 1, Rīga (https://goo.gl/maps/EzJGE5Y9xB2U8W2z9)
13.30-14.00	Meeting with Ministry of Agriculture regarding budget and deliverables Republikas Laukums 2, Rīga (https://goo.gl/maps/dtqNT928o4bg2uvu9)
14.00-15.00	Project Steering Group meeting Republikas Laukums 2, Rīga (https://goo.gl/maps/dtqNT928o4bg2uvu9)
15.30-17.30	Lunch

Thursday, November 9th

11.40	Departure

Epilogue

This report is based on the knowledge and understanding that the NIBIO review team obtained during the in-country mission, 6th-9th of November.

Key words:	soil classification, soil information, soil carbon monitoring, GHG emissions
Other publications:	NIBIO Report Vol. 8, No. 24, 2022. Enhancement of sustainable land soil resource management in agriculture – E2SOILAGRI. NIBIO Inception report NIBIO Report Vol. 8, No. 67, 2022. The Norwegian Soil Information System. Data capture, Data management, Data processing and Dissemination. NIBIO Report Vol. 8, No. 149, 2022. Enhancement of sustainable land soil resource management in agriculture – E2SOILAGRI. Project mid-term report

NIBIO - Norwegian Institute of Bioeconomy Research was established July 1 2015 as a merger between the Norwegian Institute for Agricultural and Environmental Research, the Norwegian Agricultural Economics Research Institute and Norwegian Forest and Landscape Institute.

The basis of bioeconomics is the utilisation and management of fresh photosynthesis, rather than a fossile economy based on preserved photosynthesis (oil). NIBIO is to become the leading national centre for development of knowledge in bioeconomics. The goal of the Institute is to contribute to food security, sustainable resource management, innovation and value creation through research and knowledge production within food, forestry and other biobased industries. The Institute will deliver research, managerial support and knowledge for use in national preparedness, as well as for businesses and the society at large.
NIBIO is owned by the Ministry of Agriculture and Food as an administrative agency with special authorization and its own board. The main office is located at Ås. The Institute has several regional divisions and a branch office in Oslo.

Front cover photo: Soil experts studying a soil profile (Photo: Geir-H Strand/NIBIO)
Back cover photo: Measurement equipment (Photo: Geir-H Strand/NIBIO)

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