AdaptaN II - Integrated approaches of the Moravian-Silesian Region landscape to climate change adaptation.

Report NIBIO activities – Part 1: Mitigation measures.

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SAMMENDRAG/SUMMARY:

Denne rapporten gir en oversikt over NIBIO sine aktiviteter i AdaptaN II prosjektet gjennomført i samarbeid med tsjekkiske partnere. NIBIO har bidratt med vurdering av erosjonsrisiko og modellering av erosjonstiltak for klimatilpasning på jordbruksarealer for et nedbørfelt i Větřkovice i Moravian – Silesian Region i Tsjekkia. Delrapport 1 gir en oversikt over aktuelle erosjonstiltak i bruk i Norge samt regelverk, støtteordninger og subsidier for miljøtiltak. Delrapport 2 gir en oversikt over faktorer ved vurdering av erosjonsrisiko og resultat fra modellering av utvalgte erosjonstiltak, spesielt vegetasjonssoner og grasdekte vannveier for studieområdet i Tsjekkia.

This report gives an overview of NIBIO activities in the AdaptaN II project and cooperation with the Czech partners. NIBIO has contributed with evaluating erosion risk, modelling of erosion and measures to reduce erosion for the Větřkovice cadastrial area in the Moravian – Silesian Region. Report- Part 1 presents an overview of the erosion measures used in Norway and overview of regulations and support systems for such measures. Report- Part 2 gives an overview of the work with evaluation of the erosion risk factors and modelling erosion measures for the study area in Czech Republic. It includes identifying crucial factors for erosion in the landscape and modelling effect og selected adaptation measures like buffer zones and grassed waterways.

NIBIO
NORSK INSTITUTT FOR BIOØKONOMI

LAND/COUNTRY:	Czech Republic
STED/LOKALITET:	Větřkovice cadastrial area

APPROVED	**PROJECT LEADER**
Anja C. Winger	Lillian Øygarden
ANJA C.WINGER	**LILLIAN ØYGARDEN**

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Content

Norway grants

STATE ENVIRONMENTAL FUND OF THE CZECH REPUBLIC

Working together for a green Europe
Supported by Norway through the Norway Grants.

Norway grants AdaptaN II

Preface

The report gives an overview of NIBIO's activities in the project: AdaptaN II- Integrated approaches of the Moravian-Silesian Region landscape to climate change adaptation. The AdaptaN II project is funded by the Financial Mechanism within the Norway Grants Programme (2014- 2021), grant call 4A Bergen. Project registration number 320- 4200006. The project period has been July 2021- April 2024.

In the project NIBIO has cooperated with partners from Czech Republic under the leadership of professor Miroslav Dumbrovsky at Brno University of Technology. Assistant professor Veronika Sobotkova at Brno University of Technology has been the contact person for the administrative matters during the project period, including reporting and organizing joint project meetings.

During the project period, the project teams from NIBIO and Czech partners have visited each others institutes and field locations for experiments. Joint exursions of the project teams into different landscapes in the two countries have documented differences in topography, soils and agricultural practices and environmental influence. It has also given opportunity to discuss and compare efficient environmental measures to reduce runoff and erosion from agricultural areas. During these meetings there has been knowledge sharing of working methods, field experiments and modelling. These excursions and meetings are documented on the webpages for the project.

NIBIO has contributed with two reports in the project:

AdaptaN II- Integrated approaches of the Moravian-Silesian Region landscape to climate change adaptation:

Report -Part 1 gives an overview of erosion measures used in Norway and overview of regulations and support systems for such measures.

Report -Part 2 gives an overview over modelling for the Větřkovice cadastrial area in Moravian Silesian region. It includes identifying crucial factors for erosion in the landscape and modelling effects of selected adaptation measures like buffer zones and grassed waterways.

Dominika Krzeminska, Robert Barneveld and Lillian Øygarden have been the core team from NIBIO. We have also had valuable contributions from collegues giving presentations at AdaptaN II project meetings at NIBIO.

Marie- Cecile Gruselle has contributed to collect information from available reports about agricultural measures used in Norway and finalizing the reports. Csilla Farkas has contributed with information about NIBIO modelling activities and models being used in ongoing projects. Anja C. Winger has read the reports for quality check.

From the administration in NIBIO we have got a lot of assistance from Susanna Pedersen, Anne Kallum and Hanne Sørli with follow up contracts and documents for the reporting periods during the project.

Lillian Øygarden

Project leader

Ås 24.04 2024

1. Background and introduction

1.1 Background

The AdaptaN II project is funded by the Norwegian Financial Mechanism within the Norway Grants Programme (2014 - 2021), grant call 4A Bergen. Project registration number 320 - 4200006. Project period: July 2021- April 2024. The project builds on the previous, successfully evaluated project AdaptaN I, which was performed in the period 2015-2016 and was financially supported by the EEA mechanism Norwegian Funds.

Project webpage: https://adaptan2.eu/o-projektu

NIBIO -webpage: https://nibio.no/en/projects/adaptan-ii.integrated-approaches-of-the-moravian-silesian-region-landscape-to-climate-change-adaptation

The aim of the project is to support the implementation of selected nature-friendly adaptation and mitigation measures in the Moravian-Silesian region in Czech Republic.
The Moravian-Silesian Region (MSR) was the first region in the Czech Republic to develop "Adaptation Strategy of the Region for the Impacts of Climate Change. The project will support next phases of implementation and realization of adaptation measures in MSR, will elaborate the whole implementation process of adaptation for free landscape and suburban zones as a model for other Czech regions. It will apply integrated approaches according to the National Action Plan for Climate Change and it will contribute to the implementation of 7 measures according to the MSR Adaptation Strategy.

The main goal of the project is professional support for implementation of the "Adaptation strategy of the Moravian-Silesian region against impacts of climate change." As such, the project is supporting the goals of regional, national and European strategies for adaptation to climate change by addressing protection against drought and erosion, reduction of material runoff, improving water retention and the green infrastructure of the landscape.

The sub goals of the project are:

- Model example of methods and course of implementation nature-related adaptation measures in rural and suburban areas within the Region and target user groups, including promotion.
- Locational targeting of measures for relevant and vulnerable areas.
- Demonstration of measures in pilot areas using integrated approach.

Project partners:
Project leader of AdaptaN- II has been Professor Miroslav Dumbrovsky at Brno University of Technology. Overview of project partnes;

- Brno University of Technology, Faculty of Civil Engineering, Institute of Landscape Water Hydrology,
- T.G. Masaryk Water Institute
- ARVEN-Academy of Rural Development, registered association
- Slovak University of Agriculture in Nitra
- NIBIO-Norwegian Institute of Bioeconomy Research

Detailed description of partners at: https://adaptan2.eu/o-projektu

1.2 NIBIO's contributions

NIBIO has been involved in several project activities. The main contributions:

- Modeling erosion risk at the catchment level and effectiveness of implemented (and/or potential) measures → as contribution to:
  - **Indicator 8:** Infiltration belt alongside water courses to reduce contamination by erosion runoff-buffer zones.
  - **Indicator 24:** Application of methods to identify factors in terms of erosion intensity and runoff ratio in the non-vegetation period and proposal of adaptation measures.
- Overview of measures, rules, subsidy schemes in Norway→ as contribution to indicator 8 and indicator 24 (see description above) as well as in combination with contributions and input to **Indicator 25** (described below).

NIBIOs main activities have been performed in the catchment of Větřkovice cadastral area (about 10 km^2). In this study area the Norwegian team has worked with erosion and drainage conditions and measures to reduce erosion and nutrient fluxes from the areas by:

- Applying methods and modelling for identifying and optimization of crucial factors in terms of erosion and drainage condition in non- vegetated period (wintertime).
- Proposal of adaptation measures including reduction of substance efflux, with regard to hydropedologic and climate conditions within the pilot area (including map of locations).
- Proposal for the location and establishment of protective grass belts- buffer zones along watercourses in the pilot area (including map).

The project also includes a comparative study **(indicator 25)** for the Cizina River catchment where the methods and approaches for integrated landscape protection used by the Norwegian (from Větřkovice), Slovakian and Czech partner will be compared. The study includes transfer of examples of good practice and model demonstrations.

In addition to the modelling work at catchment scale and evaluating measures, NIBIO has been involved in:

- Establishment of network, scientific cooperation and exchange of knowledge between NIBIO and Czech partners. This has included scientific joint meetings and excursions to landscapes and monitoring stations in Norway and the Czech study area. The joint meetings and visits have been reported on the project's webpages.

- Information about the AdaptaN- II project and about the EEA mechanism Norwegian Funds, the Norwegian Financial Mechanism within the Norway Grants Programme (2014 - 2021), grant call 4A Bergen. The information activities include the AdaptaN II project webpage at the NIBIO -webpage: https://nibio.no/en/projects/adaptan-ii.integrated-approaches-of-the-moravian-silesian-region-landscape-to-climate-change-adaptation. It has also been produced a poster about the project, and the Czech and Norwegian activities. This, along with other informational material from the project, is available on the webpage.

1.3 Activities and indicators

ADAPTAN II – Integrated approaches of the Moravian-Silesian Region landscape to climate change adaptation

Stage 01: Territorial study to implement adaptation measures close to nature in the territory of the Moravian-Silesian Region.

Substage 07: Preparation and implementation of model demonstration projects of adaptation measures in the catchment area and floodplains with a focus on reducing unwanted substance flows and water contamination.

Activity 07-21: Various ways of using protective grass belt- "bufferzones" along water course to reduce water contamination by erosion runoff in the pilot area (Větřkovice).

Indicator 8: Infiltration belts alongside water courses to reduce contamination by erosion runoff-buffer zones.

Outcome; Proposing the location and establishment of protective grass belt-bufferzones along the watercourse in the pilot area. NIBIO Report- Part 2 (details given below)

Activity 07-22: Modeling of erosion processes for the identification of decisive factors in terms of the intensity of erosion and runoff conditions in the off-vegetation period.

Indicator 24: Application of methods for the identification of decisive factors in terms of the intensity of erosion and runoff conditions in the off-vegetation period and the design of adaptation measures. Proposal of adaptation measures including reduction of substance efflux with regard to hydropedologic and climatic conditions within the pilot area.

Outcome: NIBIO Report- Part 1 (mitigation, indicator 24) and NIBIO Report -Part 2 (modelling, indicator 8 and indicator 24):

AdaptaN II - Integrated approaches of the Moravian Silesian region landscape to climate change adaptation.

Report NIBIO activities - Part 1: Mitigation measures. Dominika Krzeminska, Robert Barneveld, Lillian Øygarden.

Report NIBIO activities - Part 2: Modeling effectiveness of measures. Robert Barneveld, Dominika Krzeminska, Lillian Øygarden.

The Programme: *„Environment, Ecosystem and Climate Change" financed from Norway Grants 2014–2021.*

Call for proposals *„Bergen" on the implementation of selected nature related adaptation and mitigation measures, Call No.: Call-4A*

Document Processors for this Report:

Partners:

April 2024

More information – Czech website:

- Státní fond životního prostředí ČR: www.sfzp.cz/norskefondy
- Ministerstvo financí České republiky: www.norskefondy.cz
- Fondy EHP a Norska: https://eeagrants.org/.

More information – English website:

- State Environmental Fund of the Czech Republic: https://www.sfzp.cz/en/norway-grants/
- Ministry of finance of the Czech Republic: https://www.eeagrants.cz/en/
- EEA and Norway Grants: https://eeagrants.org/

2 Mitigation measures in agricultural catchments in Norway - current situation and challenges

Arable land is a very scarce resource in Norway as only around 3,5 percent of Norway's land area is currently being cultivated 1, 1 mill ha, including croplands and cultivated pastures[1]
Runoff and agricultural influence on, and contribution to, water quality is very dependent on climate, soil and dominating production systems in the different regions. Cereal production, about 30 % of the cultivated area, is mainly located in the southeastern and central part of Norway, often on marine sediments that are prone to erosion. Cultivated grassland constitute about 51 % of the cultivated area and pasture about 16 % of the area. These areas are connected to animal production and are concentrated in the western part of Norway and in districts. Runoff from areas where animal manure is applied has a significant influence on water quality.

The Norwegian Agricultural Environmental Monitoring Programme (JOVA)[2] has monitored water quality and agricultural management practices for more than 30 years. It is a national programme for soil and water monitoring in agricultural dominated catchments in Norway. The 11 catchments represent the most important agricultural areas in Norway with regard to climate, soil and management practices. Results from the monitoring programme are being used by agricultural and environmental authorities when deciding and developing rules, regulation and environmental support systems. NIBIO is leading the monitoring programme and responsible for monitoring stations and reporting. In most of the monitoring stations there is a continuous record of water-flow and sampling for analysis of nutrients, particles and pesticides. JOVA programme has established a database with long time-series of data for nutrient runoff, soil erosion, pesticide loss and agricultural management practices. The results from JOVA are used by the government in their national and international reporting, and in their follow-up of the agricultural policy and general agreement with the farmers including subsidy and support schemes. Data from the monitoring catchments can be downloaded for free at: https://jovadata.nibio.no/. The monitoring data are also used for modelling and research projects like extreme weather analyses, trends in phosphorus losses and long-term trends in monitoring. (Confesor et al., 2023, Liu et al., 2023, Bechmann & Deelstra (Ed), 2013).

The Water Framework Directive (WFD) and the Water regulation, which implements the WFD, provide the basic framework for water management in Norway. Through those, Norway is obliged to achieve a good ecological condition in water, lakes, waterways and the coast by 2027, unless some water bodies have been given an extended deadline to reach the target (2033). In addition, all water bodies must be protected against pollution. Information and data about water quality of water bodies in Norway, guidance document for support systems, measures can be found at; https://www.vannportalen.no/verktoy/vann-nett/

The agricultural sector has an independent responsibility for environment protection, especially when it comes to sediment and nutrient losses. The National Environmental Programme[3] for agriculture provides a comprehensive overview of how the authorities facilitate achieving environmental and climate targets, through agriculture management practices. These includes the mechanism at national, regional and local levels. The National Environmental programme was establishing first in 2004 and it

[1] https://arealbarometer.nibio.no/nn/norge/.

[2] https://www.nibio.no/en/subjects/environment/the-norwegian-agricultural-environmental-monitoring-programme-jova

[3] https://www.landbruksdirektoratet.no/nb/nyhetsrom/rapporter/nasjonalt-miljoprogram-2023-2026

is revised every four years with the intention to ensure that current and emerging environmental and climate considerations are taken into account in agriculture (Fig. 2.1).

Today, surface runoff from fields and ditches is the biggest negative impact factor on the water environment from agriculture. Consequently, the environmental targets set for agricultural sector in Norway are:

- the condition of water bodies in areas dominated by agriculture should not deteriorate.
- water bodies in agriculturally dominated areas that are particularly exposed and polluted, where the condition is to be improved.

These targets require considerable effort from agriculture, therefore there is a need to advocate for efficient and cost-effective mitigation measures targeting environmental challenges in Norwegian agricultural catchments. The most important mitigation measures in agriculture in Norway are management of manure, fertilizer planning, reduced soil tillage, grassed buffer zones along open water, mitigation of point sources and sedimentation ponds.
In addition to measures for reducing losses to water, agriculture also need to reduce emission of greenhouse gases. Some of these measures have synergies with measures to reduce effects on water quality, like measures for manure, fertilizer use, catch crops, measures to increase carbon storage.

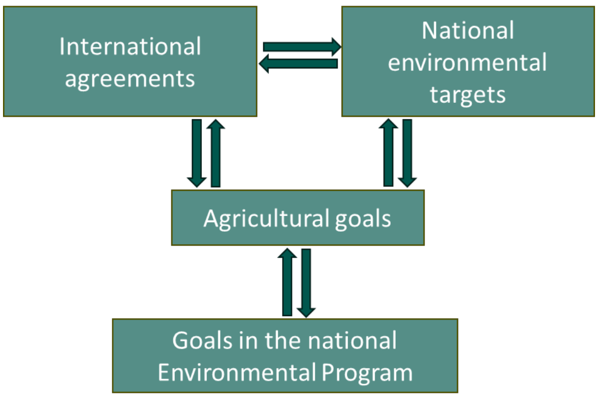


Figure 2.1. Overview of environmental goals at different levels (adapted from National Environmental Programme, (Nasjonalt Miljøprogram) 2023-2026. (Landbruksdirektoratet, 2022).

Most of the listed measures aims at retention of water and nutrients within the catchment by slowing down overland flow and will have a water retention effect. Some measures (tillage, crop cover) protect the surface against erosion from overland flow from rainfall and snow melting. These, measures are then subjects to research activities covering the whole operationalization cycle:

- design - including dimensioning, designing for processes etc.
- optimization of measure(s) location within the catchment
- design and implementation of monitoring programme
- modeling effectiveness of the measures at different spatial and time scales
- forecast the processes and effectiveness of the measures in the future.

In this report, we present and discuss measures crucial for managing runoff from agricultural areas. These measures may become even more relevant with the increase in rainfall and change of winter conditions due to climate change. While measures to reduce greenhouse gases from agriculture have garnered increased interest, they are not included in this report.

3 Planning for mitigation measures in Norway

3.1 Crucial factors for mitigation measures in Norway

The implementation of soil conservation measures requires the allocation of resources. They include time, space/location and money that all could be spent on optimising the output and gains from agriculture. The choice to implement measures for individual farmers is a trade-off between the different objectives of the farming economy. For authorities, rules and regulations around soil conservation measures are expected to represent a balance between agricultural production and environmental protection. As a result, the spatial aspect of planning the implementation of soil conservation measures is important for both the efficiency of the measures and continued societal support.

Soil erosion is one of the most serious threats to productive agricultural land (Weigert and Schmidt, 2005, Boardman et al., 2009, Yakutina et al., 2015). This is especially true in Norway, where the amount of cultivated land is limited and often only has a thin layer of nutrient rich soil (Lundekvam et al., 2003).

In most climates, soil erosion is governed by the surface runoff of water during excessive rainfalls and/or snow melting. It is true for Norway as well. Majority of the erosion events are observed in spring and autumn when the flooding risk is high (Skarbøvik and Bechmann, 2010). Based on the Høbol river example, large differences in water discharge are observed in the cures of the years (Skarbøvik et al., 2014): from relatively stable discharge (1.0–3.0 m^3/s) in winter and summer periods, to dynamically changing high discharge (7.0–48.0 m^3/s) in spring and autumn. However, under Nordic climate conditions these are soil erosion rates in winter and early spring account for a major part of annual soil, phosphorus, and nitrogen losses in agricultural catchments (Deelstra et al., 2011; Confesor et al, *2023*). Snowmelt, combined with rain and frozen (sub-) soil, may lead to severe runoff and consequent soil erosion (Lundekvam and Skøien, 1998, Øygarden, 2003, Deelstra et al., 2009). However, the severity of the erosion is often amplified by preceding winter conditions (Fig. 3.1).

Figure 3.1. Runoff and erosion during winter period. Frozen soil may restrict infiltration and give high runoff and soil losses on fields that are cultivated. (Photo: L. Øygarden).

Consequently, there are several factors that are crucial when planning for soil conservation measures in Norway. These factors are summarized in the form of erosion risk map for Norway.

3.2 Erosion risk map

Erosion risk map is an important part of the soil conservation strategies in Norway. In this map, soil erosion risk classes are presented. These, in turn, create the base for funding optional location of particular soil conservation measures (and may influence the level of subsidies for measures, *see section 4.2*).

Norway's current erosion risk map consists of two layers that represent the three main processes that drive erosion from agricultural soils: sheet, drainage and gully erosion (Fig.3.2; Kværnø *et al.*, 2020). Sheet erosion calculations are based on a process-oriented model (PESERA; Kirkby *et al.*, 2008). This map replaced a USLE based calculation in 2020, and is optimized to use existing, spatially explicit, input data in order to predict erosion rates in a variety of climatic conditions and different soil types. The model's main input data are:

1. Weather statistics*: monthly average and total precipitation, number of rain days and coefficient of variance, and monthly average and range of the day temperatures.*
2. Terrain characteristics: *slope inclination, slope length factor (RUSLE-type).*
3. Soil physical properties: *bulk density, effective hydrological depth (TOPMODEL-type), erodibility.*

Much of Norway's agricultural soils do not have sufficient natural drainage capacity to evacuate the precipitation surplus. Tile drains are therefore widely installed, presumedly on any soil that does not have a very significant sand fraction. About 2/3 of the agricultural areas need artificial drainage for securing agricultural production. Soil loss through drains can occur on soil with macropores and cracks and is also dependent on filter type around the drains. Soil loss through the tile drain system is calculated by means of an empirical function, derived from a series of runoff plots in different agro-climatic regions in Norway. The sum of sheet and drainage erosion is presented by the four classes in the erosion map (from pink to the purple tone in Fig.3.2a). The classes are: low erosion risk, middle risk, high risk and very high risk.

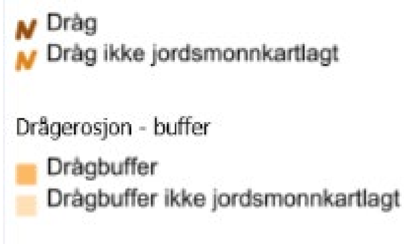
The brown lines in Fig.3.2a represent locations in the landscape that are prone to ephemeral gully erosion. These locations are identified through a terrain analysis that combines location slope conditions with annual accumulated overland flow, a by-product of PESERA.

The model's primary spatial unit is the soil map polygon. Norway's soil map covers about 50% of the country's agricultural area, although the percentage for arable land only is in the range between 80 and 90%.

Figure 3.2a. Norway's erosion risk map (colour scale for sheet/drainage erosion, line elements for gully erosion).

Erosion risk classes: Line elements for gully erosion (*nor: dråg*) with buffer areas:

Very high
High
Middle
Low



In the subsidy/application system, the two layers are combined into a subsidy map (blue colours) with six classes (Fig. 3.2b). This is the map that individual farmers use when they apply for subsidies, by drawing in polygons and labeling them with their planned soil conservation measure. Subsidies are paid after erosion risk classes and choice of measure to reduce erosion (see also *section 4.2*). There are different subsidies after the four erosion risk classes and combination with gully or not for each field.

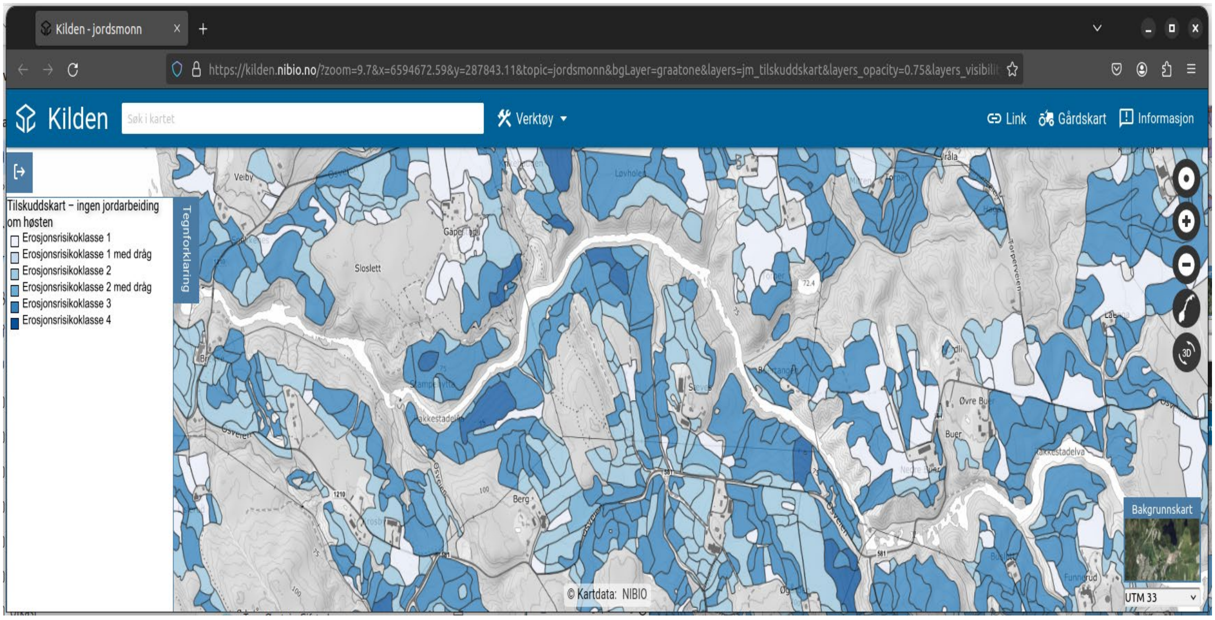


Figure 3.2b. The subsidy classes map, used by farmers in the application process. Erosion risk classes 1- 4 and combination erosion risk class and gully (*nor: med dråg*).

3.3 Examples of soil conservation measures in Norway

There is a wide range of soil conservation measures that are relevant in Norway. NIBIO is providing an overview of different measures together with the "state of the art" of their operationalization, in the webpage; 'Guide to environmental measures in agriculture' (nor: *'veileder for miljø og klimatiltak'*)[4]. For the erosion risk map there is available specific guidelines: Erosion risk measures: https://nibio.brage.unit.no/nibio-xmlui/handle/11250/2723843

[4] https://www.nibio.no/en/subjects/environment/guide-to-environmental-measures-in-agriculture?locationfilter=true

The examples of measures listed under these guidelines, and relevant for AdaptaN II project, are:

- Reduced tillage - no tillage in autumn, stubble during the winter

A stubble field within Kråkstad catchment, April 2022. Photo: A-G. B. Blankenberg

- Permanent grass cover within areas prone to flooding and erosion

Area along Hobøl river. Photo: D. Krzeminska

- Catchcrops

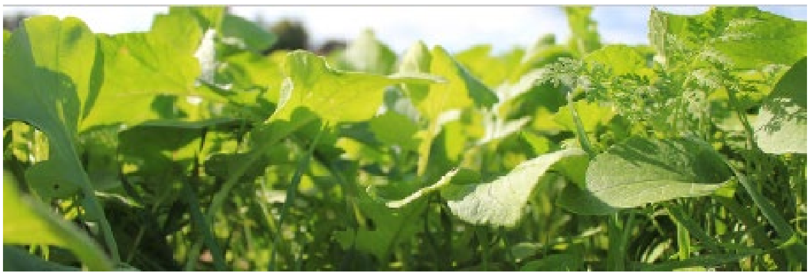


Photo: NLR

- Grassed covered buffer zones

Hobøl river, Norway. Photo: D. Krzeminska

- Grassed waterways

Example of grassed natural waterway in the landscape. Photo: A-G. B. Blankenberg

- Constructed wetland

Constructed wetland within Kråkstadelva catchment. Photo: A-G. B. Blankenberg)

- Retention/Sedimentation ponds

Small Retention Pond in the forest at Svinndal, with different stages of water level in the pond: empty (left) and full (right). Photo: D. Krzeminska

In addition to these field management and structural/design measures, it is important to also mention drainage systems and measures for control of surface runoff and hydrotechnical solutions like:

- intersection ditches
- reduce long slopes (Fig. 3.3)
- maintenance of drainage system (Fig 3.4)
- inlets and downspouts to the drainage system (Fig 3.5)
- securing drainage outlets at stream banks (Fig 3.6)
- stabilizing stream banks (Fig 3.7)

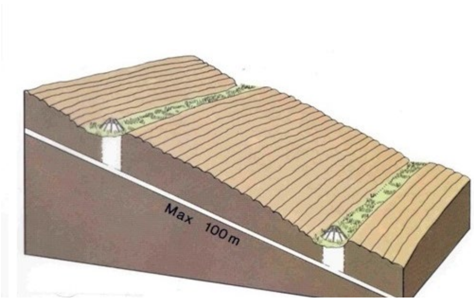


Figure 3.3. Schematic presentation of the mitigation strategy aiming at “breaking down” long slopes with grass strips, combined with inlets for surface runoff (L. Øygarden).

Figure 3.4. Repair of damaged drainage systems and inlets for surface runoff (Photos: Atle Hauge, Lillian Øygarden)

Figure 3.5. (left) Schematic representation of grassed waterways in topographic depression in the field combined with inlets for surface runoff (L. Øygarden) (right) trench for leading excess water from forest into inlets to avoid runoff into entering agricultural areas (Photo: Ingrid Tenge).

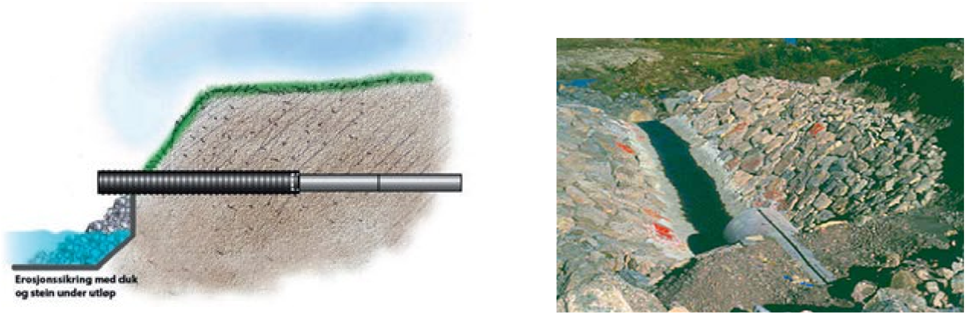


Figure 3.6. Securing drainage outlet at streambanks. (Figure 19 in Hauge & Haraldsen, 2017).

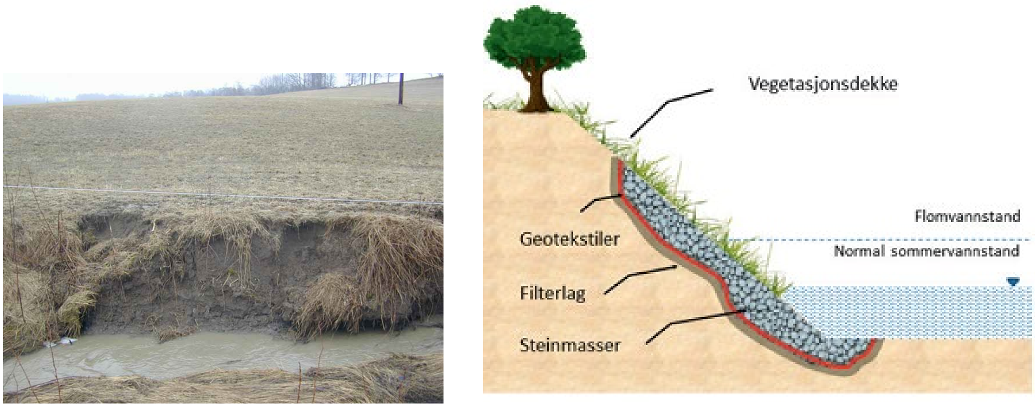


Figure 3.7. a. Erosion in stream bank (photo: L. Øygarden) b. stabilization by geotextiles, stones and vegetation cover. (Fig. 6 in Hauge & Haraldsen, 2017).

3.4 Efficiency of the measures

(This overview is based on the internal NIBIO report from SirkVann project, Chapter 4, by Farkas C., Barneveld R. and Krzeminska D.)

The effectiveness of the mitigation measures depends on several aspects, including land use, terrain characteristic, soil characteristic, design, and placement of the measure as well as scale of observations. The key aspect is optimal location of the measures, which allows to make the best use of the terrain (Stolte & Barneveld, 2020). Therefore, the efficiency of the measures is case study dependent.
Below (Table 3.1) we list some examples of the measures we work on in NIBIO and their estimated effectiveness.

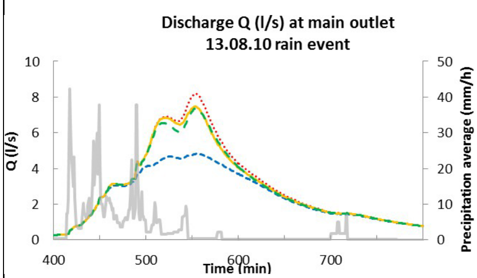
Table 3.1. Examples of mitigation measure studied in NIBIO, with their effectiveness (based on field experiments and/or modelling.

<table>
<tr><th>Measure</th><th>Source of information</th><th colspan="3">Effectiveness</th></tr>
<tr><td rowspan="6">Reduced soil tillage</td><td rowspan="6">INCA_P model runs for the same settings as published in Farkas et al. (2013)</td><td rowspan="2">Soil tillage system</td><td>soil loss</td><td>TP loss</td></tr>
<tr><td colspan="2">kg/ha/year</td></tr>
<tr><td>Autumn ploughing</td><td>1844</td><td>2.8</td></tr>
<tr><td>Autumn harrowing</td><td>1198</td><td>1.6</td></tr>
<tr><td>Spring tillage</td><td>461</td><td>0.5</td></tr>
<tr><td colspan="3">NOTE: The values are valid for agricultural areas of S-E Norway, erosion risk class 3. (Skuterud catchment)</td></tr>
</table>

<table>
<tr><td>Land use change</td><td>INCA_P model runs for the same settings as published in Farkas et al. (2013)</td><td>
<table>
<tr><th>Land use class</th><th>soil loss</th><th>TP loss</th></tr>
<tr><th></th><th colspan="2">kg/ha/year</th></tr>
<tr><td>Grass</td><td>110</td><td>0.180</td></tr>
<tr><td>Forest</td><td>15</td><td>0.008</td></tr>
<tr><td>Urban</td><td>80</td><td>0.010</td></tr>
</table>
NOTE: The values are valid for agricultural areas of S-E Norway, erosion risk class 3.</td></tr>
<tr><td rowspan="2">Retention ponds

Morsa water region, Norway
Svinndal retention pond, Norway</td><td>MORSA project/modelling (LISEM)

(based on Stolte and Barneveld, 2020)</td><td>Calculated flood peak for areas with dam (as a percentage of calculated flood peak without dam). Numbers <100 means smaller flood peak for areas with dam.
<table>
<tr><th></th><th colspan="3">rainfall event</th></tr>
<tr><th>area</th><th>5 Years</th><th>10 years</th><th>25 years</th></tr>
<tr><td>Vestre Løvstad</td><td>1</td><td>74</td><td>24</td></tr>
<tr><td>Hvitsten</td><td>9</td><td>59</td><td>20</td></tr>
<tr><td>Slituveien</td><td>65</td><td>64</td><td>37</td></tr>
<tr><td>Hundstrop</td><td>93</td><td>85</td><td>74</td></tr>
</table></td></tr>
<tr><td>RECARE project/monitoring and stakeholders' perception</td><td>Although the number of floods was not quantified during the monitoring, according to the statements of the farmers, the flooding over the agricultural land is reduced from 2-3 times a year to once every second year (reduction in local flooding) (Krzeminska et al., 2018)</td></tr>
<tr><td>Grass covered buffer zones- Skuterud catchment, Norway</td><td>Exflood project/modelling (LISEM)

https://app.cristin.no/results/show.jsf?id=1499214</td><td>There were several scenarios considering modelling the outflow from Skuterud catchment. Results are presented in the figure below:


without measures
with grass strips along channel
grass strips along contour lines
grassed waterways
Precipitation</td></tr>
<tr><td>Buffer zones with different vegetation types

Hobølelva, Norway</td><td>BUFFERKLIMA/field measurement

(based on Krzeminska et al, 2020)</td><td>Buffer zones are expected to have better infiltration capacity compared to agricultural soil. Meaning that they should contribute to reduction of surface runoff.
<table>
<tr><th>Buffer zone with:</th><th>Infiltration</th></tr>
<tr><td>Grass</td><td>little or no effect</td></tr>
<tr><td>Bushes</td><td>little or no effect</td></tr>
<tr><td>Trees</td><td>positive effect</td></tr>
</table>
NOTE#1: only considering surface flow
NOTE#2: Bushed was newly planted</td></tr>
</table>

Constructed wetlands	Internal NIBIO project connected to JOVA programme (based on *Krzeminska et al., 2023*)	The monitoring results showed an average of: - 39 % annual removal efficiency for sediment - 22 % annual removal efficiency for phosphorus (during monitoring period 2003-20218) At the seasonal level: - the highest sediment and phosphorus removal efficiency is observed in the summer seasons (47% for sediment and 29% for phosphorus) - the lowest in autumn (23% for sediment) and in winter (4% for phosphorus)
Grassed waterways Romerike (Akershus)	Internal NIBIO reporting	The effect of grassed waterways on soil loss has been documented in only a few studies. In Norway, only one study examined the effect of grassed waterways in a small agricultural catchment (26.8 daa or 2.68 ha) in Romerike (Akershus) and it showed 55% reduction of soil loss (average from 8 years) after implementation of grassed waterways.

It is important to stress that in case of modelbased estimates of the efficiency of the measures the results depend strongly on the parametrization of the measures in the model (see *AdaptaN II report – Report Part2: Modeling*).

For some of the measures there are not annually documentation, but field inventory after extreme events or after snow melting can document erosion and sedimentation processes. Figure 3.8 show a schematic figure of erosion and sedimentation after a winter runoff event (Øygarden, 2003). Erosion rills from an autumn tilled field were reduced by 50 % when entering into a winter wheat field. Erosion material sedimented in the grassed waterway, with 8 cm depth at the edges of the waterway and with 20 cm depth in the middle of the waterway.

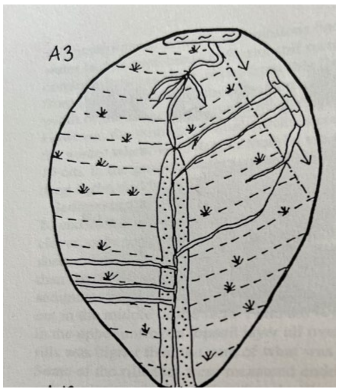


Figure 3.8. Grassed waterway where sedimentation was monitored (Øygarden, 2003). a. grassed waterway in the topographical depression. b. Illustration of erosion rills and sedimentation after an erosion event.

3.5 Location of measures in agricultural catchment

It is known that location of the measures and the maintenance have significant influence on their effectiveness over time (e.g. Barneveld 2022). Identification of optimal locations of measures is therefore a very important step in the implementation process and should be done best at the catchment level.

The increased availability of geodata, including weather data, in combination with an ever-increasing computing power of pc's and cpu's, enables researchers and planners creating several scenarios including combination of measures in the catchment, accounting for their optimal location, spatial distribution and interconnections.

3.5.1 Field/crop management measures

The field/crop management measures can be implemented for a whole or part of the field- and for many or only selected fields in a catchment. Knowing the erosion risk in particular fields can help locate fields with high erosion risk for optimizing locations, by identifying where the measure could have the highest efficiency. e.g. reduced tillage in the areas of high erosion risk class (RMP Oslo and Viken, 2023; see also *section 4.2*).

NOTE: In Norway, reduced tillage is the soil conservation strategy that is most widely used. There are several reasons for this. The subsidies for reduced tillage (stubble in autumn, light harrowing) was established after the event with algae blooming in the North Seas late in the 1980s. Diffuse runoff from agricultural areas transporting phosphorus and nitrogen to the sea was one of the major sources and there was also algae blooming in inland waters at the same time. This put focus on the need to reduce the losses from agricultural areas- and initiated erosion research and producing the first erosion risk maps in Norway. The maps should help finding areas with high risk of erosion where measures should be implemented. These maps included only sheet and some rill erosion but not gully erosion. Erosion measured in plot studies (Norwegian plot studies) documented soil loss from autumn ploughing with spring tillage, light harrowing, direct drilling and grassland. Factor for relative erosion risk were established (C-factors) between tillage timing and method, and this was used for payment of subsidies for implementing measures (Lundekvam, 2002; 2007). It was given priority to measures for whole fields - use of stubble and light harrowing (payment after risk of erosion). Measures for buffer zones and grassed waterways were implemented some years later. Example of C-factors: Autumn tillage and spring cereals is set to erosion risk 1. Stubble during autumn and winter period reduce the risk factor to 0,66 in erosion risk class 3, to 0,46 in erosion risk class 3 and 0,34 in erosion risk class 4. Direct drilling reduces the erosion risk to 0,27 in erosion risk class 2, to 0,16 in erosion risk class 3 and 0,11 in erosion risk class 4. Use of gras would reduce the risk to only 0,09 in erosion risk class 2, 0,04 in erosion risk class 3 and 0,02 in erosion risk class 3 (Kværnø et al., 2014).
Reduced tillage is considered of little importance for yield reduction (Tørresen *et al.*, 2015). Exceptions are very wet spring periods that result in delays in the start of the operations after winter. Reduced tillage does not require any reallocation of capital in the production process. The measure is part of a well-established system of production/soil conservation strategies (*see also section 4.1*). One important part of this system is the connection and link to the national soil erosion risk map (Fig.3.2; Kværnø *et al.*, 2020). This is the basis for classifying fields for erosion risk and payment of subsidies.

3.5.2 Structural/designed measures

For the structural measures various approaches can be used to find the best location. Below we show the procedures to find the best location of some mitigation measures in the agricultural catchment that are most relevant for AdaptaN II project.
NOTE: The premise for all methods presented here is that the required data are readily available in Norway's national geodata repositories, and therefore applicable at any spatial scale without additional data acquisition. The overview presents the methods used in Norway for buffer zones, grassed waterways and constructed wetlands.

Buffer zones

Buffer zones are vegetated areas along the streams or rivers. The increased surface roughness that results from the perennial or permanent vegetation is slowing down the overland flow coming from fields lying above/hillslope the vegetated areas. This reduces the sediment transport capacity and increases the infiltrating fraction of the surface runoff.

Since, buffer zones are situated alongside riverbanks, creeks, and as such, they are easily mapped for small or large areas. In Norway, the geodata source that represents surface waters best is provided by Kartverket (2015). This map contains two layers:

- one containing lines, represents small watercourses and creeks, the latter more sizeable rivers and lakes.
- one containing polygons, representing larger streams and rivers.

Once both the line and polygon elements are checked against aerial imagery or another source of verification, potential location of buffer zones is calculated by creating a polygon of desired width at either side of line and/or polygons (Fig. 3.9).

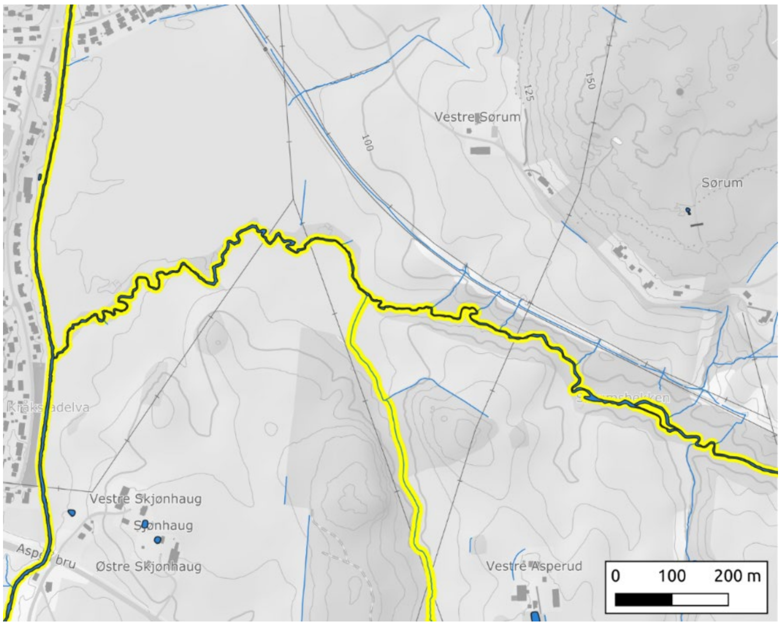


Figure 3.9. Example of 6m wide buffer zones along water bodies in Norway. See also Figure 3.10.

NOTE#1: Care should be taken to not draw the potential buffer zones in the areas that already have natural vegetation (e.g. forest). Moreover, potential location of the buffers should be double checked against existing infrastructure.

NOTE#2: The width of the typical buffer zone in Norway ranges between 5 and 10m depending on the region, and this is a tradeoff between buffer zones efficiency measures in the field (Syversen, 2002), reviewing national and international literature (Blankenberg et al., 2017) and practical approach (e.g. size of the equipment used for establishing and maintenance of buffer zones).

Grassed waterways

Grassed waterways are located in talweg; linear areas of concentrated overland flow. On agricultural soils in Norway, these areas are prone to ephemeral gully erosion. An ephemeral erosion risk map was developed by NIBIO and published in 2020 as part of the national erosion risk map (NIBIO, 2022). The optimal placement of grassed waterways is therefore easily obtained by drawing a 6 m wide buffer (size required by RMP, *see section 4.1*) with the existing gully erosion risk lines as the center lines (Fig. 3.10)

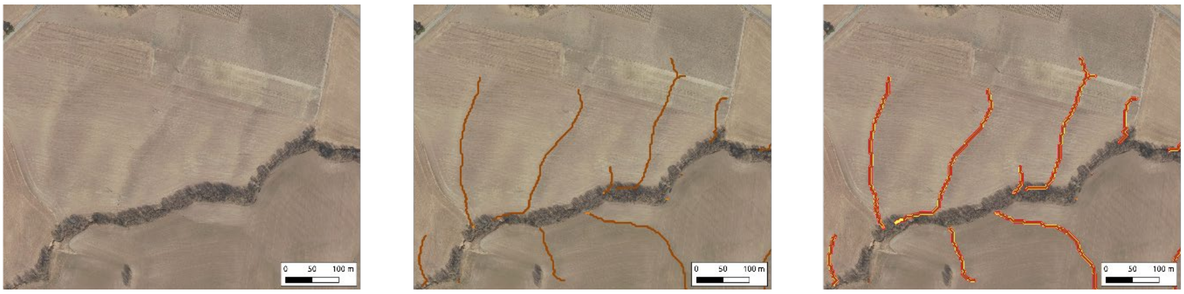


Figure 3.10. Example of placement of grassed waterways: terrain > gully erosion risk > grassed waterways (6 m width).

NOTE: Grassed waterways can be combined with inlets for surface runoff (see fig 3.5).

Constructed wetlands

The optimal placement of constructed wetlands (CW) is prescribed by its function, and its hydraulics. In Norway, the main aim of the wetland is to improve the quality of runoff from agricultural soils by removing sediment and nutrients, mainly phosphorus. A typical CW in Norway consists of a deeper sedimentation chamber, followed by one or more shallow vegetation filters, often divided by thresholds (e.g., dams, stones, baffles: Fig 3.11).

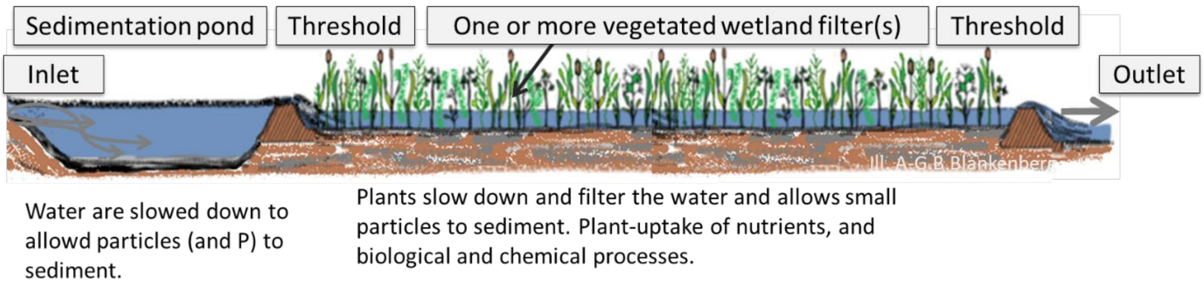


Figure 3.11. The components of a "typical" Norwegian constructed wetland, designed mainly to remove suspended sediment and phosphorus, due to that these traditionally are the main cause of eutrophication in surface water in Norway.

The first condition for optimal placement therefore is the percentage of agricultural land use in the contributing area of the wetland. Earlier research by NIBIO showed that the optimal location of a constructed wetland has a contributing area between 0,5 and 3,0 km² (Grønsten *et al.*, 2008). The hydraulic function of constructed wetlands requires the presence of a longitudinal flat area with a natural depression, or at least characterized by terrain that can be excavated and/or levelled. Therefore, constructed wetlands in Norway are often located at the outlet of the agricultural dominated catchment, by widening of the existing stream. These conditions can be mapped quantitatively at any spatial scale because of the availability of the required geodata: the availability of a national Norwegian elevation model with a high spatial resolution (a 1x1 meter raster grid), provides the opportunity to assess the presence of naturally occurring depressions in the landscape (Fig. 3.12 and fig. 3.13).

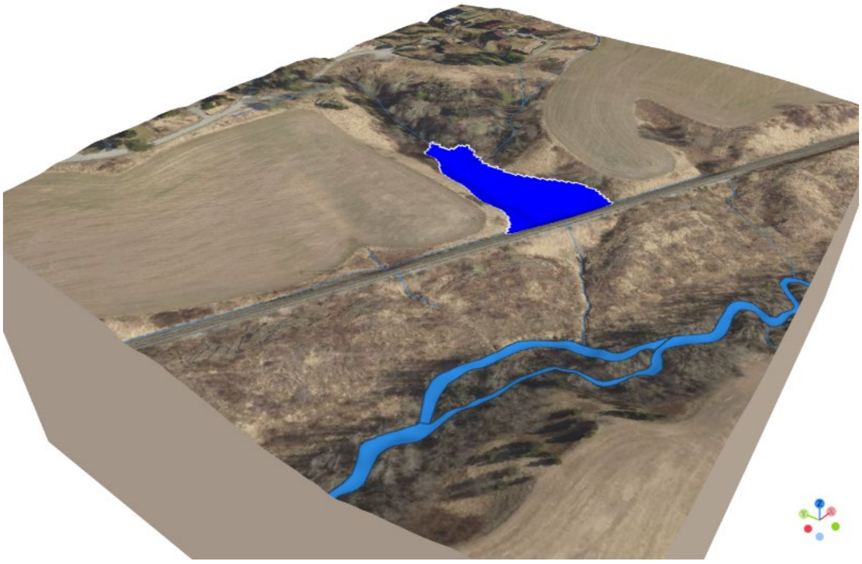


Figure 3.12. Detailed mapping of depressions in the terrain (dark blue indicates a potential retention or wetland location).

NOTE#1: additional suitability indicators that can be included when optimizing location of CW can be 1) nature value, 2) presence of quick clays (prone to land sliding), and 3) hydrological connectivity or 4) the percentage of agricultural land use in the contributing area of the wetland.

NOTE#2: Result of potential location of CW can then be presented for further discussion with land users, municipality or county administrators and other stakeholders.

Retention dams

Retention dams are planned for peak flow reduction and flood prevention. The primary qualification for locations in the landscape is the possibility to store significant volumes of water, and to release it naturally with a lower discharge rate. Retention dams can be constructed to protect infrastructure, built up areas and agricultural areas. NIBIO has undertaken mapping exercises for large areas in South-eastern Norway; Haldenvassdraget, Øyeren, Morsa and Glomma-Sør (Stolte and Barneveld, 2020).

The steps to find optimal location of retentions dams are as follow (Stolte and Barneveld, 2022):

1) identifying sizeable sinks/depressions in the landscape - the availability of the 1 m Digital Elevation Model for Norway allows for the mapping of small and narrow sinks, that might not be detectable with lower resolution elevation data.
2) Ranke the suitability of sizable sinks according to the preferences set by the objective of the dams. In the example by Stolte and Barneveld (2020) retention dams were projected to protect agricultural land. Therefore, further selection of the sinks was based on:
    a. Their location in the forested areas, upstream from agricultural land and
    b. The significance of contributing areas
    c. The extent of the area that could be flooded.
    d. Etc.

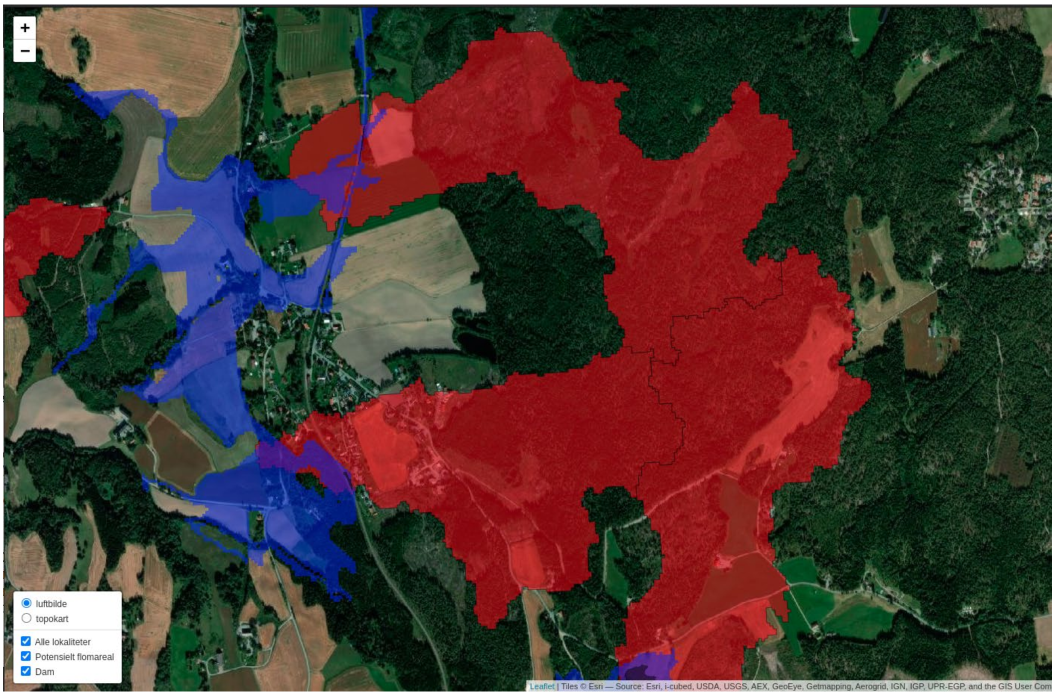


Figure 3.13. Example of an online representation of a selection of potential locations for retention dams. The red areas are contributing areas, the blue areas are at risk of being flooded by storm waters from these catchments.

NOTE: Result of potential location of retention ponds can then be presented for further discussion with land users, municipality or county administrators and other stakeholders.

4 Regulations, subsidy schemes in Norway

4.1 Legislation and Subsidies

The Ministry of Agriculture and Food (*nor: Landbruks- og matdepartementet; LMD*) and the Ministry of Climate and the Environment (*nor: Klima- og miljødepartementet, KLD*) are the highest authorities in Norway working on instruments limiting the impact of agriculture on the water environment. These includes legal, financial and administrative instruments (Table 4.1).

The administrative instruments include information, advice, and knowledge development. Continuous work is ongoing to develop and adopt knowledge about environmentally friendly operations, their operationalization, and relevant best practices. A comprehensive presentation of environmental measures in agriculture is given in the National Environmental Programme (Landbruksdirektoratet, 2022).

It is the National Environmental Programme (Nasjonalt Miljøprogram, NMP) that sets the frame for goals and developments important for nutrient retention and climate mitigation strategies at the national level. It also provides the basis for the regional agri-environmental rules and regional and local financial mechanisms, while it is the Land Act that allows the government to formulate operating rules.

At national level, the Regulation on Production Subsidies is a central economic instrument, while the most important regional and municipal economic instruments are respectively the Regional Environmental Program in Agriculture (RMP) and Special Environmental Measures in Agriculture (SMIL). Regional and local level legislation and strategies are core documents as these set the frames for financial support and for environmental requirements in agriculture. The priorities, subsidies management and supervision lays within responsibility of regional (County Governor; *nor: Statsforvalteren*) or local (municipality; *nor: Kommune*) administration.

Table 4.1. Legislation and policy documents relevant for sediment and nutrient retention measures in agriculture.

Legislation document	Listing relevant issues covered by legislation
National level	
National Environmental Program. *(Nasjonalt Miljøprogram, NMP)*	Gives an overall picture how the authorities can contribute to development in agricultural sector focusing on improving environment and adaptation to climate changes. Provide the legal basis for regulating substances for agricultural measures. Provide national predefined list of compulsory and voluntary agricultural and environmental measures
The Land Act *(Lov om jord, jordlova)*	Allows the government to formulate operating rules (such as regulations for subsidies) to ensure sustainable agricultural land use. *NOTE: Authorizes agricultural regulations on regional level (inc. Regulation of agricultural subsidies, Regulation about new cultivation, SMIL)*
Water Resource act. § 11[NBZ] *(Vannressursloven)*	Set obligation to maintain 'sufficient' buffer zone alone all water bodies *(size not defined)*
The Planning and Building Act, water regulation. *(Plan- og bygningsloven, Vannforskriften)*	Provide legal basis for all permits and planning considering land use. Provides and overall objective for Norwegian water management. Puts the requirement of making water management plans. Governs regulations on new cultivation activities

Regulation of agricultural production subsidies *(Forskrift om produksjonstilskudd)*	Important economical instrument Production subsidies depends on maintenance of buffer zones (*NOTE: this refers to natural buffer zones)* There is a requirement to maintain natural buffer zone of: minimum 2 meters width within existing fields minimum 6 meters when establishing new fields *NOTE: there are also other restrictions in order to receive production subsidies, like requirement of fertilization plan (based on nutrient status in soil samples) in accordance with current fertilizing regulations (nor: gjødselregelverk)*
Regulation about new cultivation [NBZ] *(Forskrift om nydyrking)*	Not allowed to cultivate peatland without specific permission.
Regional level (economical instrument)	
Regional Environmental Program *(Regional Miljøprogram i jordbruket RMP)*	Developed within the frames of the National Environmental Program (NMP) It involves cross-compliance with a combination of legal obligations and economic incentives. Stimulates/provides funding for the implementation of measures to, among others, reduce the runoff of nutrients and particles into waterways *NOTE: In addition, there are special rules for the catchments/areas with lakes that are used as a source of drinking water. Within these areas the subsidies for measures are higher. (see also description below table).*
Local Level (economical instrument)	
Special environmental measures in agriculture *(Spesielle miljøtiltak i jordbruket, SMIL)*	Promote the natural and cultural heritage values in the agricultural cultural landscape and to reduce pollution from agriculture. Stimulates/provide funding for locally prioritised measures, mostly "one-shot interventions" – depends on the municipality. *NOTE: The strategy of measures needs to consider a national predefined list (from NMP) and funding is received from the state on an annual basis.*

[NBZ] Maintenance of **natural buffer zones** (NBZ) along the rivers and streams is common water quality focus measure in Norway. Therefore, they are specifically referred to in several legislations' documents. While **buffer zones** as agricultural measures are referred to/and get financing support via SMIL program.

The Figure 4.1 shows how the environmental goals are associated with decision support and financial support mechanism at different administration levels.

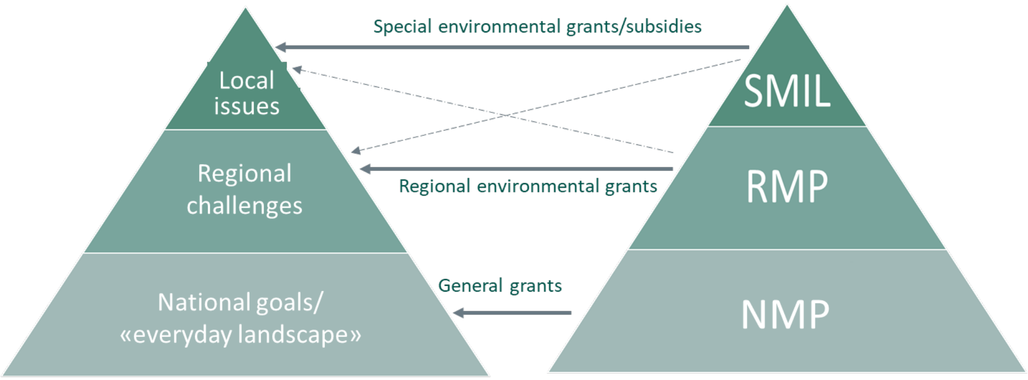


Figure 4.1. Environmental goals and associated financial mechanisms. NMP – National Environmental Program, RMP - Regional Environmental program, SMIL - Special environmental measures in agriculture.

Areas with specific regulations. In areas where runoff can influence water quality e.g. used for drinking water or there is risk for not fulfilling the requirements set by the Water Framework Directive, specific regulation, legislation can be decided. In such prioritised areas (Table 4.2) the level of subsidies can be higher than for other areas. In Oslo and the nabouring counties, Akershus, Østfold and Buskerud, the regulation for prioritised areas with specific regulations (*nor: Miljøkravsone 2*) include:

- No tillage nearer than 2 meters from inlets for surface runoff.
- Bufferzones along all water courses
- No autumn tillage in areas with risk of flooding, specific support for gras at such areas.
- No tillage in topographical depressions with erosion risk (risk of gully erosion) 6m permanent buffer at each side of the depression /gully area if the field is being tilled.
- For areas in erosion risk class 3 and erosion risk class 4, 60 % of the area used for cereals must be in stubble, gras covered, direct drilling for winter wheat or have catch crops during the winter period. For winter wheat it is allowed with a light harrowing (max 10 cm depth and leaving 30 % organic matter visible at surface layer).

4.2 Examples of mitigation measures in agriculture with relevant incentives

Agriculture is largely a regulated industry, and farmers are used to following, assessing, and complying with the authorities' objectives and instruments. The authorities have the following tools: financial (subsidies: RMP and SMIL), legal (laws and regulations: NMP, RMP) and administrative (information).

Research shows that farmers' motivation for implementing certain operations is a combination of a more complex set of motivational factors than only financial compensation (Vik and McElwee 2011; Veidal and Flaten 2011; Alsos et al. 2003). While making decisions, farmers tend to maximize benefit (Gasson 1973) that includes both economic (providing income for themselves and family, employment), agronomic (managing and utilizing land resources, agriculture in practice), social (farming as a lifestyle, acceptance from local communities) and environmental (biological processes) factors.

In table 4.2 we present the examples of measures that are most implemented (Bechmann and Veidal, 2020) and relevant for ADAPTAN II, together with the relevant financing mechanisms.

Table 4.2. Examples of mitigation measures in agricultural catchment with relevant financing mechanisms. Subsidies given in euro/ha. RMP= regional environmental programme, SMIL = Special environmental measures.

Measure	Short description of the measure	Subsidies
Reduced tillage/stubble	The grant will encourage arable land not to be tilled in the autumn after the last harvesting. It considers area with cereals, oil crops, leguminous crops, seed meadows and maize. The area must not be tilled before 1st of March of the year after the application and the stubble on this area must not be burned. The subsidy can be given to areas in all erosion risk classes within 'priority areas' and other areas. 'Priority areas' are areas below the marine boundary. *NOTE: In order to apply to these subsidies, farmers need to log in to the online system (Gårdskart) where erosion classes for each field is given and select the measure they apply subside for- for each field. The level of subside will automatically be calculated after location of area (priority /other areas) and erosion risk class.*	RMP: 90 - 177 euro/ha at priority areas and 35 - 65 euro/ ha at other areas at risk outside the priority areas Level of subsidies depends on the erosion risk class. Highest subsides for field with risk of both sheet and gully erosion

Grass or stubble in flood and erosion prone areas	Grow/maintain perennial crops on arable land that is particularly prone to flooding and erosion (as defined in the regional environmental requirements) The plants must be well established in the autumn of the application year. Tillage and sowing must take place between 1st of March and 1st of July.	RMP: 103 euro /ha at priority areas and 65 euro /ha in other areas
Catch crops (cover crops)	Promote green cover of the soil - cover crops protect the soil surface from erosion and runoff of nutrients during heavy rainfall and floods. It can also contribute to increased carbon storage. The catch crop must be sown after early harvesting. The catch growth must be well established in autumn. *NOTE: there are several specific restrictions about maintenance of cover crop din order to be entitled for subsidies (see RMP Oslo and Viken, 2023)*	RMP: 160 euro/ha for cereals and 260 euro/ha for catch crops in vegetables and potatoes.
Grass covered buffer zones in the fields and in the meadow	Perennial grass cover along the borders/edge towards waterways on arable land. <u>In a field</u>: Minimum 8 m wide, with at least 6 m on fully cultivated area. The plants must be well established in the autumn, must not be fertilized, or sprayed with pesticides, but should be maintained. Tillage and sowing must take place between 1st of March and 1st of July. <u>In a meadow</u>: the edge towards watercourses (normally 6 m, with at least 4 m on fully cultivated area) is not fertilized or sprayed with pesticides. Harvested by mowing or grazing in the year of application. Tillage and sowing must take place between 1st of March and 1st of July.	RMP: 2 euro /m of established buffer zones
Grassed waterways	Perennial grass covering gullies and local depression within the fields with a minimum width of six meters. The plants must be well established in the autumn of the application year.	RMP: 3 euro/ m of established grassed waterways
Establishing and/or emptying (maintenance) of constructed wetland	Constructed wetlands established on or adjacent to the agricultural land, with proven effectiveness. Maintenance of the constructed wetland	SMIL: up to 70% of costs of establishment
Retention pond	Retention pond as a flood mitigation measures that delay runoff and can reduce the flood peaks.	SMIL: up to 70% of costs
Drainage (repair of hydrotechnical measures Inlets of surface water to drainage system (nor: kum mer)	Subsidies for hydrotechnical measures under the SMIL scheme must primarily be for the repair of damage to existing facilities, in addition to normal maintenance to reduce erosion and runoff of soil and nutrients. This could be the repair of damaged sumps and pipe outlets, security measures, repair of some cut-off ditches, the need for increased capacity due to changed rainfall conditions and similar measures.	SMIL: up to 70% of costs

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NIBIO
NORSK INSTITUTT FOR BIOØKONOMI

Norsk institutt for bioøkonomi (NIBIO) ble opprettet 1. juli 2015 som en fusjon av Bioforsk, Norsk institutt for landbruksøkonomisk forskning (NILF) og Norsk institutt for skog og landskap.

Bioøkonomi baserer seg på utnyttelse og forvaltning av biologiske ressurser fra jord og hav, fremfor en fossil økonomi som er basert på kull, olje og gass. NIBIO skal være nasjonalt ledende for utvikling av kunnskap om bioøkonomi.

Gjennom forskning og kunnskapsproduksjon skal instituttet bidra til matsikkerhet, bærekraftig ressursforvaltning, innovasjon og verdiskaping innenfor verdikjedene for mat, skog og andre biobaserte næringer. Instituttet skal levere forskning, forvaltningsstøtte og kunnskap til anvendelse i nasjonal beredskap, forvaltning, næringsliv og samfunnet for øvrig.

NIBIO er eid av Landbruks- og matdepartementet som et forvaltningsorgan med særskilte fullmakter og eget styre. Hovedkontoret er på Ås. Instituttet har flere regionale enheter.

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