SUSTAINABLE AGRICULTURE SELECTED AGRI-ENVIRONMENTAL INDICATORS, FIRST RESULTS

EU 4 Green:
Support the implementation of the Green Agenda for the Western Balkans
WP 1-17 Agri-Environmental indicators & Monitoring

IPA/2021/429-949

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ABBREVIATIONS

ADA	Austrian Development Agency
AEI	Agri-Environmental indicator
ALB	Albania
BIH	Bosnia and Herzegovina
DG	Directorate General (of the European Commission)
DG ENEST	Directorate General for Enlargement and the Eastern Neighbourhood
EC	European Commission
EAA	Umweltbundesamt (Environment Agency Austria)
EEA	European Environment Agency
EU ETS	EU Emissions Trading System
EU	European Union
GARI	Green Agenda for the Western Balkans Action Plan Implementation Report
GAWB	Green Agenda for the Western Balkans
GHG	Greenhouse Gases
GIZ	German Agency for International Cooperation GmbH
GNB	Gross Nutrient Balance
HNVF	High Nature Value Farmland
IPA	Instrument for Pre-Accession (of the EU)
IPARD	IPA Rural Development
MKD	North Macedonia
MNE	Montenegro
MRVA	Monitoring, reporting, verification of emissions & accreditation of verifiers
RCC	Regional Cooperation Council
SRB	Serbia
SWG	Standing Working Group for Regional Rural Development South East Europe
UAA	Utilised agricultural area
WB	Western Balkans
WB6	Albania, Bosnia and Herzegovina, Kosovo*, Montenegro, North Macedonia, Serbia
WP	Work package
WS	Workshop
XKX	Kosovo

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1. INTRODUCTION

The EU4Green project plays a key role in the European Commission's ongoing commitment to supporting the Western Balkans in their transformative journey towards sustainability, aligned with the Green Agenda for the Western Balkans (GAWB) (European Commission, 2020c, Regional Cooperation Council, 2020, Regional Cooperation Council, 2021).

EU4Green fosters progress across all five pillars of the Green Agenda for the Western Balkans, addressing the challenges of EU ETS MRVA, circular economy, depollution of water, air, and soil, biodiversity, sustainable agriculture, and cross-cutting themes such as green finance, monitoring and reporting, communication, education, and stakeholder participation. The project remains a key instrument in helping WB6 economies transition toward EU standards and foster climate neutrality by 2050. EU4Green is a comprehensive project that draws on the collective expertise and close collaboration of the economies involved, coordinated by Umweltbundesamt, Environment Agency Austria (EAA).

The aim of this work package of the EU4Green project has been to improve data availability and disseminate knowledge of the methodology for Agri-Environmental indicators (AEIs) as well as exploring ways of presenting AEIs. This work package focuses especially on indicators related to the topics addressed by the Green Agenda (European Commission, 2020c, Regional Cooperation Council, 2020) and thus show the state and progress of specific GAWB actions and initiatives:

- to promote environmentally friendly and organic farming and to reduce the use of synthetic chemicals in food production
- to support measures to reduce emissions and adapt to climate change in agriculture.

The work on the Agri-environmental Indicators and Monitoring is also linked to the GAWB Action Plan by supporting monitoring and reporting mechanisms and addressing Actions 44, 46, 50 of the Action Plan (Regional Cooperation Council, 2021). For more information regarding the GAWB Action plan, see chapter 2.
Further, the evaluation of the IPARD[1] programmes and the possible use of AEI for this purpose was a major driver for the work.

[1] IPARD = Instrument for Pre-Accession (of the EU) Rural Development

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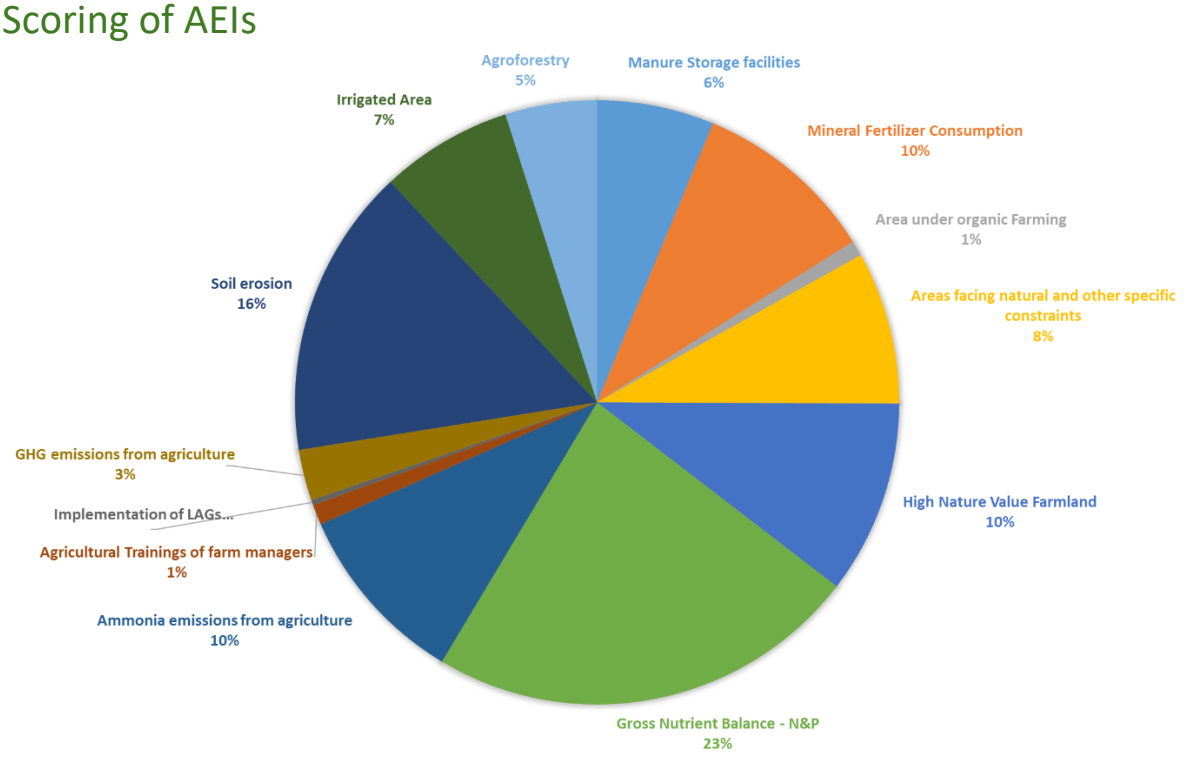
Based on a comprehensive overview of existing AEIs at European level[2] , which supplement the EU Common Agricultural Policy, AEIs were selected in cooperation with experts from the six Western Balkan economies at a dedicated regional workshop in Tirana in September, 2023 (see Figure 1-1). Attendees from all beneficiaries were asked to rank indicators from a preselected list of European AEIs. Based on the discussions and the selection, three "core indicators" were chosen.

- Gross Nutrient Balance (GNB),
- High Nature Value Farmland (HNVF) and
- Soil Erosion, to be determined by the proxy-indicator "Area of erosion vulnerable/prone crops".

Figure 1-1: Scoring of AEIs by participants at the workshop in Tirana, 20 September 2023



Throughout the project and especially in the months following this workshop, data on these indicators were collected in close cooperation with the WB6 Thematic Coordinators and experts from all beneficiaries. The preliminary results of the AEIs were presented at a regional online workshop in May 2025. All attendees were asked to provide feedback on the collected datasets, in both written and verbal form.

[2] More background information: https://agriculture.ec.europa.eu/system/files/2023-02/pmef-context-impact-indicators_en.pdf, https://ec.europa.eu/eurostat/web/agriculture/database/agri-environmental-indicators

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The present report thus contains the first initial results for the three selected core AEIs. These results are based on data received and the intensive exchange of information with all Thematic Coordinators for Sustainable Agriculture in the WB6 economies and the nominated experts. These results should be interpreted as first steps or starting point in the development of AEIs that the Western Balkan economies will need to establish.

2. AEIS FOR GAWB IMPLEMENTATION

Based on the indicators for Sustainable Agriculture laid down in the Action Plan for the implementations of the Sofia Declaration on the GAWB (Regional Cooperation Council, 2021), the Green Agenda Western Balkan (GAWB) Implementation Report 2022 (Regional Cooperation Council, 2023) contains two Agri-Environmental indicators:

- Share of the area under organic farming in the total utilised agricultural area (%)
- GHG emissions from agriculture.

The indicator values for ”Share of the area under organic farming in the total utilised agricultural area (%)” remain generally low, ranging from 0.1 % to 1.8 %, compared with the EU27 mean, which was 9.1% for 2020 (Regional Cooperation Council, 2023). It is stated that organic farming still remains a niche production system. However, the proportion of land used for organic farming within the total utilised agricultural area in all Western Balkan economies increased from 2016 to 2020. Montenegro and Kosovo* registered the highest growth with a relative increase of 0.51% and 0.24%, respectively. Growth in other economies such as Albania, Bosnia and Herzegovina and North Macedonia, is far lower than 0.10% (Regional Cooperation Council, 2023).

The indicator “GHG emissions from agriculture” shows a decline in each economy in the period 2016-2021 (Climate Watch, 2025, Regional Cooperation Council, 2023).

In addition to these two agri-environmental indicators, which were not developed within EU4Green but originate from other frameworks, this work package introduces further AEIs in the context of GAWB. These newly developed indicators are presented in this report and are intended to complement and enhance the existing ones.

3. METHODOLOGY OF THE THREE DEVELOPED CORE AEIS

This chapter gives an overview of the European methodologies of the three core indicators. Results for each WB6 can be found in the subchapters below.

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The three core AEIs Gross Nutrient Balance (GNB), High Nature Value Farmland (HNVF), Soil Erosion: proxy-indicator "Area of erosion vulnerable/prone crops" have been developed and are presented in the following chapters. They are based on data received from the Thematic Coordinators for Sustainable Agriculture in the WB6 economies and nominated experts.
This report contains only first, preliminary results for the three core AEIs and the results should be interpreted as first steps or a starting point for the AEI development.
On the basis of the elaborated calculation files (excel-files) and qualitative assessments, the work can be continued by the Western Balkan economies by improving the input data (activity data, economy-specific coefficients and expert assessments), indicator presentation and interpretation, assessment texts or other related contents.

3.1.1. Gross Nutrient Balance (GNB)

The methodology for GNB calculation is laid down in the Eurostat/OECD handbook (EUROSTAT/OECD, 2013). The methodology and results for some EU Member States are published at the Eurostat website (Eurostat, 2025a).
The Agri-Environmental Indicator Gross Nutrient Balance (GNB) is a key indicator for the targets of the EU Farm to Fork Strategy (European Commission, 2020a) and the EU Biodiversity Strategy (European Commission, 2020b) for the reduction of nutrient losses by at least 50%, while ensuring that there is no deterioration in soil fertility.
In the EU Common Agricultural Policy (CAP) the AEI Gross Nutrient Balance is an Impact Indicator (I.15 Improving water quality: Gross Nutrient Balance on agricultural land) under the current performance monitoring and evaluation framework (PMEF) (2023-2027). The impact indicators will assess the achievement of the general and specific objectives set out in the Regulation establishing rules on CAP Strategic Plans (European Parliament and the Council of the European Union, 2021). Furthermore, GNB is one of the 28 EU Agri-environmental indicators to track the integration of environmental concerns into the CAP (European Commission, 2006). In the Western Balkan IPARD Programmes GNB is used as a Context Indicator for Water Quality.

The Gross Nutrient Balance describes the nutrient input and output of the utilised agricultural area. The calculations and assessments made during the EU4Green project solely deal with Nitrogen, at EU CAP level also Phosphorus balances are carried out.
The EU Implementing Regulation (EU) 2024/2212 regarding statistics on nutrients sets out the methodological frame, the datasets needed and the methodologies to calculate the Gross Nutrient Balance at national level from 2029 onwards (European Commission, 2024).
The table below and Figure 3-1 show the current methodology for GNB calculation and the five most important steps, which were calculated for the Western Balkan economies within this project.

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These five steps were used to make the first calculations of the gross nitrogen balance per beneficiary over several years, depending on the availability of data.

Table 3-1: "5 steps" for GNB calculation: Nitrogen Inputs to and Outputs from the Utilized Agricultural Area

	Nitrogen Inputs to the Utilised Agricultural Area:		
1	Mineral Fertilizer: Nitrogen Amounts	Mineral (inorganic) fertilizer consumption by agriculture: N in tonnes	Data from Statistical Offices, Data is often available from Greenhouse Gas Inventories
2.	Livestock numbers + Nitrogen Excretion coefficients (per animal category)	Annual Livestock statistics + Nitrogen Excretion Coefficients for Livestock Categories (kg N per head per year)	Data from Statistical Offices, Data is often available from Greenhouse Gas Inventories, N excretion coefficients from Universities, Agricultural institutes, Advisory services, etc.
3.	Area of legume crops + Biological Nitrogen fixation coefficients	leguminous crops: area (1000 ha) + Coefficients (kg N per ha)	Data from Statistical Offices, N coefficients from Universities, Agricultural institutes, Advisory services, etc.
	Nitrogen Outputs from the Utilised Agricultural Area:		
4.	Crops and Forage: Yields and Nitrogen contents	Crop and Forage Production: Amounts (Yields) + Nitrogen Contents (kg N per tonne yield)	Data from Statistical Offices, N contents from Universities, Agricultural institutes, Advisory services, etc.
	Reference Unit:		
5.	Utilised agricultural area (UAA)	Area in hectare	Data from Statistical Offices

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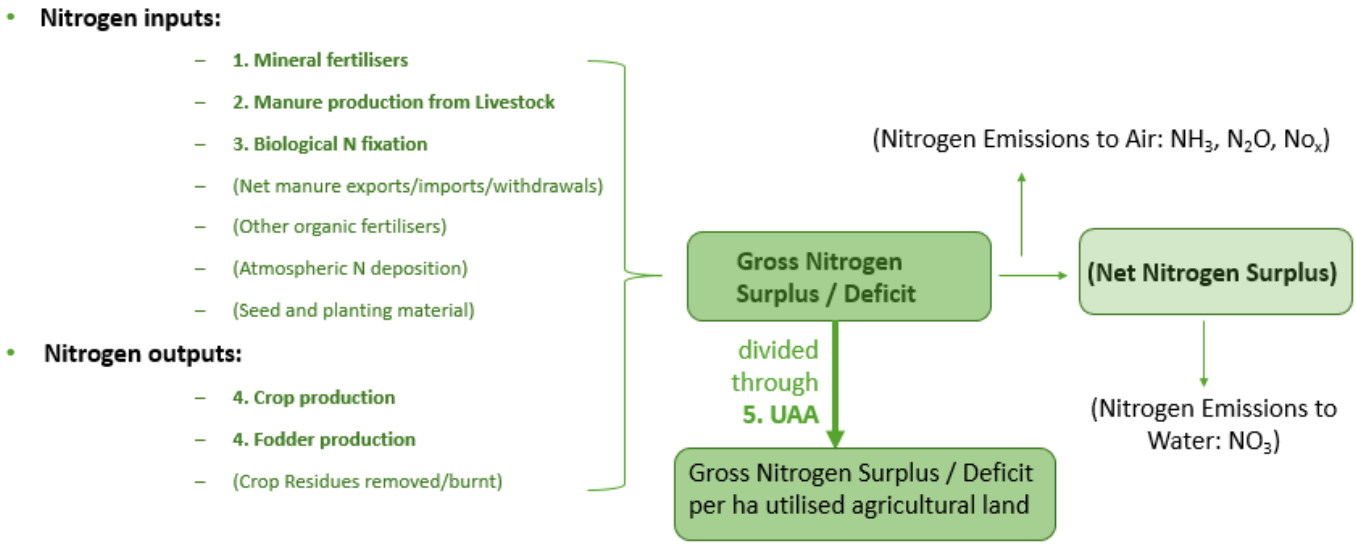
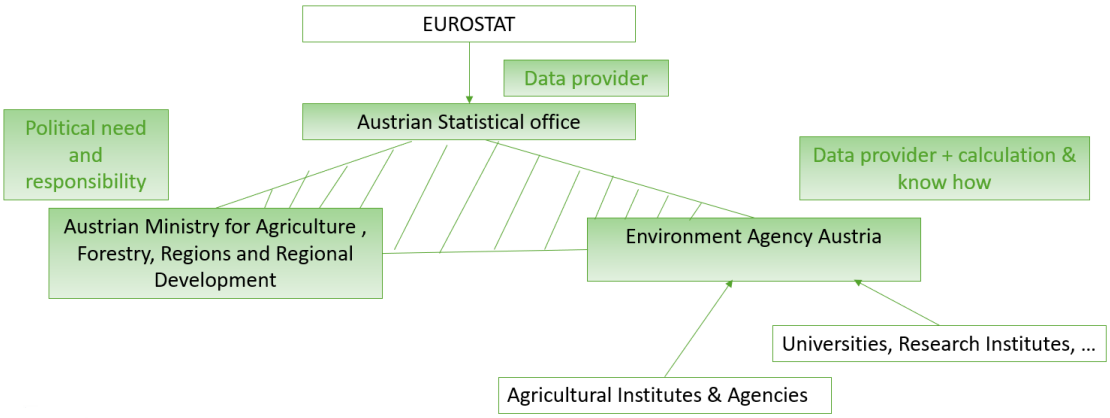
Figure 3-1: Methodology and results of the Gross Nitrogen Balance: Important 5 steps (1., 2., 3., 4., 5.)



To support the collaboration between the institutions in the Western Balkan economies that is necessary for GNB calculations, the institutional arrangements and cooperation for the calculation of GNB in Austria is shown as an example in Figure 3-2.

Figure 3-2: Organizing data provision and calculations for the GNB– example Austria: „Triangle of institutions"



3.1.2. High Nature Value Farmland (HNVF)

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The concept of High Nature Value Farmland (HNVF) describes the inherent positive effect of certain agricultural measures and activities on biodiversity conservation. Certain habitat types and species depend on low-intensity farming practices, that have evolved in certain regions according to the local environmental conditions. While HNVF refers to areas of agricultural landscape that are ecologically important, HNV-farming refers to the type of agriculture that leads to the conservation and development of HNVF or contributes to it. While many different types of agricultural utilization can contribute to the conservation of biodiversity, mosaic landscapes with semi-natural farmland are considered an essential component. These include semi-natural pastures and grasslands, orchards, landscape elements such as hedges and creeks. This creates complex landscape networks that not only provide habitats for wildlife, as well as various other ecosystem services such as wildfire prevention, storage of genetic diversity, cultural values and unique agricultural products (Weiß, Schwaiger, 2024, EFNCP, 2025).
In 1990 the EEA (European Environment Agency) and UNEP created a definition for HNVF and developed methods for identifying HNVF areas on a European scale. The first version of a European HNVF map was published in 2008 and identified three types of HNVF (Paracchini, Petersen, Hoogeveen, Bamps, Burfield, van Swaay, 2008):

- Type 1 – Farmland with a high proportion of semi-natural vegetation.
- Type 2 – Farmland with a mosaic of low intensity agriculture and natural and structural elements, such as field margins, hedgerows, stone walls, patches of woodland or scrub, small rivers etc.
- Type 3 – Farmland supporting rare species or a high proportion of European or World populations.

These three types are not mutually exclusive, they all contribute to biodiversity conservation (Paracchini, Petersen, Hoogeveen, Bamps, Burfield, van Swaay, 2008).
The indicator High Nature Value farmland used to be a mandatory agri-environmental indicator for EU member states. However, in the current period (2023 – 2027) it is not obligatory anymore. Member states are still encouraged to track the development. Links of the HNVF Indicator to the IPARD programmes of the specific economies are described in the dedicated chapters.

The Pan-European approach developed in 2008 has been revised several times over the years. For 2025 the EEA plans to update and publish the new results for HNVF in Europa, including more detailed results for the Western Balkan region. Currently, the mapping of HNVF in Europe involves the following steps:

1. **Selection of Corine Land Cover (CLC) Classes:**
   HNVF comprises the core agricultural classes (2xx) and selected grazed semi-natural classes (3xx and 4xx). The final selection of CLC classes varies and is based on expert consultations for each economy, including the WB6. The full list of CLC classes can found in the Annex, **Table *7-1***. In the EU27 semi-natural classes are further

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differentiated by the application of grazing shares, based on habitats according to the EU habitats directive (European Commission, 1992). Grazing shares are available for the WB6 with the new EEA update.

2. **Expert rules for detailed exclusion and inclusion of Corine Land Cover (CLC) Classes**
   The basic CLC selection (see step 1) is further refined by additional expert rules. CLC classes can be included or excluded in specific environmental zones or regions. For example, in Cyprus vineyards (class 221) are included above 400 m, but complex cultivation patterns (242) in coastal areas are excluded due to intensive use.
   Expert rules are also available for the WB6 and have been revised in cooperation with the regional experts of EU4Green.
3. **Special areas**
   Important Bird Areas are added due to their value for biodiversity, thus they can "overrule" the expert rules.
4. **Spatial refinement by Copernicus High Resolution Layers (HRL)**
   Due to the low spatial accuracy and the broad minimal mapping unit (25 ha) of CLC, pan-European Copernicus products are added to improve the spatial resolution. This way, areas that are not used for agriculture (e.g. sealed areas) can be excluded. On the other hand, grassland patches, that are too small to be shown in CLC, can be included. The HRLs that are used to further refine the HNVF layer are: Grassland (GRA); Imperviousness Density (IMD), Tree Cover Density (TCD) and Water and Wetness (WAW). Areas with more than 30 % of soil sealing and areas of permanent water are generally excluded. Other rules are specifically made for each CLC class.
5. **Intensity assessment (Total N-Input)**
   Total Nitrogen Input by CAPRI is used to identify areas with high intensity that are unlikely to contain HNVF and is only applied to central agricultural land (2xx). However, this data is only available for EU27. The assessment of WB6 has not been affected by this step (Weiß, Schwaiger, 2024).

For the assessment of HNVF in the WB6 as part of the EU4Green Agri-Environmental Indicators work, the European approach was used as a baseline. In cooperation with the EEA, regional experts were included in the ongoing discussion of expert rules and further refinement of the HNVF layer for the WB6. The results of this work package will directly contribute to the HNVF update planned for 2025. In the report on hand the assessment of the AEI HNVF focuses on literature research and the previous results from 2012 of the European approach.

3.1.3. Proxy-Indicator for Soil Erosion by water: Soil erosion prone crops

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Soil Erosion has been identified as a main driver of land degradation in the Western Balkans region. On hillsides and sloping areas soil erosion by water is a dominant factor. Unplanned deforestation in some parts of the region further exacerbates the problem. With more extreme weather phenomena caused by climate change, agricultural land is expected to become more vulnerable to increased erosion and land degradation. While 5 out of 6 beneficiaries report soil erosion and consequent soil degradation as an important environmental issue, many lack official data regarding soil erosion or monitoring systems. A report by the SWG has determined that particularly agricultural land is in danger of degradation by soil erosion. A soil health assessment by the JRC has estimated that 45 % of agricultural land in the Western Balkan region is affected by soil erosion, being also a main driver of desertification. About 25 % of the area in Albania and Montenegro are currently subject to desertification (Zdruli, Jones, 2022). For example, it has been estimated by the SWG that 80 % of agricultural land in Serbia and 33.5 % in North Macedonia is affected by soil erosion. In Albania 22 % of the land area has intolerable values of soil loss rates with values up to 185/t/ha/year being reported (SWG, 2018b, SWG, 2022, Vidojevic, 2022).

Priorities and actions related to soil erosion are set out in policy documents and environmental and agricultural strategies. However, to develop efficient policies and action plans, data regarding soil erosion is needed. Currently, the understanding of the impact of agricultural management is to some extent incomplete. Expanding the knowledge and the data available on soil erosion is vital to tackle future challenges. An indicator on soil erosion for the Western Balkans will enable a better understanding of the current state and can assist in policy monitoring and evaluation (SWG, 2018b, SWG, 2022, Vidojevic, 2022).

In the current list for context and impact indicators for the European common agricultural policy (CAP) to track the socio-economic, sectorial and environmental impacts also includes Soil erosion by water (I.13; C.41). The European impact indicator (I.13) *Reducing soil erosion* consists of two specific indicators: 1) estimated rate of soil loss by water erosion (t/ha/year) and 2) percentage of agricultural land at risk of moderate and severe soil erosion. It assesses potential soil loss by water erosion (e.g. rain splash, sheetwash, rills) and identifies agricultural areas susceptible to a rate of soil erosion considered unsustainable. They are based on an empirical computer model called Revised Universal Soil Loss Equation (RUSLE2015), developed by the Joint Research Center of the European Commission (JRC-ISPRA). The model provides an estimate of soil erosion by water based on scientific knowledge, peer review published manuscripts, technical judgment and input datasets (Eurostat, 2024).
Erosion rates are classified as follows:

- Moderate (5-10 t/ha/yr)
- Severe (> 10 t/ha/yr) (Eurostat, 2024).

The RUSLE model consists of various inputs:

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- R-Factor: Erosivity of rainfall
- K-Factor: Erodibility of soils
- L- and S-Factors: Slope length and steepness
- C-Factor: Crop cover and management
- P-Factor: Soil protection factor

However, compiling this data is challenging. In some cases, data is not yet available for all beneficiaries. For this reason, it was decided to focus on the C-Factor (crop cover and management) and develop a proxy-indicator for soil erosion by water. The trend of the area of erosion-prone crops has been proven to be a valuable proxy for soil erosion by water, as erosivity increases with the percentage of erosion-prone crops area. With currently available data for all WB6, it is possible to determine the development of the area of erosion-prone crops as proxy-indicator for soil erosion.

Thematic Coordinators for Sustainable Agriculture and other experts from all WB6 were invited to share their experiences and to work on this proxy indicator. In a first step, local experts determined the vulnerability against soil erosion of crops grown in the Western Balkans. In case local values were not available, values from neighbouring economies were used. The vulnerability for soil erosion was given on a scale from 0 – 3 (0 being no vulnerability, 3 being high vulnerability for soil erosion by water). Consequently, crops with values 2 or 3, such as corn or pumpkin, were considered prone to soil erosion. Experts also provided a written explanation of the chosen values for each crop.

Secondly, teams from all WB6 and Environment Agency Austria collected data on crop areas for all crops and total agricultural land. If possible, statistical offices were included in the data gathering process and official data was used. However, collection of complete and comparable datasets has often proven as a challenge. Due to different definitions and categories in databanks comparability between the WB6 economies is limited. In order to complete the tables, data from FAOSTAT (FAOSTAT, 2023) was included as well. With these values, it was possible to determine the development of the total area of erosion prone crops in absolute numbers and percentage of agricultural area over periods of at least 10 years for all WB6. The allocation to different crops further gives a trend of crop development and a share of the main soil-erosion prone crops for each economy. Further recommendations can be found in the JRC Soil Health Report (Zdruli, Jones, 2022).

Soil erosion by water is also an IPARD context indicator, which can be described in tonnes per hectare and year (calculated by RUSLE equation), but also as agricultural area affected or at risk (in ha or %).

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4. RESULTS OF THE THREE DEVELOPED CORE AEIS

4.1. Albania

Agriculture in Albania is a key sector of the economy, deeply tied to its traditions and rural communities. It features a combination of small-scale farming and larger agricultural ventures, producing a variety of fruits, vegetables, and grains, alongside livestock farming. While Albania's fertile soil and favourable climate offer great potential for agriculture, the sector faces challenges such as outdated methods and environmental issues like soil erosion (SWG, 2018a). Table 4-1 gives the area for UAA, arable land, permanent crops and permanent grassland as an average from 2014 to 2022.

Table 4-1: Overview of total utilised agricultural area (UAA) in Albania, as average from 2014 to 2022, based on Eurostat (2025b)

Average 2014 - 2022

UAA	**1 172 100**	**ha**		
Arable land	563 667	ha	48	% of UAA
Permanent crops	84 767	ha	7	% of UAA
Permanent grassland	478 122	ha	41	% of UAA

4.1.1. Gross Nutrient Balance (GNB) in Albania, preliminary results

4.1.1.1. Data sources

The data sources for the most important “5 steps” of GNB calculation (see ch. 3.1.1) are given in **Table *4-2***.

Table 4-2: Data sources for GNB of Albania

		Data source	Data submitted by
1.	Mineral Fertilizer: Nitrogen Amounts (t)	FAOSTAT	Center of Agriculture Technology Transfer, Fushë Krujë
2.	Livestock numbers	FAOSTAT	Center of Agriculture Technology Transfer, Fushë Krujë
	Nitrogen Excretion coefficients (per animal category) (kg N/head per year)	• Regulation on the principles of good agricultural practice for the application of fertilizers (Official Gazette of Montenegro, 2014)	

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		• IPCC 2019, default values for Eastern Europe, Chapter 10, Table 10.19.	
3.	Area of legume crops (ha)	FAOSTAT	Center of Agriculture Technology Transfer, Fushë Krujë
	Biological Nitrogen fixation coefficients (kg N/ha)	Austrian coefficients (Umweltbundesamt, 2024)(Umweltbundesamt, 2024, LfL, 2022)	
	Nitrogen Outputs on the Utilised Agricultural Area:		
4.	Crops and Forage: Yields (1000 t)	FAOSTAT	Center of Agriculture Technology Transfer, Fushë Krujë
	Nitrogen contents (kg N per t yield)	Austrian and German N contents (Umweltbundesamt, 2024, LfL, 2022)	
	Reference Unit:		
5.	Utilised agricultural area (UAA) (ha)	FAOSTAT	Center of Agriculture Technology Transfer, Fushë Krujë

4.1.1.2. Results

The average (Gross) Nitrogen Surplus per hectare of UAA for the years 2016-2022 was calculated as 32 kg N/ha.
The detailed figures for this period are given in **Table *4-3***.

Table 4-3: GNB results for Albania, 2016-2022

	2016	2017	2018	2019	2020	2021	2022
INPUTS, t N	**96 341**	**107 099**	**88 620**	**96 903**	**84 807**	**86 012**	**61 255**
Mineral Fertilizers	42 896	39 185	24 769	38 330	32 579	36 123	16 466
Livestock manure	51 608	66 170	62 064	56 756	50 443	48 091	43 017
Biological N fixation	1 836	1 744	1 788	1 818	1 785	1 798	1 771
OUTPUTS, t N	**59 229**	**46 163**	**50 713**	**50 702**	**51 534**	**51 042**	**52 107**
Harvested crops	17 861	17 864	17 554	17 336	18 144	17 897	18 622
Harvested forage	41 367	28 299	33 159	33 365	33 390	33 145	33 485
Surplus (Input minus Output), t N	**37 112**	**60 936**	**37 907**	**46 202**	**33 273**	**34 970**	**9 149**
UAA (1000 ha)	1 183	1 176	1 176	1 176	1 167	1 138	1 136

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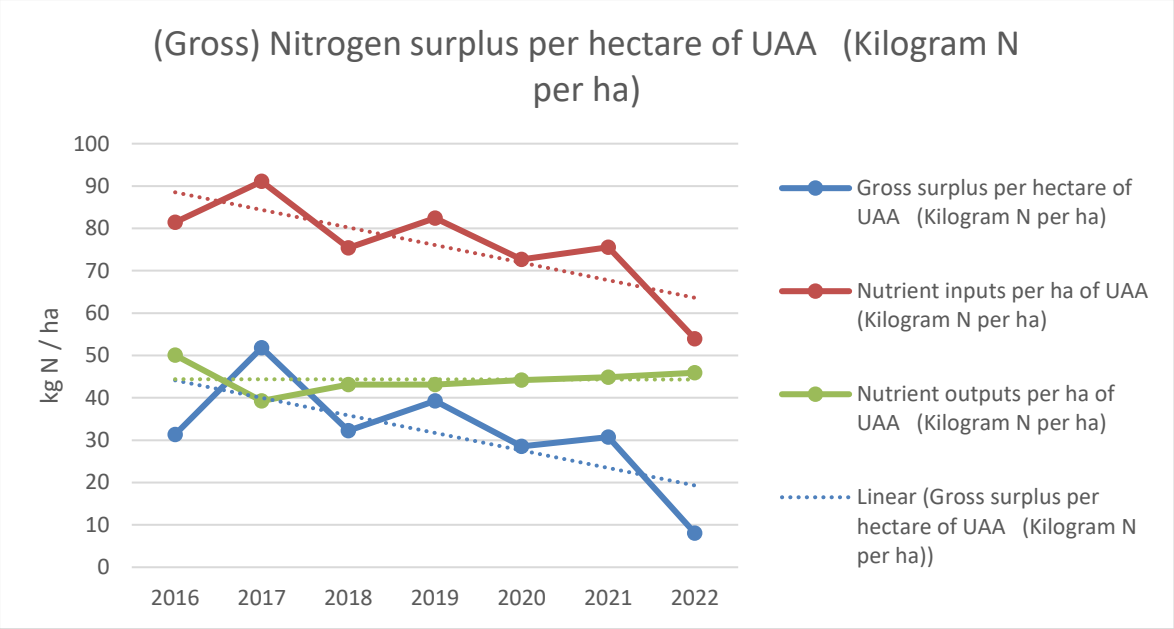
	2016	2017	2018	2019	2020	2021	2022
Surplus in kg N per ha	**31**	**52**	**32**	**39**	**29**	**31**	**8**

Figure 4-1: GNB results for Albania, 2016-2022



4.1.1.3 Potential for Improvements

The following items of the GNB "5 steps" (see ch. 3.1.1) could be worked on in the future to improve the result of the Gross Nitrogen Balance:

- Step 1. Mineral Fertilizers: Data from FAOSTAT was taken, because no data from other sources in the economy was available.
- Step 2. Livestock manure: Nitrogen Excretion coefficients (per animal category) (kg N/head per year): Development of economy-specific nitrogen excretion coefficients Nex (amount of Nitrogen excreted per livestock category per year).
- Step 3. Nitrogen fixation by legume crops: Development of economy-specific biological fixation coefficients (kg N/ha per year): Development of amount of Nitrogen fixed in the soil per legume crop type and ha.
- Step 4. Crops and Forage: Data on Permanent grassland yields would improve the estimated Nitrogen amounts at the output side of the GNB. Area data for permanent grassland are available (EUROSTAT main area), therefore only average "yield per ha"-values would be needed to calculate total Permanent grassland yields.

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- Step 4. Crops and Forage: Development of economy-specific nitrogen contents per crop type (kg/t): kg of Nitrogen contained in 1 tonne of crop yield, per crop type.

4.1.2. High Nature Value Farmland (HNVF) in Albania

Assessment of HNVF in Albania will raise awareness on these common and extensive practices and the management of biodiversity-rich areas. For quantitative data, this report uses the EEA approach from 2012 (EEA, 2012) and the updated results from 2025. Currently, there is no Albanian indicator for High Nature Value Farmland or traditional grazing.

Natural and semi-natural grasslands in mosaic landscapes with small plots of arable land and forests, orchards and vineyards are common in Albania. Domestic breeds of local cattle, donkeys and goats usually graze these grasslands. Small farms with 10 – 30 animal heads (usually a mixture) are still common, but medium sized farms with an average of 150 sheep are becoming more common in areas closer to urban centres, especially in the south. Fertilizer is traditionally not used to increase the productivity of the grazed grasslands. In 2011, 400.000 ha of unfertilized summer and winter pastures were registered. Summer pastures are usually located in the more mountainous regions and are grazed from May to October. Winter pastures are located along the coast and in valleys, for example in Delvine and Vrine. Prior to 1990, transhumance systems were still common, but nowadays they are declining and are only found in the south-eastern part of Albania. However, grazing in forest and woodland patches with shrubs are still commonly practiced (Oppermann, Beaufoy, Jones, 2012, EFNCP, 2011b).

- Pasture Management in Albania

Law No. 9693 on the Pasture Fund, enacted on March 19, 2007, governs the management and protection of forests and pastures (Albania, 2007). This law outlines the responsibilities of central and local state bodies in administering and safeguarding pastures and meadows. It also emphasizes the role of specialized research institutions in this sector.

In recent years, efforts have been made to enhance the sustainable management of forests and pastures. For instance, the Environmental Services Project (2014-2021) facilitated the sustainable management of 12 320 hectares of uplands by forest user associations and other entities. This initiative aimed to improve land management practices, reduce soil erosion, and bolster agricultural and forestry productivity (World Bank Group, 2023).

Additionally, integrated forest and pasture management plans have been developed for several municipalities, including Has, Maliq, Berat, Malesi e Madhe, and Korce. These plans, covering a total of 166 172 hectares, balance economic, social, and ecological aspects to maximize benefits for local stakeholders (OIKON, s.a.).

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With the Law No. 81/2017, "On Protected Areas", updated with the Law No. 21/2024 "On some additions and amendments to the Law No. 81/2017 "On Protected Areas", during the exercise of the function of granting temporary use of pastures, it has been decided that the municipalities become the beneficiary of the income stemming from the temporary use of pasture lands.

4.1.2.1. Results

In 2012, the EEA approach estimated that 80 % of the agricultural area in Albania is HNVF (EEA, 2012), showing the importance for extensive agriculture. Experts from Albania were asked also within EU4Green to contribute to the EEA HNVF, which is currently updated.

The ongoing work by EEA was presented to the local experts at a dedicated workshop with invitation for feedback. The experts were consulted in the selection and detailed inclusion and exclusion of CLC classes (expert rules). For example, in Albania CLC 243 Land principally occupied by agriculture and 321 Natural grasslands are fully included in the assessment, while the class 324 transitional woodland/shrub is only considered to be HNVF in the Continental Zone.

Local experts were also asked for their expertise of grazing shares of semi-natural areas. According to them, all goats and sheep and more than 90 % of the cows (incl. dairy cows) are grazed extensively. For more information regarding the methodology see chapter 3.1.2. The quantitative results, including the updated HNVF area and share, will be published by EEA in due course.

4.1.3. Proxy-Indicator for Soil Erosion by water: Soil erosion prone crops in Albania

Soil degradation caused by soil erosion has been identified as a significant issue in Albania. The natural conditions, such as topography, soil characteristics and heavy rainfalls, classify more than 50 % of the land area in Albania as naturally prone to erosion. Due to its history of unsustainable farming practices, landslides and soil erosion are even more prevalent. This issue is further exacerbated by damage caused by illegal logging and other anthropogenic impacts. Soil erosion by water is 2 – 3 times higher than in other Mediterranean countries. The average soil loss is about 30 t/ha/yr and 22 % of the area experiences a severe soil loss rate (>10 t/ha/yr). It is estimated that these 22 % are responsible for the majority (93 %) of soil erosion. The highest rates of soil loss have been found in mixed agricultural land, orchards and vineyards on steep slopes. Mixed agricultural land is commonly used as intensive pastures and is prone to overgrazing, thus further increasing erosion rates. Additionally, 75 % of the agricultural area is at high risk of soil erosion, while the remaining 25 % of agricultural area faces a medium risk for soil erosion. (SWG, 2018a, SWG, 2022, Vidojevic, 2022, Zdruli, Jones, 2022).

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Despite this, data on soil erosion by water is lacking and not regularly updated. Given the long-term consequences of continued soil loss and soil degradation due to soil erosion, developing a baseline indicator for soil erosion by water is crucial. With comprehensive data it will be possible to make evidence-based policy decision and implement measures to prevent further soil loss in agricultural areas (SWG, 2018a, SWG, 2022).

4.1.3.1. Data sources

The proxy indicator "area of soil-erosion prone crops" can help to identify areas at high risk of soil erosion and raise awareness about suitable agricultural measures and crops. As a first step, Albanian experts assigned vulnerability values to crops commonly grown in Albania, ranging from 0 to 3. Here, 0 indicates no vulnerability, while 3 represents high vulnerability of soil erosion caused by water. Table 4-4 provides an overview of the assigned values, along with explanations from local experts. Crops with vulnerability values of 2 or 3 are classified as to be soil-erosion prone.
According to INSTAT data, approximately 9 % of vegetables are grown in greenhouses. For example, in 2023 out of 43 261 ha vegetables, 3 791 ha were grown in greenhouses and are thus not considered erosion prone. However, there is no dataset available for vegetables grown in open fields, thus a verification of this data is not possible.

Table 4-4: Expert assessment on vulnerability for soil erosion for chosen crops in Albania from 0 (no vulnerability) to 3 (high vulnerability)

VULNERABILITY for soil erosion	Crop	Expert opinion: explanations for the vulnerability against soil erosion
3	**Corn / Maize**	Maize needs ploughing and irrigating several times. Wide rows leave a lot of bare ground. This increases the risk of runoff and soil erosion as there is no vegetation to trap the soil. Moreover, cultivation in steep slopes makes the erosion more present.
2	**Vegetables**	Intensive agriculture, chemical fertilizers, pesticides and herbicides used
2	**Strawberries**	Intensive agriculture, chemical fertilizers, pesticides and herbicides used
2	**Potatoes**	Intensive agriculture, chemical fertilizers, pesticides and herbicides used
1	**White beans**	They improve soil in N
2	**Sunflower**	Intensive agriculture, chemical fertilizers, pesticides and herbicides used
1	**Soya**	They improve soil in N
2	**Sugar beet**	Intensive agriculture, chemical fertilizers, pesticides and herbicides used
2	**Fruit trees / Orchards**	
2	**Fruit trees / Apple**	
2	**Fruit trees / Plum**	
2	**Fruit trees / Cherries**	

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VULNERABILITY for soil erosion	Crop	Expert opinion: explanations for the vulnerability against soil erosion
2	Fruit trees / Fig	
2	Fruit trees / Nectarine	
2	Vineyards	

Data for the crop growing areas with complete timelines from 2013 to 2023 has been gathered from INSTAT Albania[3]. The data for total utilised agricultural area (UAA), area of arable land and area of permanent crops is taken from FAOSTAT (FAOSTAT, 2023), due to incomplete datasets from INSTAT.

4.1.3.2. Results

Figure **4-2** shows the total area of erosion prone crops and permanent crops with a vulnerability value of 2 or 3 in Albania. The vulnerability to soil erosion of permanent crops significantly depends on the management and agricultural practices, for example greening in between rows of permanent crops (orchards, vineyards). In Albania, the most important permanent crops are vineyards and fruit trees/orchards. Together, they account for more than 50 % of permanent crops in Albania. Both are considered vulnerable to soil erosion by local experts. The most important arable crop is maize, accounting for around 10 % of the arable land. Maize is considered very vulnerable to soil erosion. The second most important crop is vegetables, however when this crop is grown in greenhouses there is no danger of soil erosion. In combination with other arable crops with vulnerability values of 2 or 3, soil erosion prone crops account to around 17 % of the total arable land. The percentage of selected arable crops can be found in Figure 4-4.

While the total area of erosion prone arable crops has been slightly increasing since 2013, permanent crops have made a noticeable jump from 2017 to 2018. As shown in Figure 4-3, this is mostly due to a significant increase in fruit trees. The main crop, corn, has not increased significantly since 2013. The complete data table for the proxy indicator area of soil erosion prone crops in Albania can be found in the Annex.

Figure 4-2: Total area of erosion prone arable crops and permanent crops in Albania; vulnerability ≥ 2; from 2013 to 2023, including the trend lines

[3] https://www.instat.gov.al/

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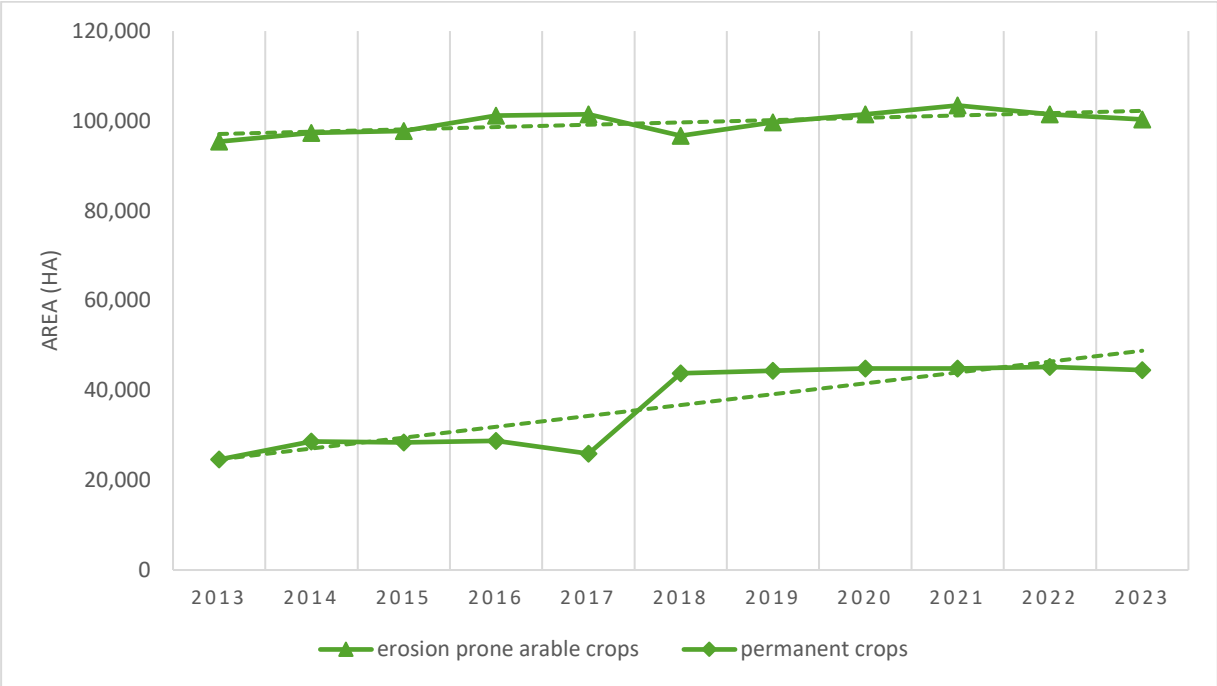

Figure 4-3: Area of erosion prone crops (arable and permanent) in Albania from 2013 to 2023; separated by crop type

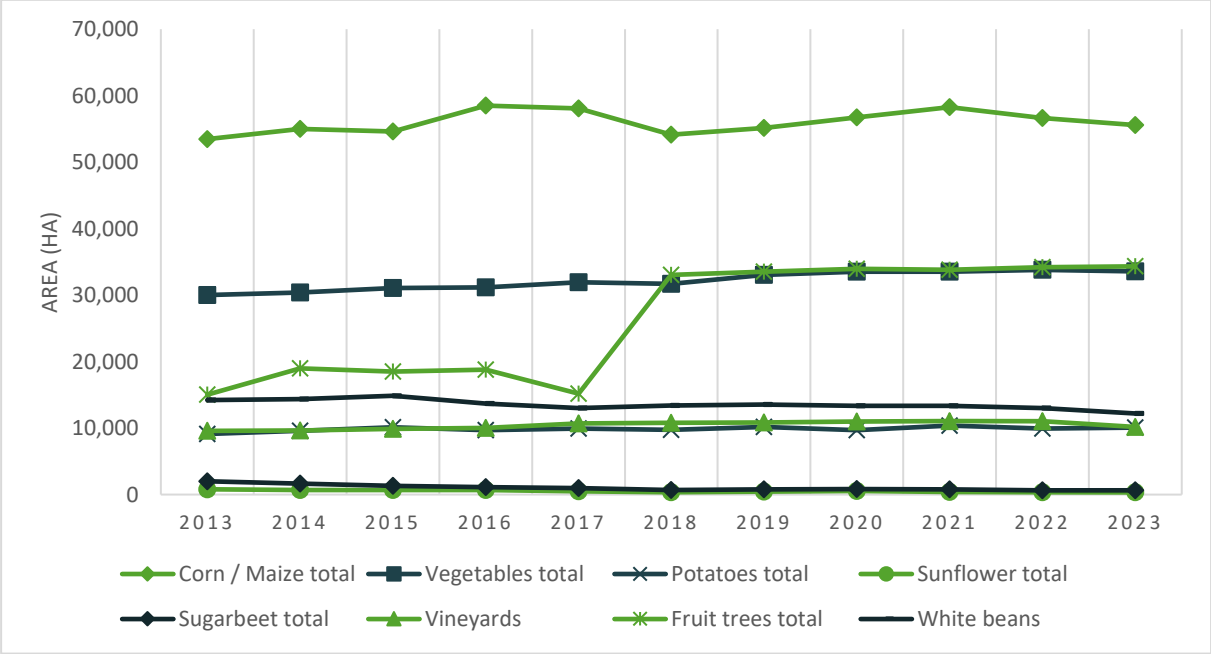

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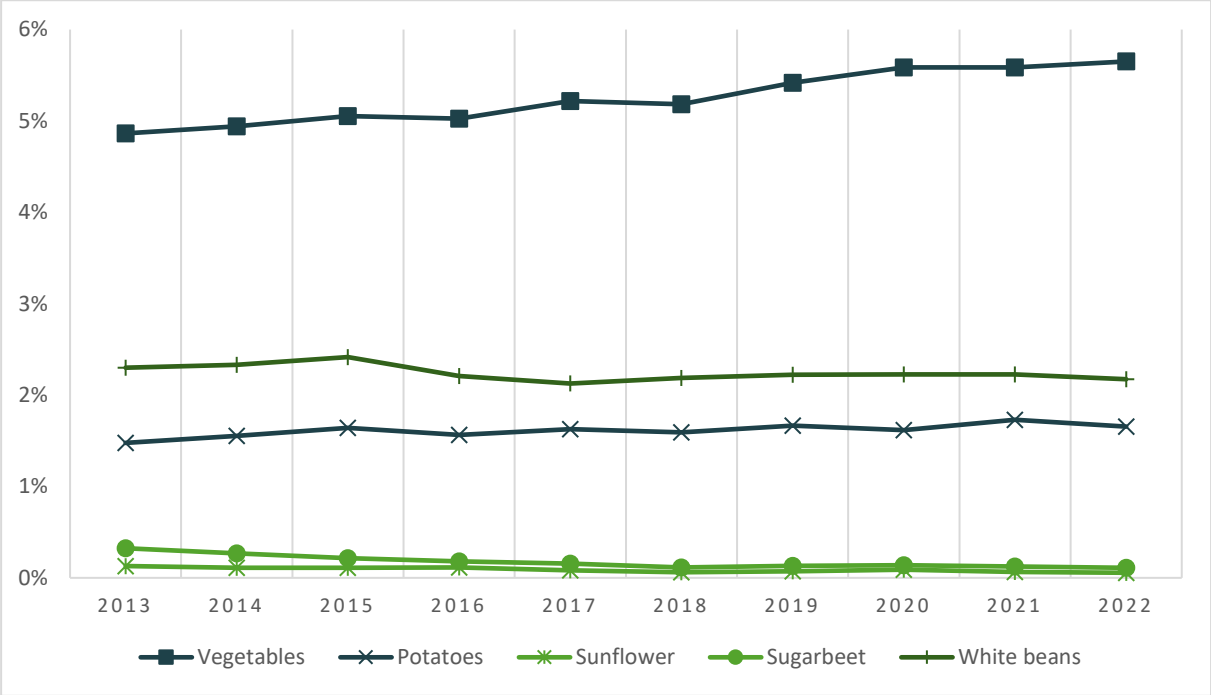
Figure 4-4: Percentage of selected erosion prone arable crop in total arable land; from 2013 to 2023, Albania



4.2. Bosnia and Herzegovina

Agriculture in Bosnia and Herzegovina is a vital part of its economy and cultural identity, deeply rooted in its rural traditions. The sector benefits from diverse landscapes, enabling the cultivation of various crops and livestock farming. However, challenges such as fragmented land ownership, outdated farming practices, climate change, abandonment and limited access to modern technology have hindered its full potential (SWG, 2018a) .
Table **4-5** gives the area for UAA, arable land, permanent crops and permanent grassland as an average from 2012 to 2022.

Table 4-5: Overview of Utilised agricultural area in Bosnia and Herzegovina as average from 2012 to 2022, based on Eurostat (2025 b)

Average 2012 - 2022

UAA	**1 713 935**	**ha**		
Arable land	571 314	ha	33	% of UAA
Permanent crops	102 696	ha	6	% of UAA
Permanent grassland	1 039 027	ha	61	% of UAA

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4.2.1. Gross Nutrient Balance (GNB) in Bosnia and Herzegovina, preliminary results

4.2.2.1 Data sources

The data sources for the most important "5 steps" of GNB calculation (see ch. 3.1.1) are given in Table 4-6.

Table 4-6: Data sources for GNB of Bosnia and Herzegovina

		Data source	Data submitted by
1.	Mineral Fertilizer: Nitrogen Amounts (t)	FAOSTAT, imputed values	
2.	Livestock numbers	Agency for Statistics of Bosnia and Herzegovina According to the Law on Statistics of Federation of Bosnia and Herzegovina („Official Gazette of the Federation of BiH, No. 63/03 and 9/09) and the Law on Statistics of Republic of Srpska („Official Gazette of Republic of Srpska", No. 85/03) the Survey is conducted by entity statistical institutes: Federal Institute of Statistics of F BiH and Institute of Statistics of Republic of Srpska. The Agency for Statistics of Bosnia and Herzegovina in line with the Law on Statistics of Bosnia and Herzegovina ("Official Gazette of Bosnia and Herzegovina", No. 26/04 and 42/04) is authorized for compilation, aggregation and international reporting for the state level (according to Regulation No 1165/2008/EC of 19 November 2008).	Agency for Statistics of Bosnia and Herzegovina
	Nitrogen Excretion coefficients (per animal category) (kg N/head per year)	• Market Agriculture Development Program (FARM): Nitrate Directive 91/676/EEZ - Requirements and Implementation (2012), • Other Poultry: Austrian Nex coefficients (Umweltbundesamt, 2024)	
3.	Area of legume crops (ha)	Agency for Statistics of Bosnia and Herzegovina, data only available for 2022 due to time series break[4]	Agency for Statistics of Bosnia and Herzegovina
	Biological Nitrogen fixation coefficients (kg N/ha)	Austrian biological N fixation coefficients (Umweltbundesamt, 2024)	
4.	Crops and Forage: Yields (1000 t)	Agency for Statistics of Bosnia and Herzegovina, data only available for 2022 due to time series break[4]	Agency for Statistics of Bosnia and Herzegovina
	Nitrogen contents (kg N per t yield)	Austrian and German N contents (Umweltbundesamt, 2024, LfL, 2022)	

[4] Data on crops production and crop area was provided only for the year 2022, as a break in time series was made that year for EUROSTAT. Data up to 2021 was collected based on estimates from municipal-level assessors, while from 2022 onwards it has been collected through sample-based surveys. Since the Agency for Statistics of Bosnia and Herzegovina has not received a revision of the time series from the entity level and due to the overestimated results, it cannot rely on data prior to 2021.

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		Data source	Data submitted by
5.	Utilised agricultural area (UAA) (ha)	Agency for Statistics of Bosnia and Herzegovina, data only available for 2022 due to time series break[4]	Agency for Statistics of Bosnia and Herzegovina

4.2.2.2 Results

The (Gross) Nitrogen Surplus per hectare of UAA for the year 2022 was calculated as 53 kg N/ha.
The detailed figures for this year are given in Table 4-7.

Table 4-7: GNB results for Bosnia and Herzegovina, 2022

	2022
INPUTS, t N	**90 824**
Mineral Fertilizers	47 947
Livestock manure	37 259
Biological N fixation	5 618
OUTPUTS, t N	**31 165**
Harvested crops	22 748
Harvested forage	8 417
Surplus (Input minus Output), t N	**59 659**
UAA (1000 ha)	1 117
Surplus in kg N per ha	**53**

Figure 4-5: GNB results for Bosnia and Herzegovina, 2022

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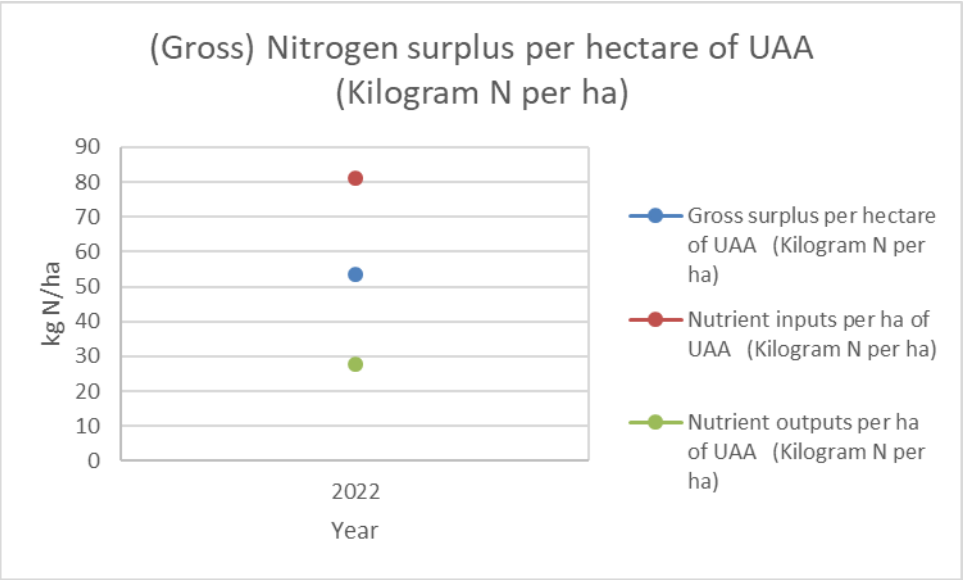

4.2.1.3. Potential for Improvements

The following items of the GNB "5 steps" (see ch. 3.1.1) could be worked on in the future to improve the result of the Gross Nitrogen Balance:

- Step 1. Mineral Fertilizers: Data from FAOSTAT was taken, because no data from other sources in the economy was available.
- Step 3. Nitrogen fixation by legume crops: Development of economy-specific biological fixation coefficients (kg N/ha per year): Development of amount of Nitrogen fixated in the soil per legume type and ha.
- Step 4. Crops and Forage: Development of economy-specific nitrogen contents per crop type (kg/t): kg of Nitrogen contained in 1 tonne of crop yield, per crop type.

Since the data on crops production and crop area was provided only for the year 2022 based on sample-based surveys according to EUROSTAT, it is recommended to take 2022 data as a starting point and continue GNB calculations from 2023 onwards.

4.2.2. High Nature Value Farmland (HNVF) in Bosnia and Herzegovina

Qualitative assessment of HNVF in BiH will raise awareness on these common and extensive practices and the management of biodiversity-rich areas. For quantitative data this report uses the EEA approach from 2012 (EEA, 2012) and the updated results from 2025. Currently, there is no indicator for High Nature Value Farmland or traditional grazing by local authorities.

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According to the Strategic Plan for rural development (*Strategic Plan for rural development of Bosnia and Herzegovina (2018 - 2021) - Framework Document,* n.d.) around 1.05 million Hectar are natural meadows and pastures. Given the history, abandonment and neglection of arable land has led to an increase of grasslands and subsequent succession of forest. Due to this steady increase of grassland and simultaneous decrease of livestock number, currently BiH lists 2.3 ha per livestock unit. For this reason, it can be said that most of the grassland is very extensively managed. According to the estimation of the EEA from 2012 (EEA, 2012), 93 % of farmland area in BiH is considered to be HNVF, with significant proportions being Type 1 HNVF.

Mountainous pastures have traditionally been grazed during the summer months with semi-transhumance practices. Local breeds of sheep in small flocks graze the hilly and mountainous, highland pastures, while better quality meadows in the lowlands are typically reserved for cattle grazing and hay making (Oppermann, Beaufoy, Jones, 2012). These Grasslands are seldomly fertilized and mown only once a year. Due to limited precipitation in certain regions, grasslands are often of low quality (*Strategic Plan for rural development of Bosnia and Herzegovina (2018 - 2021) - Framework Document,* n.d.). As many of the mountain pasture are commons or the ownership is unclear, legislation potentially hinders transhumance systems (Oppermann, Beaufoy, Jones, 2012).

Type 2 HNVF with mosaic landscapes, such as a mix of small arable plots, vegetable gardens, vineyards and orchards are very common. Especially meadow orchards with local plum variety are typical for the region (Oppermann, Beaufoy, Jones, 2012).

Worth noting are also karstic depressions (polje), which can flood regularly. These wetlands combined with grasslands have been extensively managed and grazed since generations and thus have often maintained unique habitats as important hotspots for local biodiversity (Oppermann, Beaufoy, Jones, 2012).

The diverse ecosystems of BiH offer great potential for eco-tourism, with activities such as bird watching and agro-eco tourism. The local food culture, which is strongly influenced by traditional grazing systems, provides important potential for the revitalization of HNVF.

The strategic plan also mentions the aim of responsible management of available natural resources with explicit mention of the revitalization and conservation of grazing areas (*Strategic Plan for rural development of Bosnia and Herzegovina (2018 - 2021) - Framework Document,* n.d.). The indicator for High Nature Value Farmland can potentially support this goal.

4.2.2.1. Results

In 2012, the EEA approach estimated that 93 % of the agricultural area in Bosnia and Herzegovina is HNVF (EEA, 2012), showing the importance for extensive agriculture. Experts

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from BIH were asked also within EU4Green to contribute to the EEA HNVF, which is currently updated.
The ongoing work by EEA was presented to the local experts at a dedicated workshop with invitation for feedback. The experts were consulted in the selection and detailed inclusion and exclusion of CLC classes (expert rules). For example, in BiH CLC 243 Land principally occupied by agriculture is fully included in the assessment, while the class 321 natural grassland is only considered to be HNVF in certain environmental zones. Local experts were also asked for their expertise of grazing shares of semi-natural areas. According to them, natural grasslands are mainly used for extensive grazing during the summer months. For more information regarding the methodology see chapter 3.1.2. The quantitative results, including the updated HNVF area and share, will be published by EEA in due course.

4.2.3. Proxy-Indicator for Soil Erosion by water: Soil erosion prone crops in Bosnia and Herzegovina

Given the steep topography and relatively heavy rainfalls, natural conditions in Bosnia and Herzegovina make the area prone to soil erosion. Unplanned deforestation and unsustainable practices further accelerate the problem. While there are no up-to-date assessments of soil erosion for BiH, it is estimated that 0.5 to 5 tons of soil per hectare is lost every year due to water erosion (SWG, 2018a, Vidojevic, 2022, SWG, 2022). 45 % of agricultural land is situated in hilly zones and is thus prone to soil erosion. Farming practices that are unsuitable for steep land further increase the problem. It is estimated, that 80 % of agricultural land is affected by erosion rates over 10t/ha/year (Zdruli, Jones, 2022).

A more detailed assessment is available only for the Republika Srpska. The JRC (2022) estimates that approximately 30% of the area is at risk of medium to very high erosion. However, compared to other parts of BiH, Republika Srpska has significant areas of flat land. The assessment also notes that agricultural land and areas in higher elevations (200 – 1000 m) are most prone to soil erosion. Orchards at higher elevations are specifically highlighted as suffering from high to very high soil loss.

4.2.3.1. Data sources

In a first step, the vulnerability for soil erosion for chosen crops in Bosnia and Herzegovina was assessed by local experts. The vulnerability of crops is based on the RUSLE crop factor[5] and other values available in literature. The results can be found in Table 4-8. Here, 0 indicates no vulnerability, while 3 represents high vulnerability of soil erosion caused by water. Notably, in

[5] https://efotg.sc.egov.usda.gov/references/public/IA/Universal_Soil_Loss_Equation1.pdf

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this assessment the permanent crops that are considered erosion prone are fruit trees/orchards (vulnerability = 2). However, there was no data available on fruit trees/orchards, thus no permanent crops are included in these analyses. Due to the well-researched and documented vulnerability values, these values were used as default values for other Western Balkan economies as well.

Table 4-8: Vulnerability assessment for soil erosion for chosen crops in Bosnia and Herzegovina from 0 (no vulnerability) to 3 (high vulnerability)

VULNERABILITY for soil erosion	RUSLE crop factor (C)	Crop	Expert opinion: explanations for the vulnerability against soil erosion
2	0.33–0.45	Grain maize	Moderate vegetation length, row crops with periods of bare soil exposure, medium leaf area index (LAI).
2	0.20–0.40	Green maize	Similar to grain maize but harvested earlier. If followed by another crop, which is usually the case in BiH, bare soil exposure is reduced
3	0.20–0.50	Vegetables	Shorter growing period, often high soil disturbance, and wide row spacing leading to exposed soil.
1	0.02–0.10	Strawberries	Low-growing plants with ground cover or mulching reducing soil exposure.
3	0.30–0.60	Potatoes	Intense soil disturbance during planting and harvesting, wide row spacing, and low initial leaf area index. Usually grown on sloped terrain.
2	0.20–0.35	Bean grain	Relatively low-growing crops with moderate vegetation cover and medium row spacing.
2	0.25–0.45	Soya	Moderate vegetation cover and row spacing, providing some protection against erosion during the growing season.
1	0.05–0.20	Vineyards	Less vulnerable when cover crops are used between rows, with protection from both plant structure and ground cover. The value is for continental vineyards (southern vineyards are usually grown on very permeable - rocky soils)
3	0.30–0.50	Pumpkin	Large-leaf plants but wide row spacing, leaving substantial soil exposed during early growth stages.
2	0.25–0.35	Field beans	Medium ground cover, which offers protection during most of the growing season.
3	0.40–0.50	Fodder beet	High soil disturbance with bare soil between rows and low cover early in the growing season.
2	0.20–0.50	Sunflower	Tall plants with moderate LAI, but wide row spacing leaves soil vulnerable early in the growing season.
3	0.40–0.60	Sugar beet	High disturbance from soil cultivation and low cover early on, with dense canopy forming later.
1	0.10–0.40	Olives	Not vulnerable if ground cover or mulching is used; otherwise, wide spacing and sparse cover lead to higher erosion risk. In BiH, it is grown in the south, on soils with a high infiltration rate.

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VULNERABILITY for soil erosion	RUSLE crop factor (C)	Crop	Expert opinion: explanations for the vulnerability against soil erosion
1	0.02–0.30	Citrus	Not vulnerable if ground cover or mulching is used; otherwise, wide spacing and sparse cover lead to higher erosion risk. In BiH, it is grown in the south, on soils with a high infiltration rate.
2	0.02-0.40	Fruit trees	Not vulnerable when there's mulching or cover crops; higher erosion risk if the ground is bare and wide-spaced trees expose more soil. In BiH, it is usually grown with a cover crop

In a second step, the data for growing areas were collected for the entirety of BiH, as well as the two entities: the Federation of Bosnia and Herzegovina, Republika Srpska and the Brčko District. Consequently, the database differs significantly in each entity and some analyses are available on entity level only. In case of assessments on level of Bosnia and Herzegovina, data from FAOSTAT (FAOSTAT, 2023) was used to complete the datasets on UAA, total area of arable land and total area of permanent crops.

4.2.3.2. Results: Soil erosion prone crops in BiH

Figure 4-6 shows the total area of erosion prone arable crops in the entirety of Bosnia and Herzegovina from 2011 to 2021. Notably, data from 2022 was available as well, but due to significant inconsistencies with previous years it was not included in this assessment. The trendline shows a consistent increase of erosion prone arable crop in Bosnia and Herzegovina, with some valleys and peaks but still a continuous growth. Figure 4-7 shows that grain maize is the most important crop, making up around 23 % of the arable land. However, soya, potatoes and vegetables have seen continuous growth as well. Overall, arable land consists of about 32 % of soil erosion prone arable crops. The percentage of selected arable crops in total arable land can be found in Figure 4-8. The complete data table for the proxy indicator soil erosion prone crops in Bosnia and Herzegovina can be found in the Annex.

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Figure 4-6: Total area of erosion prone crops in Bosnia and Herzegovina from 2011 to 2021, including the trend line

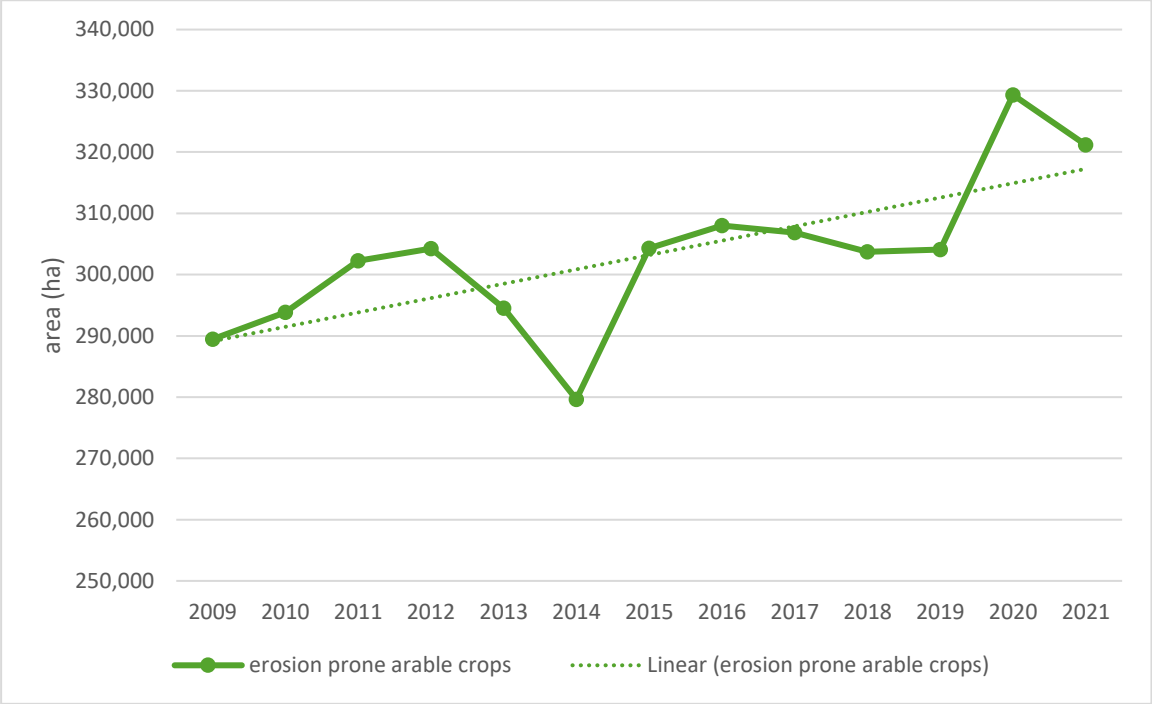

Figure 4-7: Area of erosion prone crops in Bosnia and Herzegovina from 2011 to 2021, separated by crop type

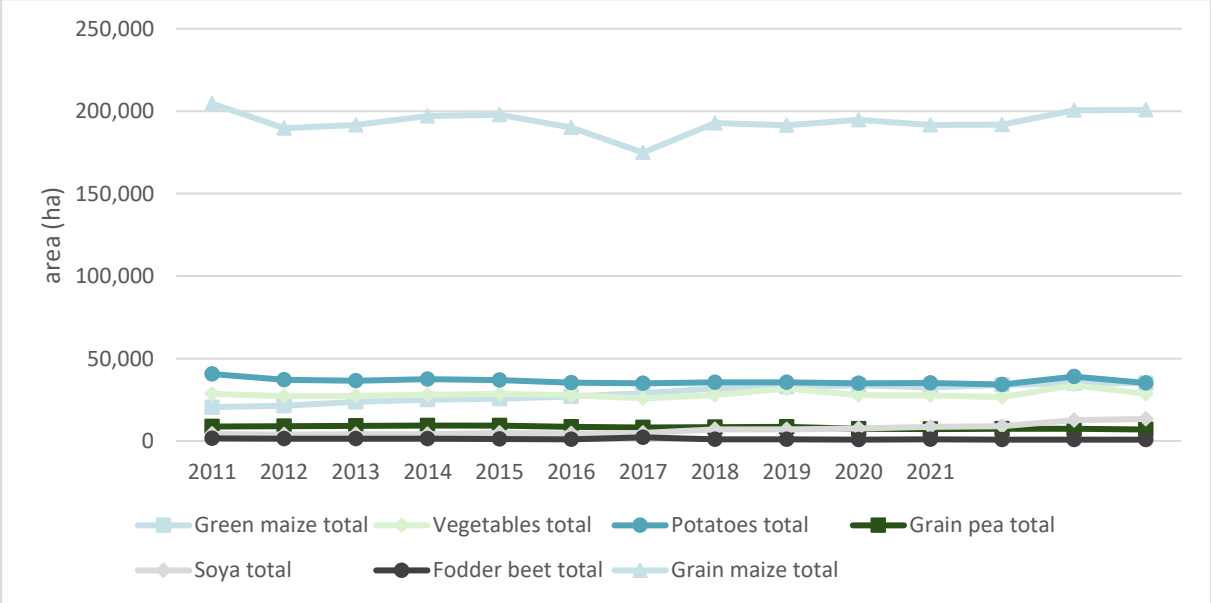

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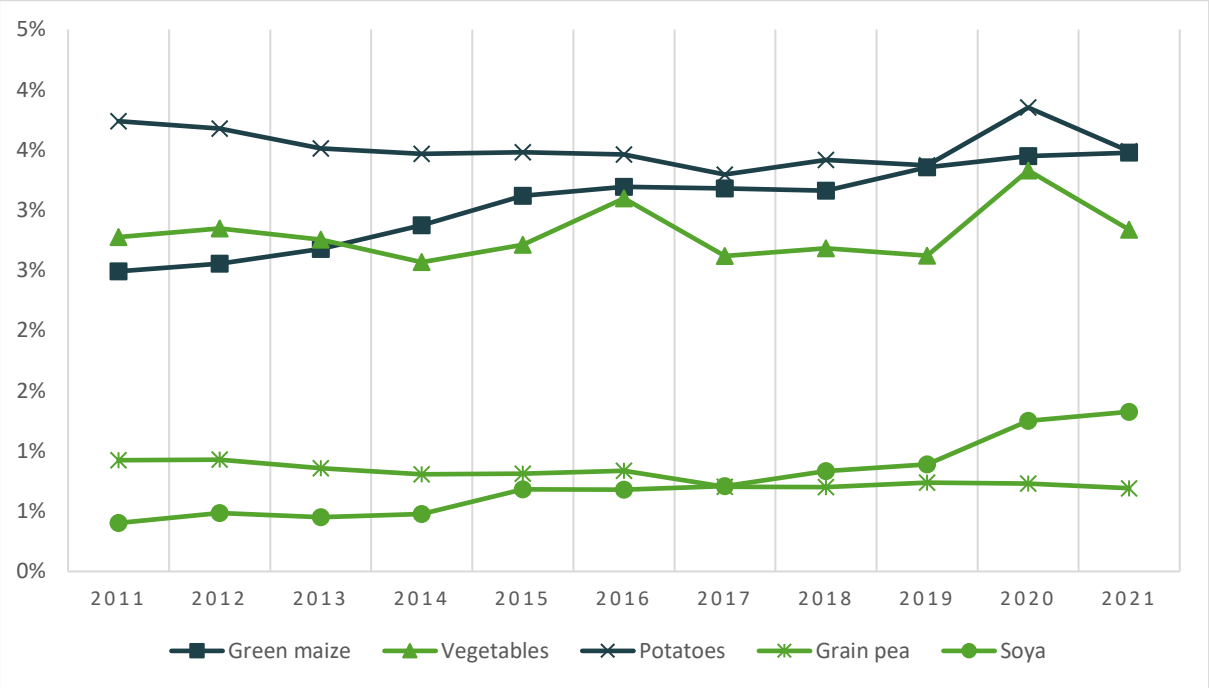
Figure 4-8: Percentage of selected erosion prone arable crops in total arable land; from 2011 to 2021, Bosnia and Herzegovina



4.2.3.3. Results: Soil erosion prone crops in Federation of Bosnia and Herzegovina

The Federation of Bosnia and Herzegovina is the main growing area for arable crops in BiH. Thus, the pattern seen in Figure 4-9 for the total area of erosion prone crops from 2008 to 2022 closely corresponds to Figure 4-7. However, the grown crops are more diverse than in the entirety of BiH, as seen in Figure 4-9. Overall, around 65 % of arable land is used to grow erosion prone arable crops. The main crops are grain maize and vegetables, with green maize increasing rapidly since 2013. The growing area of Soya has also increased about six times since 2014.

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Figure 4-9: Total area of erosion prone arable crops in the Federation of Bosnia and Herzegovina from 2008 to 2022, including the trend line

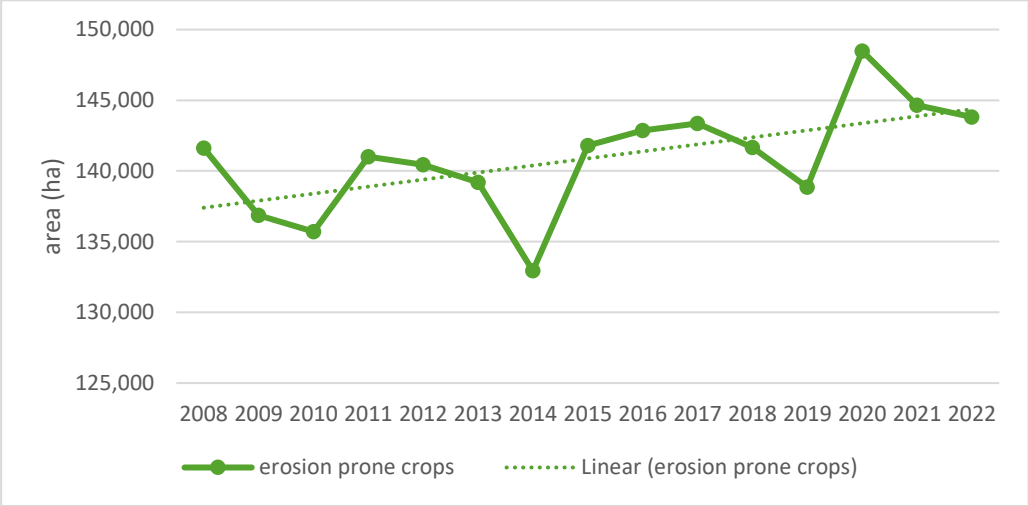
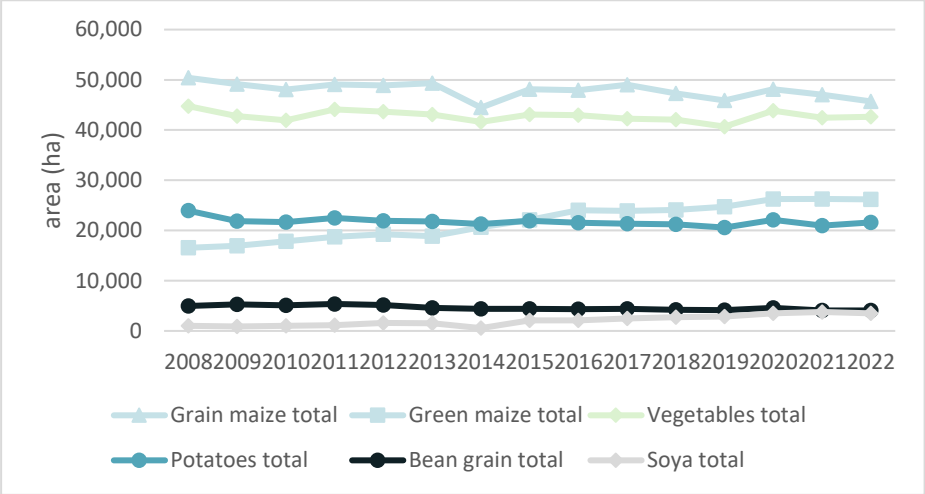


Figure 4-10: Area of erosion prone crops in the Federation of Bosnia and Herzegovina from 2008 to 2022, separated by crop type



4.2.3.4. Results: Soil Erosion prone crops in Republika Srpska

Republika Srpska has a total growing area of erosion prone arable crops of about 120.000 ha, with a more or less steady increase since 2010 (see Figure 4-11). Again, we see a similar pattern to the timeline of the entirety of Bosnia and Herzegovina (see Figure 4-7). The most important crop is maize (see Figure 4-12), however grain maize is more important than green maize. There is also a significant increase in Soya to almost 10.000 ha in 2022, while vegetables have dropped. Overall, around 60 % of arable crops grown in the Republika Srpska are considered erosion prone.

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Figure 4-11: Total area of erosion prone crops in the Republika Srpska from 2010 to 2022, including the trend line

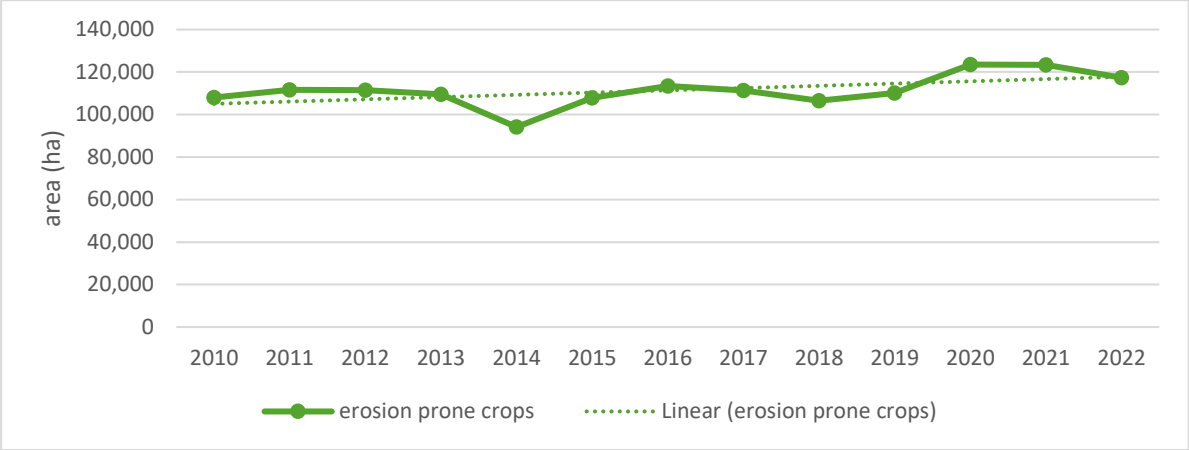
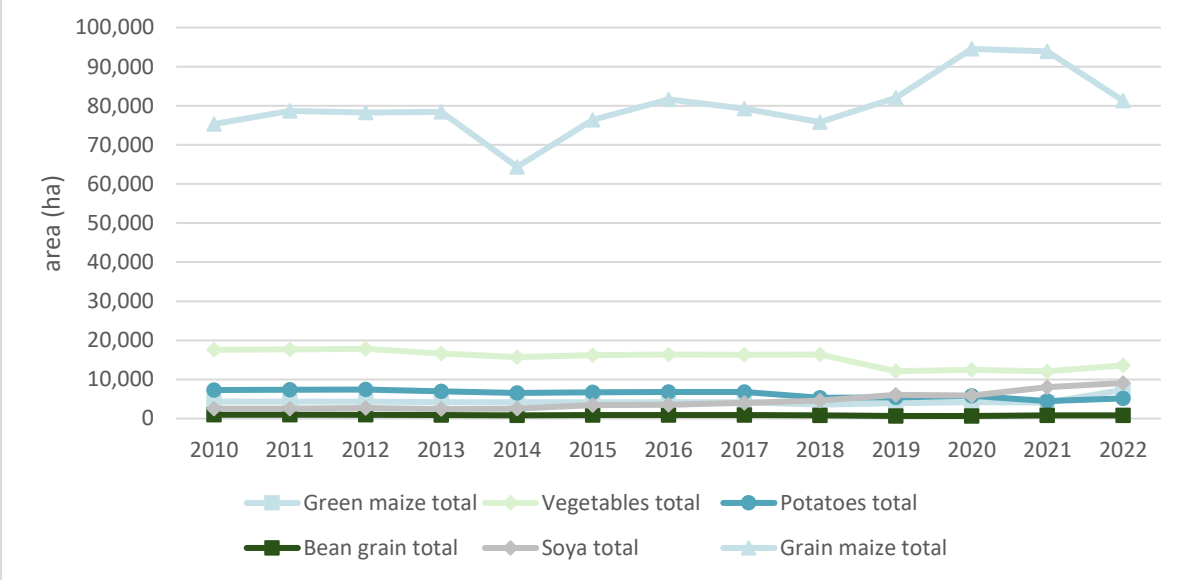


Figure 4-12: Area of erosion prone arable crops in the Republika Sprska from 2010 to 2022, separated by crop type



4.2.3.5 Results: Soil Erosion prone crops in Brčko District

Below are the results for the Brčko District for erosion prone arable crops from 2010 to 2022. Data for 2017 is not available. Similarly, to the two entities, the total growing area of erosion prone crops is increasing significantly (.

Figure 4-13). Maize is the most important crop, however there is no differentiation between grain maize and green maize (

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Figure **4-14**). Soya bean has experienced a significant increase since 2013, making it the second most important crop in the region. Notably, while pumpkin is generally considered to be erosion prone in the WB6, data for growing areas is usually not available, with the exception of the growing area in the Brčko District.

Figure 4-13: Total area of erosion prone arable crops in the Brčko District from 2010 to 2022, including the trend line (2017 data missing)

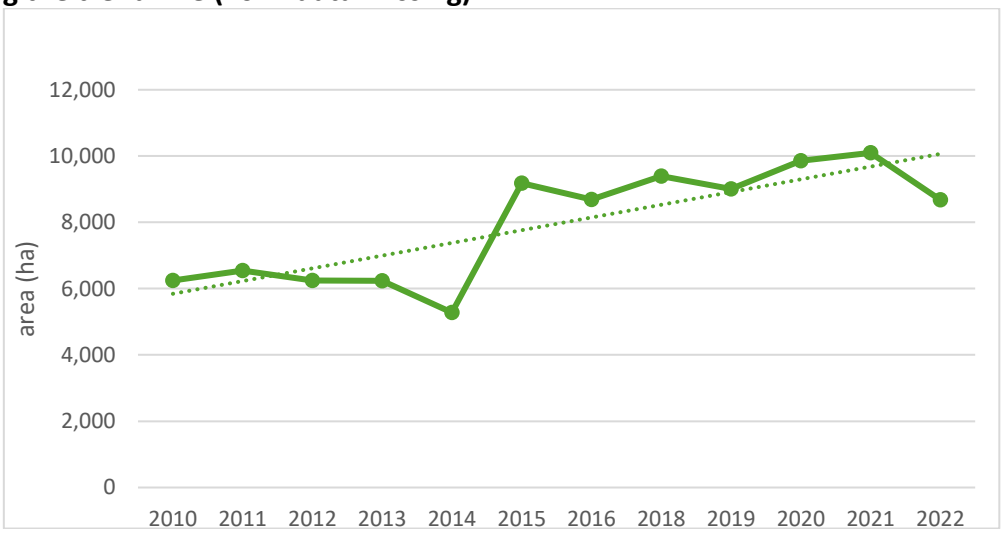
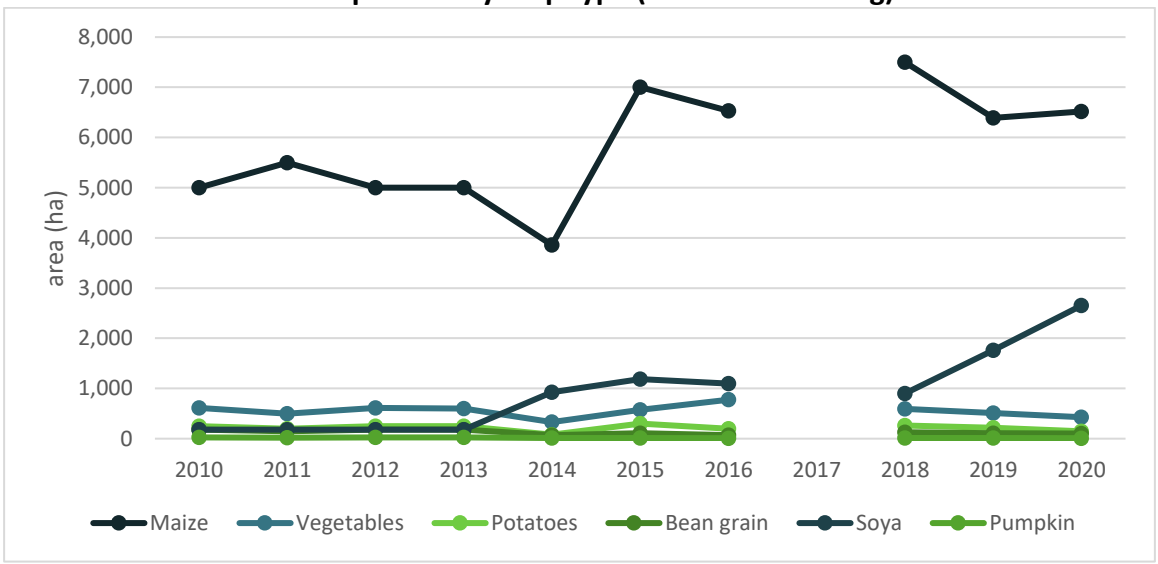


Figure 4-14: Area of erosion prone arable crops in the Brčko District from 2010 to 2022, separated by crop type (2017 data missing)



4.3. North Macedonia

Agriculture holds great importance in North Macedonia, shaping its rural economy and cultural traditions. The diverse climate and fertile lands enable the cultivation of various crops,

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including grains, fruits, and vegetables. Viticulture is especially significant, with wine production being a hallmark of its agricultural identity (SWG, 2018a).
Table 4-9 gives an overview of the Utilised Agricultural Area (UAA), such as area of arable land, permanent crops and permanent grassland as an average from 2012 to 2022.

Table 4-9: Overview of Utilised agricultural area in North Macedonia as average from 2012 to 2022, based on Eurostat (2025b)

Average 2012 - 2022

UAA	**1 265 645**	**ha**		
Arable land	418 230	ha	33	% of UAA
Permanent crops	40 172	ha	3	% of UAA
Permanent grassland	807 245	ha	64	% of UAA

4.3.1. Gross Nutrient Balance (GNB) in North Macedonia, preliminary results

4.3.1.1 Data sources

The data sources for the most important "5 steps" of GNB calculation (see ch. 3.1.1) are given in Table 4-10.

Table 4-10: Data sources for GNB of North Macedonia

		Data source	**Data submitted by**
1.	Mineral Fertilizer: Nitrogen Amounts (t)	FAOSTAT, Ministry of Agriculture, Forestry and Water Economy, State Agriculture Inspectorate, Phytosanitary Inspection: Imported amount of fertilizers	Ministry of Agriculture, Forestry and Water Economy
2.	Livestock numbers	Ministry of Agriculture, Forestry and Water Economy	Project Representative, data from Ministry of Agriculture, Forestry and Water Economy
	Nitrogen Excretion coefficients (per animal category) (kg N/head per year)	• Rules for the list of special minimum conditions for good agricultural practice and environmental protection (Ministry of Agriculture, Forestry and Water Management, 2015) • Regulation on the principles of good	Project Representative, data from Ministry of Agriculture, Forestry and Water Economy

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		Data source	Data submitted by
		agricultural practice for the application of fertilizers (Official Gazette of Montenegro, 2014)	
3.	Yields of legume crops (1000 t)	Ministry of Agriculture, Forestry and Water Economy	Project Representative, data from Ministry of Agriculture, Forestry and Water Economy
	Biological Nitrogen fixation coefficients (kg N/t)	German biological N fixation coefficients (LfL, 2022)	
	Nitrogen Outputs on the Utilised Agricultural Area:		
4.	Crops and Forage: Yields (1000 t)	Ministry of Agriculture, Forestry and Water Economy, Eurostat database	Project Representative, data from Ministry of Agriculture, Forestry and Water Economy
	Nitrogen contents (kg N per t yield)	Austrian and German N contents (Umweltbundesamt, 2024, LfL, 2022)	
	Reference Unit:		
5.	Utilised agricultural area (UAA) (ha)	FAOSTAT	Project Representative

4.3.1.2 Results

The average (Gross) Nitrogen Surplus per hectare of UAA for the years 2014-2022 was calculated as 21 kg N/ha.
The detailed figures for this period are given in Table 4-11.

Table 4-11: GNB results for North Macedonia, 2014-2022

	2014	2015	2016	2017	2018	2019	2020	2021	2022
INPUTS, t N	**42 128**	**41 077**	**50 227**	**48 558**	**36 781**	**41 990**	**48 085**	**36 231**	**37 283**
Mineral fertilizers	20 429	19 362	22 524	20 997	17 914	17 619	23 436	14 577	14 198
Livestock manure	18 363	18 351	23 435	24 201	14 769	20 270	20 506	17 989	17 904
Biological N fixation	3 336	3 363	4 269	3 360	4 099	4 101	4 143	3 666	5 181
OUTPUTS, t N	**15 914**	**13 422**	**18 498**	**13 668**	**17 079**	**16 573**	**17 139**	**16 432**	**16 928**
Harvested crops	15 914	13 422	16 448	11 983	15 026	14 566	15 146	14 615	14 536

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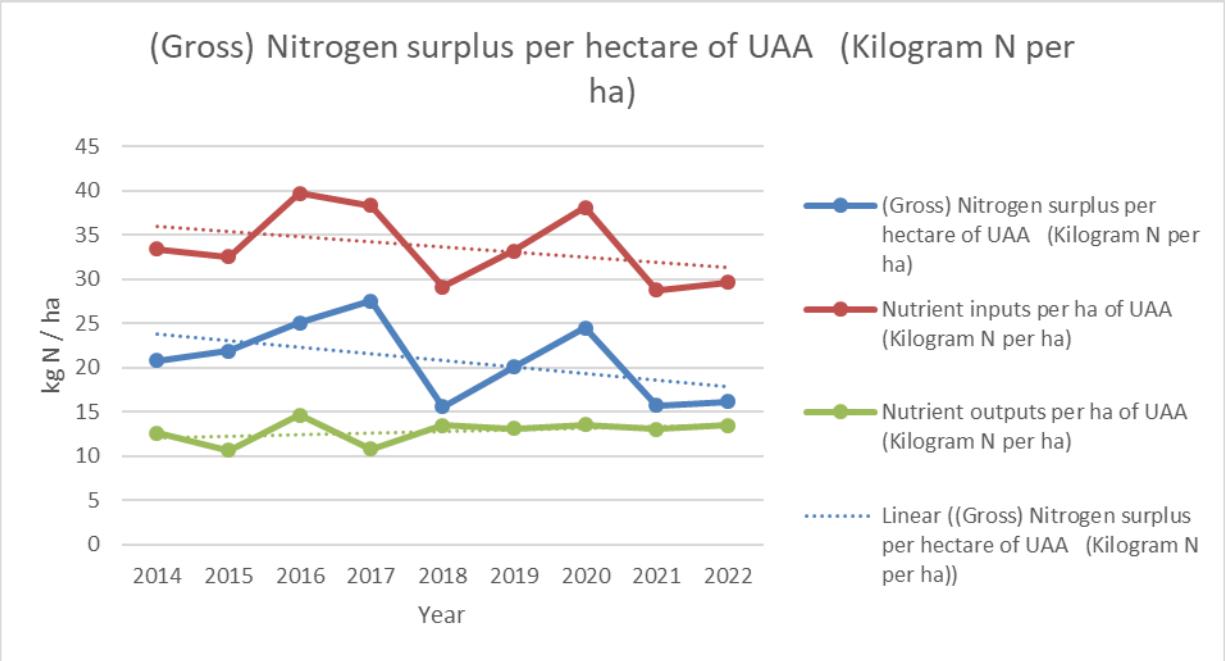
	2014	2015	2016	2017	2018	2019	2020	2021	2022
Harvested forage	0	0	2 049	1 686	2 053	2 008	1 993	1 817	2 392
Surplus (Input minus Output), t N	**26 214**	**27 655**	**31 729**	**34 889**	**19 702**	**25 416**	**30 946**	**19 799**	**20 355**
UAA (1000 ha)	1 261	1 262	1 265	1 266	1 264	1 265	1 262	1 260	1 257
Surplus in kg N per ha	**21**	**22**	**25**	**28**	**16**	**20**	**25**	**16**	**16**

Figure 4-15: GNB results for North Macedonia, 2014-2022



4.3.1.3 Potential for Improvements

The following items of the GNB "5 steps" (see ch. 3.1.1) could be worked on in the future to improve the result of the Gross Nitrogen Balance:

- Step 3. Nitrogen fixation by legume crops: Development of economy-specific biological fixation coefficients (kg N/ha per year or kg N/t yield per year): Amount of Nitrogen fixed in the soil per legume crop type and per ha or t yield
- Step 4. Crops and Forage: Development of economy-specific nitrogen contents per crop type (kg/t): kg of Nitrogen contained in 1 tonne of crop yield, per crop type

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- Step 4. Crops and Forage: Harvested forage: Plants harvested green from arable land: data for 2014-2015 would improve the GNB results for these years, with splitting into categories:
  - Temporary grasses and grazing areas
  - Leguminous plants harvested green:
    - Lucerne
    - Other leguminous plants harvested green
  - Green maize
- Step 4. Crops and Forage: Data on Permanent grassland yields would improve the estimated Nitrogen amounts at the output side of the GNB. Area data for permanent grassland is available (EUROSTAT main area), therefore only average "yield per ha"-values would be needed to calculate total Permanent grassland yields.
- Step 4. Crops and Forage: Development of economy-specific nitrogen contents per crop type (kg/t): kg of Nitrogen contained in 1 tonne of crop yield, per crop type.

4.3.2. High Nature Value Farmland (HNVF) in North Macedonia

North Macedonia consists of large areas of natural and semi-natural grassland, many of which are found in the mountainous regions. These areas are considered to be HNVF type 1. Semi-natural and natural pastures in the mountains are grazed by cattle, sheep and goats during the summer months. Like typical semi-transhumance systems, livestock is moved to the plains during the winter months. Cattle herds remain relatively small and are often made up of local breeds or cross-breeds. Nomadic sheep systems are still common and have long traditions in North Macedonia. More commercially interested farms are becoming more popular, but small, family-owned flocks still make up the majority. Recent years have also seen a steady increase of goats, due to an increased demand of dairy goat products (EFNCP, 2011b, EFNCP, 2011a, The Republic of North Macedonia, 2020).

Pastures, particularly in the mountains, are usually state owned and managed by a public enterprise. Usage rights are allocated to farmers based on the capacity of the pastures. Farmers pay per head of livestock and contracts are signed for periods of five years. Sustainable management of these pastures is reviewed based on their soil, water availability and other natural characteristics. However, while management measures are often proposed in these reviews, they are often not put into practice. Farmers thus often complain about the management and infrastructure, such as animal shelters and watering stations, and subsequently give up on grazing these areas. Abandonment, loss of grazing area and biodiversity and succession are the consequences. (EFNCP, 2011b, EFNCP, 2011a).

Direct support to extensive grazing does not exist. However, there are various schemes to support the traditional transhumance systems. For example, support for local breeds, organic

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farming and direct payments to animals are provided by the state. Shepherds can also receive supported salary from the state (EFNCP, 2011a, EFNCP, 2011b).

HNVF Type 2 with mosaic landscapes are abundant in North Macedonia. Usually they are composed of family gardens, small traditional orchards with various fruit trees and vineyards for own consumption, often in combination with beehives (EFNCP, 2011b).

While the concept of HNVF is relatively new to the region, various pilot projects do exist and local interest is high, as it naturally fits to the traditional livestock systems (Oppermann, Beaufoy, Jones, 2012). The IPARD Programme 2021 to 2027 (The Republic of North Macedonia, 2020) specifically characterizes the different HNVF types. It explains that agricultural systems with potential high nature value are combined systems of extensive pasturing on semi-natural grasslands and semi-intensive agriculture, semi-natural meadows or planted meadows used for hay, winter pastures, summer pasturing, on highland pastures, old extensive or semi-intensive orchards and system of mosaic formations. It recognizes the importance of extensive grazing for the maintenance of these systems, and names abandonment and under-grazing as threats.

For this reason, the strategic goal 6 in the IPARD III Programme is: Contributing to biodiversity protection, improving ecosystem services and preserving natural habitats and landscape includes support of indigenous breeds and livestock activities with low-intensity grazing. High nature value farming and the maintenance of diverse grasslands is recognized as an opportunity for North Macedonia. One objective of the IPARD Programme further is the promotion of environmentally friendly farming practices, within high nature value and traditional agricultural landscapes (The Republic of North Macedonia, 2020).

While High Nature Value Farmland is strikingly present in the IPARD Programme, no specific data or indicator does exist to measure the progress. The results presented here may help to develop an indicator for the specific needs of North Macedonia to track the development of High Nature Value Farmland, extensive and traditional farming systems and diverse grasslands.

4.3.2.1. Results

In 2012, the EEA approach estimated that 17 % of the agricultural area in North Macedonia is HNVF (EEA, 2012), but this result is to be expected to change significantly. Experts from North Macedonia were asked also within EU4Green to contribute to the EEA HNVF, which is currently updated.

The ongoing work by EEA was presented to the local experts at a dedicated workshop with invitation for feedback. The experts were consulted in the selection and detailed inclusion and exclusion of CLC classes (expert rules). For example, CLC class 243 Land principally occupied by agriculture and 321 natural grasslands are fully included in the assessment, while the class

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323 sclerophyllous vegetation is only considered to be HNVF in certain environmental zones. Local experts were also asked for their expertise of grazing shares of semi-natural areas. For more information regarding the methodology see chapter 3.1.2. The quantitative results, including the updated HNVF area and share, will be published by EEA in due course.

4.3.3. Proxy-Indicator for Soil Erosion by water: Soil erosion prone crops in North Macedonia

Soil erosion by water has been identified as a dominant process for land degradation in North Macedonia. Long-term negative human influence, such as overgrazing and unsuitable agricultural practices, combined with steep and rough terrain as well as the erodibility of the sediments, make various forms of soil erosion common. However, compared to the other Western Balkan economies, soil erosion occurs with less intensity, most likely due to lighter rainfall patterns. Wind erosion processes are rather minimal and very localized. (SWG, 2018a, SWG, 2022, Zdruli, Jones, 2022).
In 1992, an Erosion map was completed and further improved by 2002. However, the map has not been updated since then and is therefore considered outdated. According to the Erosion map, over 96 % of the land area is affected erosion, with over 36 % experiencing medium to extreme erosion. Annual soil loss in agricultural land is estimated at 3,7 million tonnes. Over 88.000 ha of land lose over 10 t/ha and have been identified as high priority for erosion control work. Given the high relevance of this indicator, various reports have advocated for an updated soil erosion map (SWG, 2022, SWG, 2018a, MOEPP, 2021). Irrigated land is also subject to erosion by water, with an average soil loss of approximately 300.000m³ (Zdruli, Jones, 2022). The proxy indicator soil-erosion prone crop can help to spread renewed awareness about the topic and increase the interest to update the Erosion map for North Macedonia.

4.3.3.1. Data sources

As a first step, experts from North Macedonia provided the values for the soil erosion vulnerability of crops commonly grown in North Macedonia from 0 to 3. Here, 0 indicates no vulnerability, while 3 represents high vulnerability of soil erosion caused by water. Table 4-12 gives an overview of the assigned values including the explanation by the local experts. Crops with the values 2 or 3 are considered to be soil-erosion prone.

Table 4-12: Vulnerability assessment for soil erosion for chosen crops in North Macedonia from 0 (no vulnerability to 3 (high vulnerability)

VULNERABILITY for soil erosion	Crop	Expert opinion: explanations for the vulnerability against soil erosion
2	**Corn / Maize**	Due to irrigation

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1	**Vegetables**	Grown in greenhouses
0	**Strawberries**	In foils
3	**Potatoes**	Due to inclined terrains
2	**White beans**	Due to irrigation
2	**Sunflower**	Due to irrigation
3	**Fruit trees / Orchards**	Due to inclined terrains
3	**Vineyards**	Due to inclined terrains
2	**Pumpkin**	irrigation erosion
2	**Corn / Maize**	Due to irrigation
1	**Vegetables**	Grown in greenhouses
0	**Strawberries**	In foils
3	**Potatoes**	Due to inclined terrains
2	**White beans**	Due to irrigation
2	**Sunflower**	Due to irrigation

Data on growing area of these crops was collected on MAKSTAT[6], the database of the State Statistical Office of the Republic of North Macedonia, covering the period from 2012 to 2022. Additional data on orchards was provided by MAFWE, department on fruit and wine production. However, there are noticeable data gaps and continuous timelines are not available for all crops. FAOSTAT data on agricultural area, permanent crop area and cropland (FAOSTAT, 2023) were used to complete the dataset. In case of North Macedonia, fruit trees/orchards and vineyards are the main permanent crops and are both considered to be very vulnerable to soil erosion.

4.3.3.2. Results

Figure ***4-16*** shows the total area of erosion prone arable crops and permanent crops in North Macedonia. Due to the incomplete dataset, the timeline was limited to the years 2014 to 2022. Overall, the total area of erosion prone crops is stagnant at around 13 % of arable crops being erosion prone. No growing area of a specific crop has increased significantly over the years (see Figure 4-17). The only noticeable peak has been in 2018 for corn/maize, which has since been reduced to previous numbers again. The percentage of selected erosion prone crops in total arable land can be found in Figure 4-18. The complete data table for the proxy indicator soil erosion prone crops in North Macedonia can be found in the Annex.

Figure 4-16: Total area of erosion prone crops and erosion prone permanent crops in North Macedonia from 2014 to 2022, including the trend lines

[6] https://makstat.stat.gov.mk/

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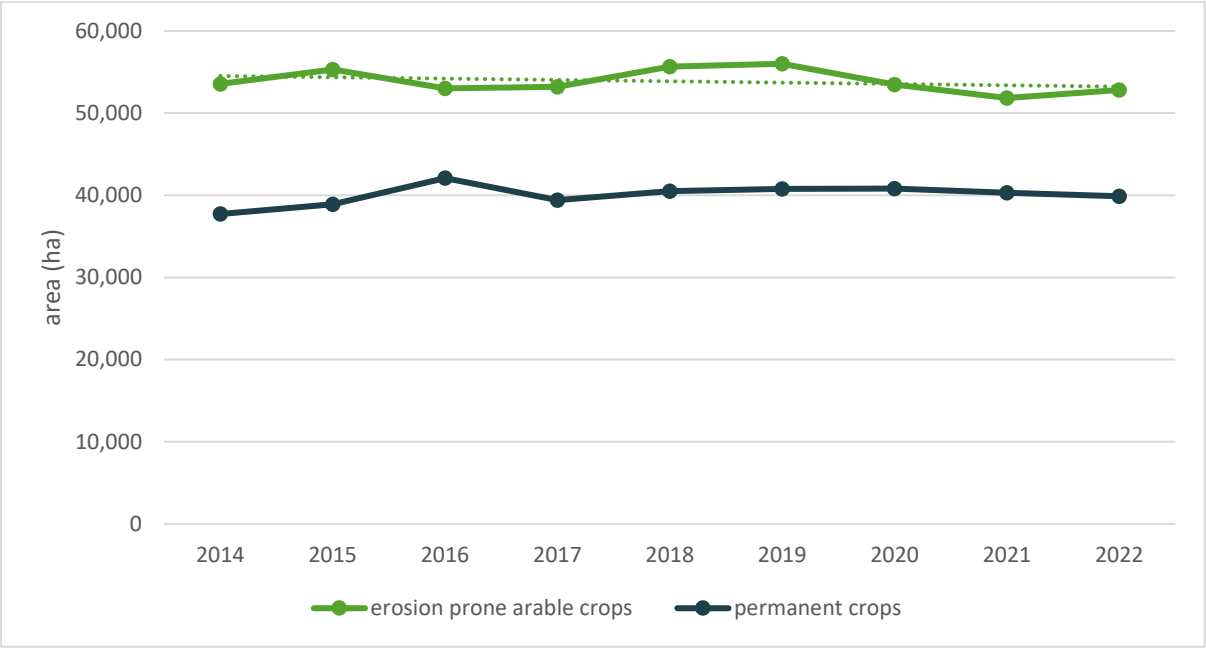

Figure 4-17: Area of erosion prone crops in North Macedonia from 2014 to 2022, separated by crop type

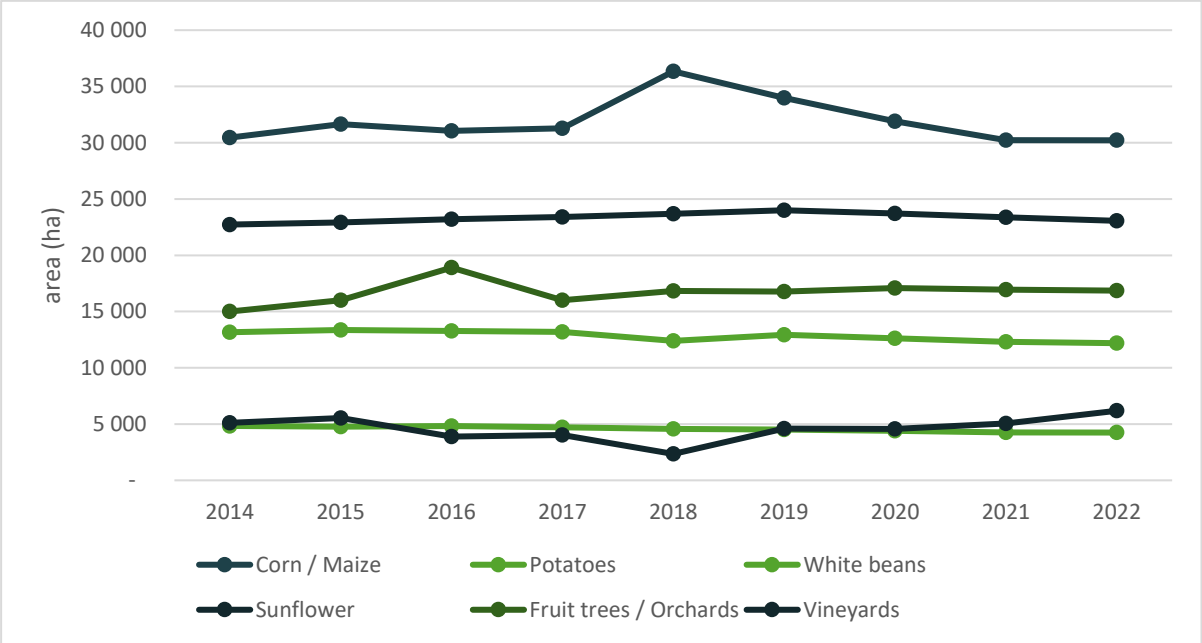

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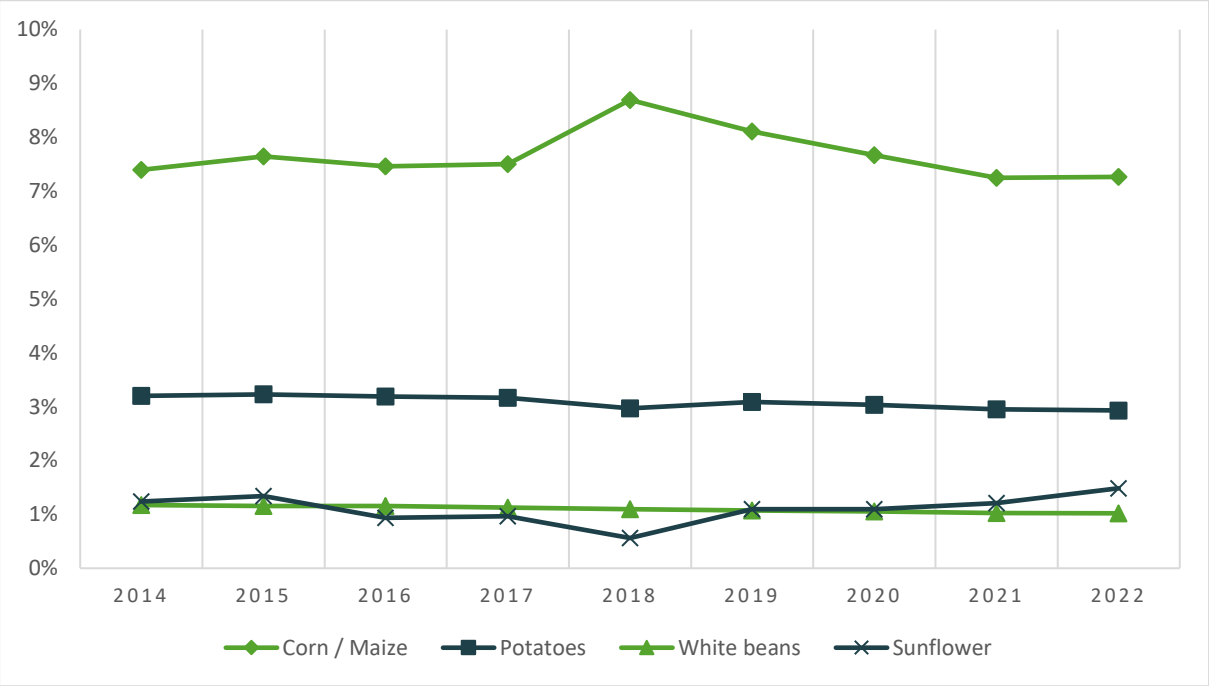
Figure 4-18: Percentage of selected erosion prone arable crops in total arable land; from 2014 to 2022, North Macedonia



4.4. Montenegro

Agriculture in Montenegro is diverse, encompassing the cultivation of olives and citruses along the coastal belt, vegetables and viticulture in the central region, and vast extensive livestock breeding (SWG, 2018a). Table 4-13 gives an overview of key agricultural indicators in Montenegro as an average from 2012 to 2022, including the total agricultural area, arable land and area of permanent grassland, which is by far the most important land cover.

Table 4-13: Overview of Utilised agricultural area in Montenegro as average from 2012 to 2022, based on Eurostat (2025b)

Average 2012 - 2022

UAA	**245 584**	**ha**		
Arable land	6 783	ha	3	% of UAA
Permanent crops	5 273	ha	2	% of UAA
Permanent grassland	231 557	ha	94	% of UAA

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4.4.1. Gross Nutrient Balance (GNB) in Montenegro, preliminary results

4.4.1.1. Data sources

The data sources for the most important "5 steps" of GNB calculation (see ch. 3.1.1) are given in Table 4-14.

Table 4-14: Data sources for GNB of Montenegro

		Data source	Data submitted by
1.	Mineral Fertilizer: Nitrogen Amounts (t)	FAOSTAT	
2.	Livestock numbers	MONSTAT	Ministry of Agriculture, Forestry and Water Management
	Nitrogen Excretion coefficients (per animal category) (kg N/head per year)	Regulation on the principles of good agricultural practice for the application of fertilizers (Official Gazette of Montenegro, 2014)	
3.	Area of legume crops (ha)	MONSTAT	Ministry of Agriculture, Forestry and Water Management
	Biological Nitrogen fixation coefficients (kg N/ha)	Austrian biological N fixation coefficients (Umweltbundesamt, 2024)	
	Nitrogen Outputs on the Utilised Agricultural Area:		
4.	Crops and Forage: Yields (1000 t)	MONSTAT	Ministry of Agriculture, Forestry and Water Management
	Nitrogen contents (kg N per t yield)	Austrian and German N contents (Umweltbundesamt, 2024, LfL, 2022)	
	Reference Unit:		
5.	Utilised agricultural area (UAA) (ha)	MONSTAT	Ministry of Agriculture, Forestry and Water Management

4.4.1.2. Results

The average (Gross) Nitrogen Surplus per hectare of UAA for the years 2016-2020 was calculated as 15 kg N/ha.

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The detailed figures for this period are given in Table 4-15.

Table 4-15: GNB results for Montenegro, 2016-2020

	2016	2017	2018	2019	2020
INPUTS, t N	**8 860**	**8 095**	**8 123**	**8 164**	**8 130**
Mineral Fertilizers	1 324	1 044	1 255	1 465	1 439
Livestock manure	7 459	6 974	6 791	6 621	6 617
Biological N fixation	77	77	77	78	74
OUTPUTS, t N	**4 039**	**4 033**	**4 348**	**4 606**	**4 653**
Harvested crops	374	343	353	329	339
Harvested forage	3 664	3 690	3 995	4 276	4 314
Surplus (Input minus Output), t N	**4 821**	**4 062**	**3 775**	**3 558**	**3 477**
UAA (1000 ha)	256	256	257	257	258
Surplus in kg N per ha	**19**	**16**	**15**	**14**	**13**

Figure 4-19: GNB results for Montenegro, 2016-2020

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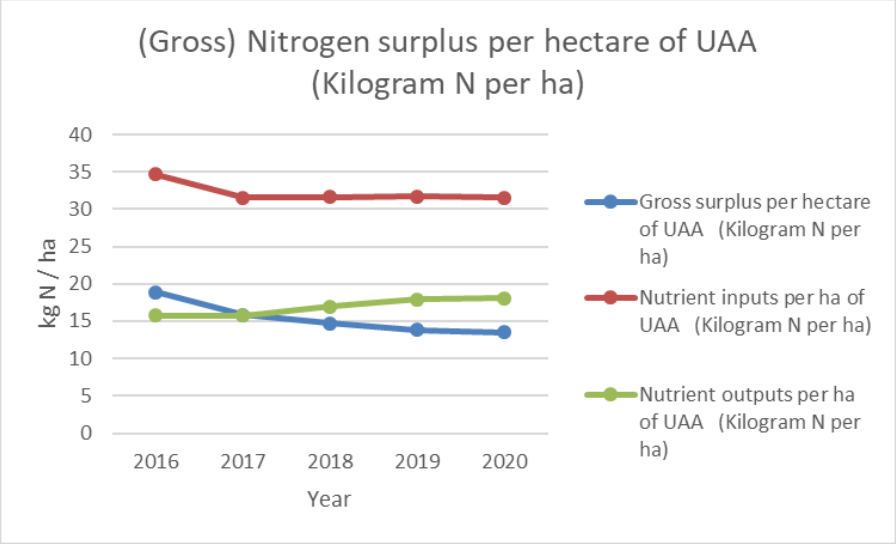

4.4.1.3. Potential for Improvements

The following items of the GNB "5 steps" (see ch. 3.1.1) could be worked on in the future to improve the result of the Gross Nitrogen Balance:

- Step 1. Mineral Fertilizers: Data from FAOSTAT was taken, because no data from other sources in the economy was available.
- Step 3. Nitrogen fixation by legume crops: Development of economy-specific biological fixation coefficients (kg N/ha per year): Development of amount of Nitrogen fixed in the soil per legume crop type and ha
- Step 4. Crops and Forage: Data on Permanent grassland yields "production of hay from meadows" from MONSTAT for 2021 and 2022 would extend the time series of the GNB results for these years.
- Step 4. Crops and Forage: Development of economy-specific nitrogen contents per crop type (kg/t): kg of Nitrogen contained in 1 tonne of crop yield, per crop type

4.4.2. High Nature Value Farmland (HNVF) in Montenegro

The landscape in Montenegro is characterized by semi-natural and natural grassland, covering over 90 % of the area. Intensive agriculture is very rare and occurs mainly in the capital area of Podgorica. Other than that, agriculture is generally very extensive and can be considered HNVF. This assessment is in line with the EEA study from 2012, which estimates that 99 % of agriculture in Montenegro is HNVF (EFNCP, 2011b, EFNCP, 2011a, EEA, 2012).

Traditional livestock systems with small herds of local cattle breeds and flocks of sheep on semi-natural grassland persist to this day. Semi-transhumance systems with movement to the

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mountain pastures during the summer extends over large parts of Montenegro (Oppermann, Beaufoy, Jones, 2012). These grazing systems can be considered as
HNVF Type 1.

Type 2 HNVF with mosaic landscapes are also common in Montenegro, usually a mix of small, hedged plots, traditional orchards and extensively grown olive trees. Landscape elements such as stone walls and terraces occur frequently in these landscapes. Traditionally, olive groves are cultivated on terraces, without irrigation and regular pruning (EFNCP, 2011a, EFNCP, 2011b).

These extensive systems have been recognized by local authorities as an opportunity for organic production, marketing and eco-tourism. For this reason, extensive grazing systems are mention several times in the IPARD Programme (Ministry of Agriculture, Forestry and Water Management, Montenegro, 2022). For example, context indicator 37 is the % of High Nature Value Farmland in national and international conservation status. However, it was not possible to gather information on the methodology of this indicator. Context Indicator 33 is the area of UAA for extensive grazing with max 1LSU/ha forage area.

The programme also recognizes the importance of extensive grazing for the protection of habitats and links it with the conservation of local breeds. Knowledge transfer, education and monitoring are mentioned as key measures to ensure these goals. For example, Sub-measure 4.1 aims for the support of sustainable use of mountain pasture with the explicit goals to maintain mountain meadows and prevent succession while preserving biodiversity. It details eligibility rules regarding the livestock density, management plans, training and records (Ministry of Agriculture, Forestry and Water Management, Montenegro, 2022).
While this report will not go into detail about the link of extensive grazing and forest fire prevention, it is worth mentioning that the IPARD Programme for Montenegro also makes note of this connection.

4.4.2.1. Results

In 2012, the EEA approach estimated that 99 % of the agricultural area in Montenegro is HNVF (EEA, 2012), showing the importance of extensive agriculture. Experts from Montenegro were asked also within EU4Green to contribute to the EEA HNVF, which is currently updated.

The ongoing work by EEA was presented to the local experts at a dedicated workshop with invitation for feedback. The experts were consulted in the selection and detailed inclusion and exclusion of CLC classes (expert rules). For example, CLC class 243 Land principally occupied by agriculture and 321 natural grasslands are fully included in the assessment, while the class 323 sclerophyllous vegetation is only considered to be HNVF in certain environmental zones. Local experts were also asked for their expertise of grazing shares of semi-natural areas. For more information regarding the methodology see chapter 3.1.2. The quantitative results, including the updated HNVF area and share, will be published by EEA in due course.

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4.4.3. Proxy-Indicator for Soil Erosion by water: Soil erosion prone crops in Montenegro

According to SWG (2018a), out of all WB6, Montenegro is the only beneficiary that does not characterize degradation of arable land and soil erosion as a main environmental challenge. Nonetheless, soil erosion caused by droughts and floods is closely related, while wind erosion is rare. Extreme precipitation in some parts of Montenegro in combination with its topography and soil characteristics, has further accelerated soil erosion processes. While grassland as the predominant land use in Montenegro (see Table 4-13) is not at high risk of soil erosion by water, arable land can be heavily affected. In total, about 90 % of the area in Montenegro is affected by soil erosion. Still, no indicator for soil erosion is currently available for Montenegro. Continuous monitoring is recommendable (Zdruli, Jones, 2022, SWG, 2022, SWG, 2018a).

4.4.3.1. Data sources

In case of Montenegro, local experts decided to use the provided default values by Bosnia and Herzegovina (see Table 4-8). For this reason, the vulnerability values for Montenegro are not specific. The growing areas of crops in the period from 2010 to 2022 was collected from Statistical Office of Montenegro (Monstat[7]). Incomplete timelines, missing data and area for total agricultural area, area of permanent crops and area of arable crops were complemented by FAOSTAT data (FAOSTAT, 2023). Local experts provided additional missing data.

4.4.3.2. Results

Given the vulnerability values of BIH, only fruit trees/orchards with a vulnerability value of 2 are considered to be erosion prone. In Montenegro, Vineyards are usually grown on terraces and are not considered at risk of erosion. Since 2010, the growing area of fruit trees has doubled, thus steadily increasing the area of erosion prone agricultural area. Figure 4-20 gives the timeline of total aera of erosion prone arable crops and permanent crops in Montenegro. The most important erosion prone arable crops are potatoes, which have also increased significantly. As shown in Figure 4-21, most of the growth in erosion prone arable crops is due to an increase in vegetables. In total, approximately 63 % of arable crops are considered erosion prone. The percentages of selected erosion prone arable crops can be found in Figure

[7] Uprava za statistiku - MONSTAT

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4-22.The complete data table for the proxy indicator soil erosion prone crops in Montenegro can be found in the Annex.

Figure 4-20: Total area of erosion prone arable crops and permanent crops in Montenegro from 2010 to 2022, including the trend lines

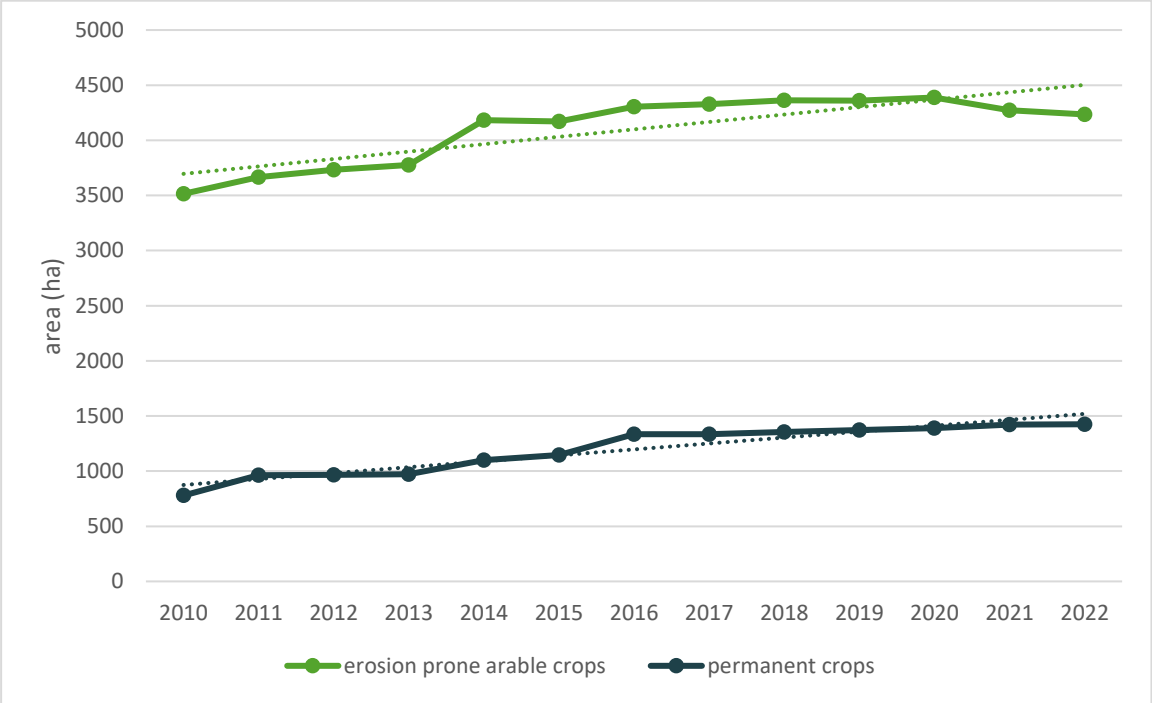

Figure 4-21: Area of erosion prone crops in Montenegro from 2010 to 2022, separated by crop type

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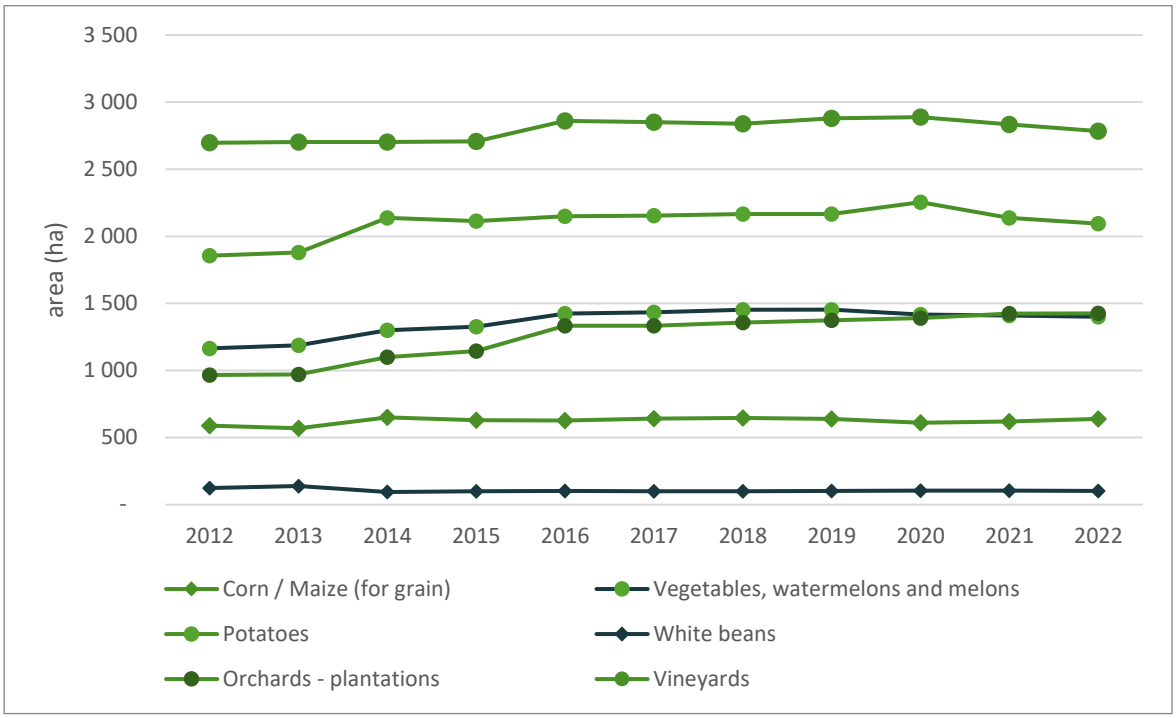
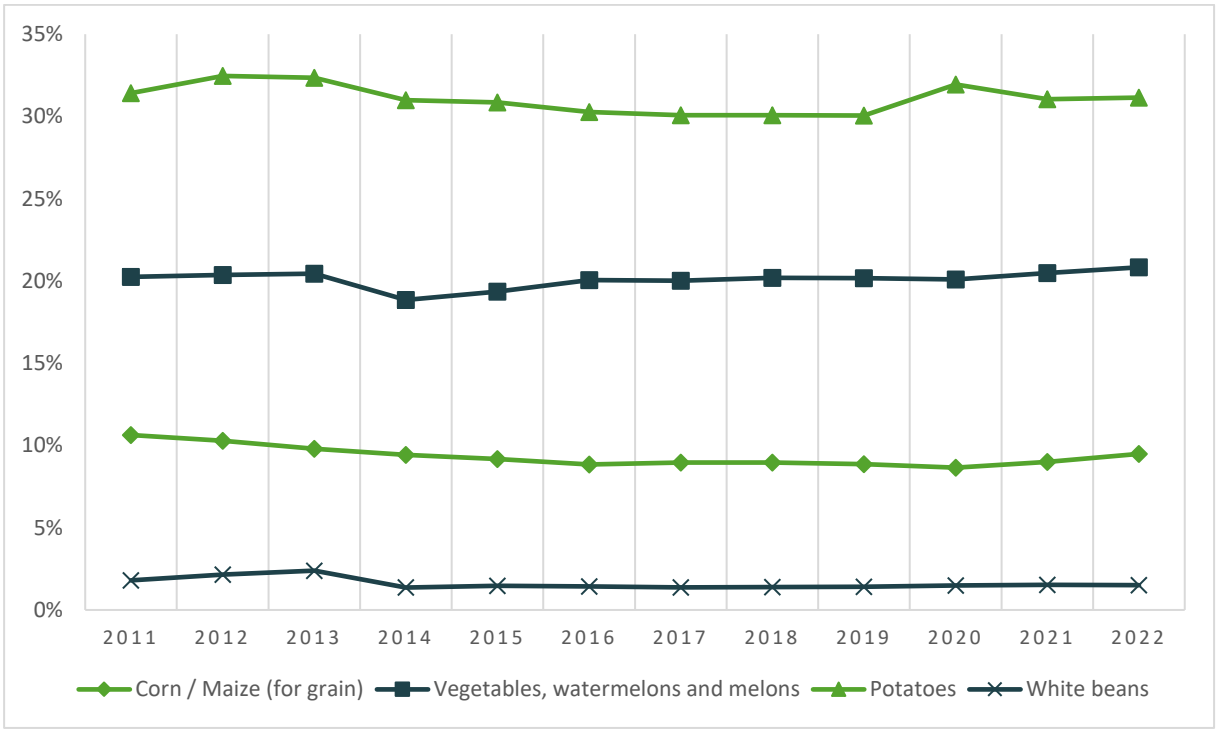


Figure 4-22: Percentage of selected erosion prone arable crops in total arable land; from 2011 to 2022, Montenegro



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4.5. Serbia

Agriculture in Serbia is a vital sector, contributing significantly to the economy and exports. The fertile Pannonian plain and southern lowlands along major rivers are key areas for agricultural production. Serbia is known for its diverse range of crops, including grains, fruits and vegetables. Table 4-16 gives an overview of key agricultural indicators, such as utilised agricultural area, arable land and grassland. Traditional family farms dominate the landscape, reflecting the rich agricultural heritage (SWG, 2018a).

Table 4-16: Overview of Utilised agricultural area in Serbia as average from 2012 to 2022, based on Eurostat (2025b)

Average 2012 - 2022

UAA	**3 489 047**	**ha**		
Arable land	2 593 220	ha	74	% of UAA
Permanent crops	197 841	ha	6	% of UAA
Permanent grassland	677 349	ha	19	% of UAA

Gross Nutrient Balance (GNB) in Serbia, preliminary results

4.5.1. Data sources

The data sources for the most important “5 steps” of GNB calculation (see ch. 3.1.1) are given in Table 4-17.

Table 4-17: Data sources for GNB of Serbia

		Data source	Data submitted by
1.	Mineral Fertilizer: Nitrogen Amounts (t)	SORS (Statistical Office of the Republic of Serbia)	Serbian Environmental Protection Agency with support of SORS (Statistical Office of the Republic of Serbia) and University of Belgrade, Faculty of Agriculture
2.	Livestock numbers	SORS (Statistical Office of the Republic of Serbia)	Serbian Environmental Protection Agency with support of SORS (Statistical Office of the Republic of Serbia) and University of Belgrade, Faculty of Agriculture
	Nitrogen Excretion coefficients (per animal category) (kg N/head per year)	• Regulation on the principles of good agricultural practice for the application of fertilizers (Official	

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		Data source	Data submitted by
		Gazette of Montenegro, 2014) • Umweltbundesamt, 2024	
3.	Area of legume crops (ha)	SORS (Statistical Office of the Republic of Serbia)	Serbian Environmental Protection Agency with support of SORS (Statistical Office of the Republic of Serbia) and University of Belgrade, Faculty of Agriculture
	Biological Nitrogen fixation coefficients (kg N/ha)	Austrian biological N fixation coefficients (Umweltbundesamt, 2024)	
	Nitrogen Outputs on the Utilised Agricultural Area:		
4.	Crops and Forage: Yields (1000 t)	FAOSTAT, EUROSTAT	
	Nitrogen contents (kg N per t yield)	Austrian and German N contents (Umweltbundesamt, 2024, LfL, 2022)	
	Reference Unit:		
5.	Utilised agricultural area (UAA) (ha)	SORS (Statistical Office of the Republic of Serbia)	Serbian Environmental Protection Agency with support of SORS (Statistical Office of the Republic of Serbia) and University of Belgrade, Faculty of Agriculture

4.5.1.2. Results

The average (Gross) Nitrogen Surplus per hectare of UAA for the years 2016-2022 was calculated as 37 kg N/ha.
The detailed figures for this period are given in Table 4-18.

Table 4-18: GNB results for Serbia, 2016-2022

	2016	2017	2018	2019	2020	2021	2022
INPUTS, t N	**418 404**	**398 538**	**300 342**	**302 200**	**368 805**	**254 612**	**299 541**
Mineral Fertilizers	265 881	244 025	151 080	147 452	213 374	101 021	151 995
Livestock manure	93 710	92 620	91 280	91 992	92 304	90 639	84 728
Biological N fixation	58 813	61 894	57 982	62 756	63 127	62 952	62 819
OUTPUTS, t N	**221 681**	**155 310**	**221 278**	**220 419**	**239 165**	**214 337**	**173 182**

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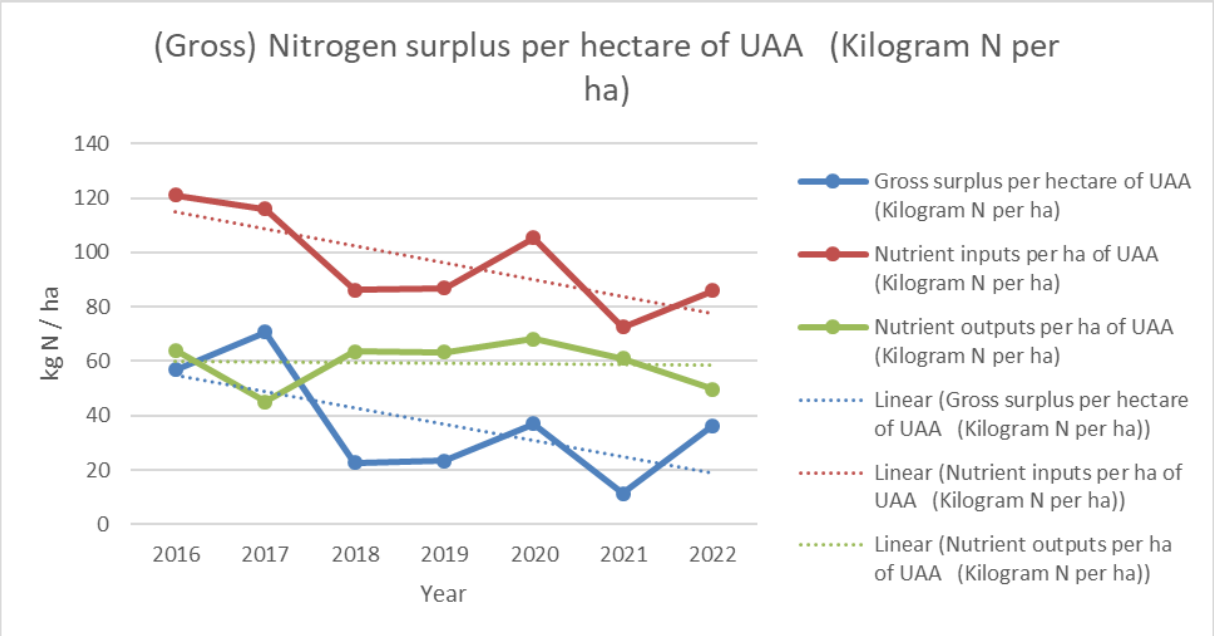
	2016	2017	2018	2019	2020	2021	2022
Harvested crops	210 610	146 688	211 499	208 679	226 847	204 812	165 425
Harvested forage	11 072	8 622	9 780	11 741	12 318	9 525	7 757
Surplus (Input minus Output), t N	**196 723**	**243 228**	**79 064**	**81 781**	**129 640**	**40 275**	**126 359**
UAA (1000 ha)	3 456	3 438	3 487	3 482	3 504	3 506	3 489
Surplus in kg N per ha	**57**	**71**	**23**	**23**	**37**	**11**	**36**

Figure 4-23: GNB results for Serbia, 2016-2022



4.5.1.3. Potential for Improvements

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The following items of the GNB "5 steps" (see ch. 3.1.1) could be worked on in the future to improve the result of the Gross Nitrogen Balance:

- Step 2. Livestock manure: Nitrogen Excretion coefficients (per animal category) (kg N/head per year): Development of economy-specific nitrogen excretion coefficients Nex (amount of Nitrogen excreted per livestock category per year)
- Step 3. Nitrogen fixation by legume crops: Development of economy-specific biological fixation coefficients (kg N/ha per year): Development of amount of Nitrogen fixed in the soil per legume crop type and ha
- Step 4. Crops and Forage: Data on Permanent grassland yields would improve the estimated Nitrogen amounts at the output side of the GNB. Area data for permanent grassland is available (EUROSTAT main area), therefore only average "yield per ha"-values would be needed to calculate total Permanent grassland yields.
- Step 4. Crops and Forage: Development of economy-specific nitrogen contents per crop type (kg/t): kg of Nitrogen contained in 1 tonne of crop yield, per crop type

4.5.2. High Nature Value Farmland (HNVF) in Serbia

In some parts of Serbia intensive production of crops and livestock is most dominant. However, in less fertile areas, and especially in the mountain regions, more traditional and extensive agriculture has remained common. These systems are mostly focused on subsistence and are very diversified in terms of landscapes and crops. Extensive grazing in the mountain woodlands, upland pastures and grasslands is still common. According to the EFNCP, the grazing density in these remote areas is around 1 LSU per 3 ha (EFNCP, 2011a). Around 1 million ha grasslands are thus considered to be HNVF. While most of these are semi-natural grasslands, grazing also occurs in mountainous pastures, woodland edges, flood valleys and steppes. While sheep are the most common livestock in these systems, cattle, free range pigs and poultry in orchards are also frequent. Sheep flocks used to be nomadic, and in some parts of Serbia semi-transhumance systems have maintained the grasslands in southeastern and eastern Serbia. However, highland pastures are increasingly abandoned and overstocking in lowland pastures is becoming an environmental risk, due to soil degradation and erosion. Simultaneously, the previous diversity rich highland grasslands are in danger of loss due to succession (EFNCP, 2011b, Oppermann, Beaufoy, Jones, 2012).

In 2010, Serbia has taken first steps in preserving HNVF. First, the potential HNVF was identified based on the EEA approach using available datasets. According to this analyses, approximately 20 % of the agricultural area are considered to be HNVF (Oppermann, Beaufoy, Jones, 2012, Ministry of Agriculture, Forestry and Water Management, Republic of Serbia, Environmental Protection Agency Serbia, 2016). This assessment is in line with the European

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HNVF update from 2012 (EEA, 2012). The Serbian assessment shows, that the majority of HNVF is grasslands (HNVF type 1), but experts also agree that the full extent of Serbian HNVF cannot be captured by this approach, as small-scale mosaic landscapes (HNVF type 2) are not fully taken into account by this approach. Essentially, they are "lost" due to the coarse European dataset. A more detailed mapping with definitions tailored the farming systems in Serbia would likely alter the number significantly. Also, the mapping and dataset have not been updated since 2010 (EFNCP, 2011a, Ministry of Agriculture, Forestry and Water Management, Republic of Serbia, Environmental Protection Agency Serbia, 2016).

While this assessment was a first step to identify HNVF, there are no policy measures specifically targeting HNVF. However, HNVF systems can indirectly benefit from other support measures. For example, farms with local breeds can also receive investment supports. Pilot projects for traditional grazing practices have also been previously introduced (EFNCP, 2011a). The IPARD III Programme for Serbia further sets out the support measures for sustainable management of meadows and pastures. According to the eligibility criteria, a management plan for stocking density, proper grazing management and practices and other requirements have to be in place. This measure explicitly aims for the promotion of biodiversity through low-level grazing by domestic livestock throughout the years (Ministry of Agriculture, Forestry and Water Management, Republic of Serbia, 2022).

4.5.2.1. Results

In 2012, the EEA approach estimated that 20 % of the agricultural area in Serbia is HNVF (EEA, 2012). Experts from Serbia were asked also within EU4Green to contribute to the EEA HNVF, which is currently updated.

The ongoing work by EEA was presented to the local experts at a dedicated workshop with invitation for feedback. The experts were consulted in the selection and detailed inclusion and exclusion of CLC classes (expert rules). For example, CLC class 321 natural grasslands is fully included in the assessment, while the class 243 land principally occupied by agriculture is more complex, and only included in certain zones. Local experts were also asked for their expertise of grazing shares of semi-natural areas. For more information regarding the methodology see chapter 3.1.2. The quantitative results, including the updated HNVF area and share, will be published by EEA in due course.

4.5.3. Proxy-Indicator for Soil Erosion by water: Soil erosion prone crops in Serbia

Soil erosion is one of the most dominant forms of soil degradation in Serbia and affects about 90 % of the total land area. It has been estimated that 80 % of agricultural land is deteriorating due to soil erosion in various forms. Erosion by water is especially dominant in hilly and

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mountainous regions, further increased by heavy rainfall. Due to climate change, intense period of rain and consequent floods are more likely to happen and will likely affect the Serbian soil. The south-east region bordering North Macedonia and Bulgaria, as well as vineyards on steep slopes are most endangered (SWG, 2022, Zdruli, Jones, 2022).

Deforestation and destruction of forests, unsustainable agricultural practices, inadequate soil cultivation, intensive grazing and uncontrolled urbanization further accelerate the development of erosion processes (SWG, 2022).

The Serbian Ministry of Environmental Protection (SEPA) has evaluated the soil erosion in Serbia in 1971 and 2009 with a national methodology. The comparison between the years shows that all categories of erosion have increased. For example, in 1971, 41 % of the land in Serbia was evaluated with the highest category of erosion (V). In 2009, this number increased to 48 %. While there are efforts to update this assessment, there is no newer evaluation of soil erosion in Serbia (SWG, 2018a). In 2015, Serbia issued a Law on Soil Protection with the aim to identify the most endangered areas and help to set-up appropriate measures and policies (Zdruli, Jones, 2022).

4.5.3.1. Data sources

For this assessment of soil erosion prone crops as a proxy-indicator for Soil Erosion by water, the default vulnerability values for Bosnia and Herzegovina were used, as no specific vulnerability values for soil erosion were provided by local experts (see Table 4-8). Due to the common practice of vineyards on steep hillsides in Serbia (Jakšić, Ninkov, Milić, Vasin, Živanov, Perović, Banjac, Vučković, Dozet, Komlen, 2021, Andreeva, Gabechaya, Morev, Samardžić, Galić, Yaroslavtsev, 2025), the vulnerability value for vineyards was marked up to 2. While BIH does not consider vineyards as erosion prone, experts in Serbia agreed that this change in the default values better reflects the practices of viticulture in Serbia.

Data on growing area was collected from the Statistical Office of the Republic of Serbia[8],the Agricultural Census 2023 and the Serbian Environment Protection Agency (SEPA). Still for some relevant crops, it was not possible to collect complete timelines. For example, growing areas for vegetables, strawberries and melons in the years from 2017 to 2019 are missing.

[8] https://www.stat.gov.rs/en-US/

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4.5.3.2. Results

Figure 4-24 shows the development of the area of erosion prone arable crops and permanent crops in Serbia from 2010 to 2023. For permanent crops, orchards and vineyards are considered in Serbia. These two crops account for almost 100 % of all permanent crops grown in Serbia. By far, the most dominant erosion prone crop is maize/corn. As shown in Figure 4-25, the total growing area for maize/corn has decreased over the years, but other crops like soya and sunflower have increased instead. Overall, around 44 % of arable crops in Serbia are considered erosion prone. The percentages of selected arable crops in total arable land can be found in

Figure **4-26**. The complete data table for the proxy indicator soil erosion prone crops in Serbia can be found in the Annex.

Figure 4-24: Total area of erosion prone arable crops and permanent crops in Serbia from 2010 to 2023, including the trend lines

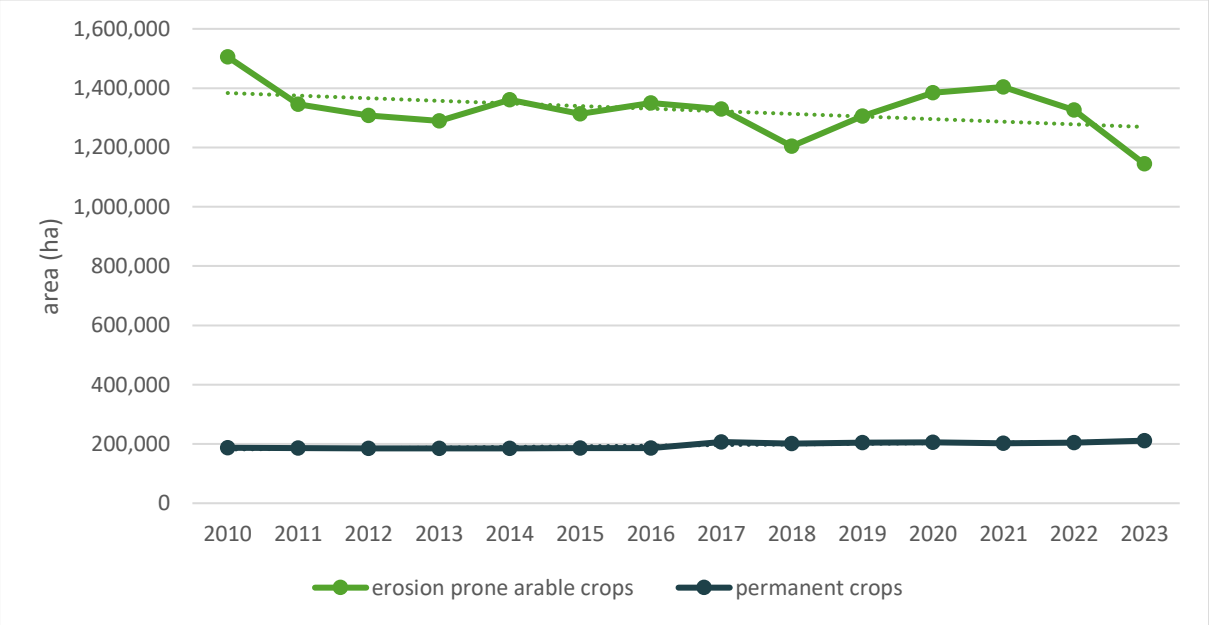

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Figure 4-25: Area of erosion prone crops in Serbia from 2010 to 2023, separated by crop type

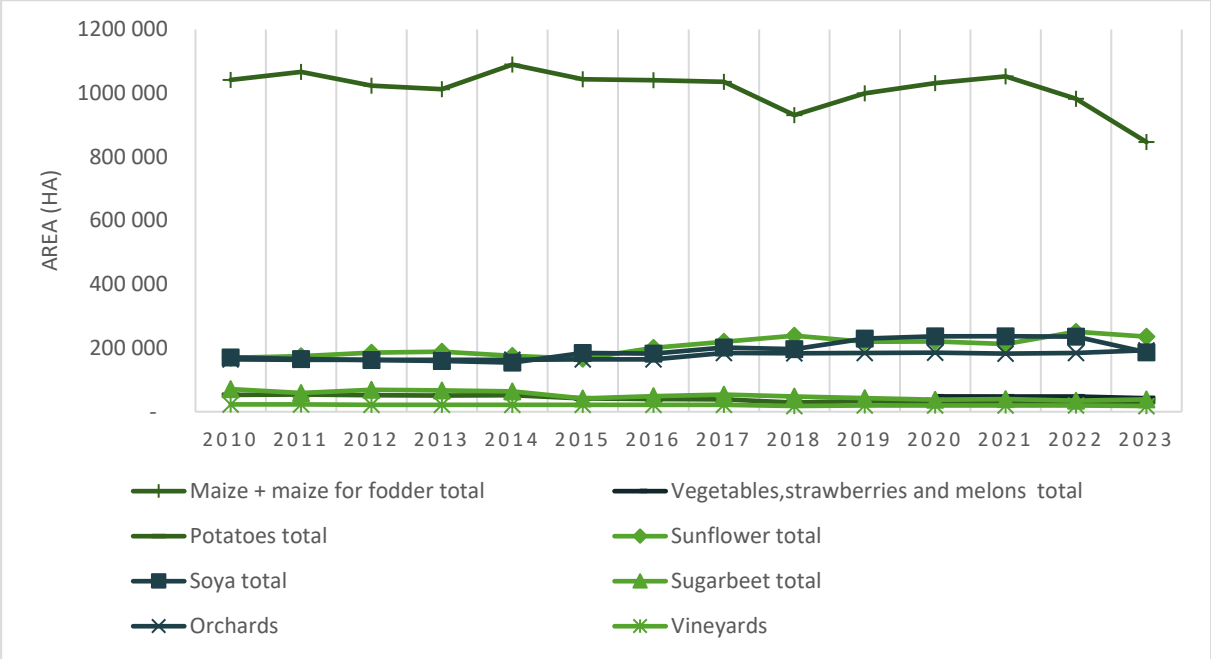
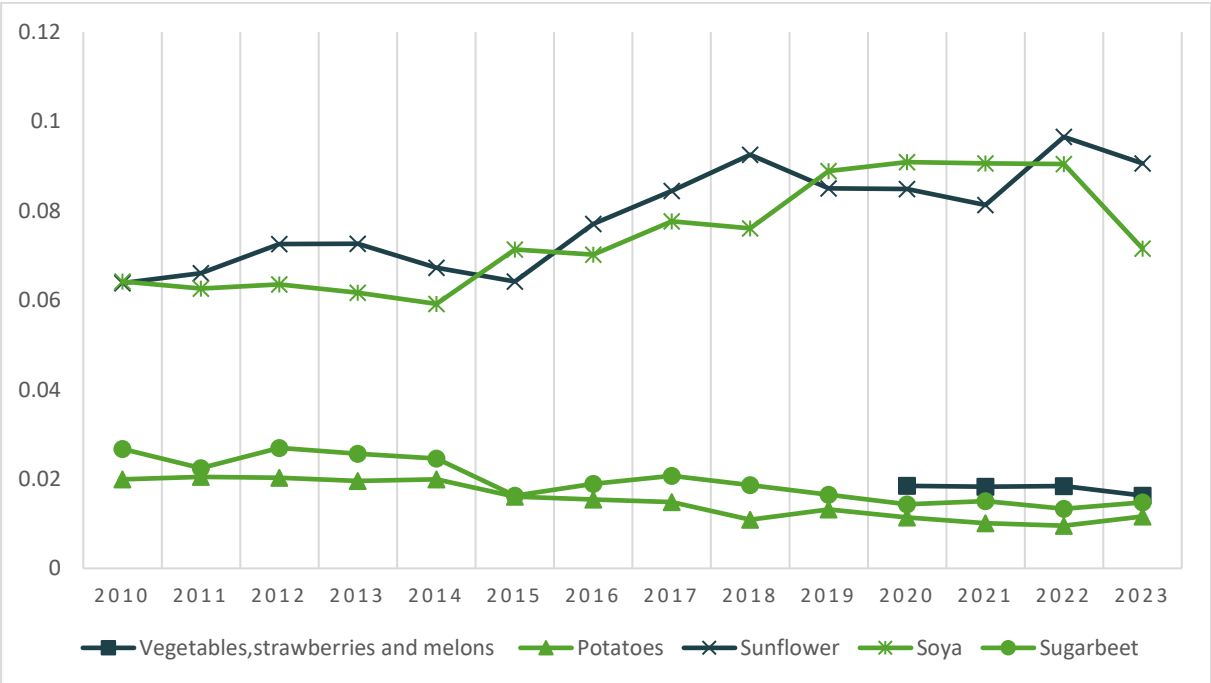


Figure 4-26: Percentage of selected erosion prone arable crops in total arable land; from 2010 to 2023, Serbia



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4.6. Kosovo

Agriculture in Kosovo plays a crucial role in the economy, with a significant portion of the population engaged in farming. The fertile land supports diverse crops, including grains, fruits and vegetables. Livestock farming is also prominent (SWG, 2018a). Table 4-19 shows the most important agricultural indicators as an average from 2012 to 2022, such as the total utilised agricultural land, area of arable land and area of permanent crops. Traditional farming methods are still dominant, reflecting a rich agricultural heritage.

Table 4-19: Overview of Utilised agricultural area in Kosovo as average from 2012 to 2022, based on Eurostat (2025b)

Average 2012 - 2022

UAA	**421 141**	**ha**		
Arable land	186 672	ha	44	% of UAA
Permanent crops	11 309	ha	3	% of UAA
Permanent grassland	222 237	ha	53	% of UAA

4.6.1. Gross Nutrient Balance (GNB) in Kosovo, preliminary results

4.6.1.1. Data sources

The data sources for the most important “5 steps” of GNB calculation (see ch. 3.1.1) are given in Table 4-20.

Table 4-20: Data sources for GNB of Kosovo

		Data source	**Data submitted by**
1.	Mineral Fertilizer: Nitrogen Amounts (t)	Kosovo Agency of Statistics	Ministry of Agriculture, Forestry and Rural Development (MAFRD)
2.	Livestock numbers	Kosovo Agency of Statistics	Ministry of Agriculture, Forestry and Rural Development (MAFRD)
	Nitrogen Excretion coefficients (per animal category) (kg N/head per year)	• Regulation on the principles of good agricultural practice for the application of fertilizers (Official Gazette of Montenegro, 2014)	
3.	Area of legume crops (ha)	Kosovo Agency of Statistics	Ministry of Agriculture, Forestry and Rural Development (MAFRD)
	Biological Nitrogen fixation coefficients (kg N/ha)	Austrian biological N fixation coefficients (Umweltbundesamt, 2024)	

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		Data source	Data submitted by
	Nitrogen Outputs on the Utilised Agricultural Area:		
4.	Crops and Forage: Yields (1000 t)	Kosovo Agency of Statistics	Ministry of Agriculture, Forestry and Rural Development (MAFRD)
	Nitrogen contents (kg N per t yield)	Austrian and German N contents (Umweltbundesamt, 2024, LfL, 2022)	
	Reference Unit:		
5.	Utilised agricultural area (UAA) (ha)	Kosovo Agency of Statistics	Ministry of Agriculture, Forestry and Rural Development (MAFRD)

4.6.1.2. Results

The average (Gross) Nitrogen Surplus per hectare of UAA for the years 2014-2022 was calculated as 59 kg N/ha.
The detailed figures for this period are given in Table 4-21.

Table 4-21: GNB results for Kosovo, 2014-2022

	2014	2015	2016	2017	2018	2019	2020	2021	2022
INPUTS, t N	**41 236**	**41 367**	**40 687**	**40 592**	**40 523**	**42 390**	**43 008**	**43 135**	**42 826**
Mineral Fertilizers	20 525	19 888	18 833	19 020	18 910	20 525	20 585	20 696	20 964
Livestock manure	16 590	16 953	17 479	17 044	16 847	16 898	17 448	17 451	16 868
Biological N fixation	4 121	4 526	4 375	4 528	4 766	4 966	4 975	4 987	4 994
OUTPUTS, t N	**15 679**	**14 901**	**17 976**	**17 027**	**16 422**	**17 130**	**18 430**	**17 516**	**18 057**
Harvested crops	9 419	9 379	11 666	10 175	9 085	9 495	10 817	10 286	10 611
Harvested forage	6 260	5 523	6 310	6 852	7 337	7 635	7 613	7 230	7 445
Surplus (Input minus Output), t N	**25 557**	**26 465**	**22 711**	**23 564**	**24 101**	**25 260**	**24 579**	**25 619**	**24 769**
UAA (1000 ha)	414	410	416	416	419	420	420	420	420
Surplus in kg N per ha	**62**	**64**	**55**	**57**	**58**	**60**	**58**	**61**	**59**

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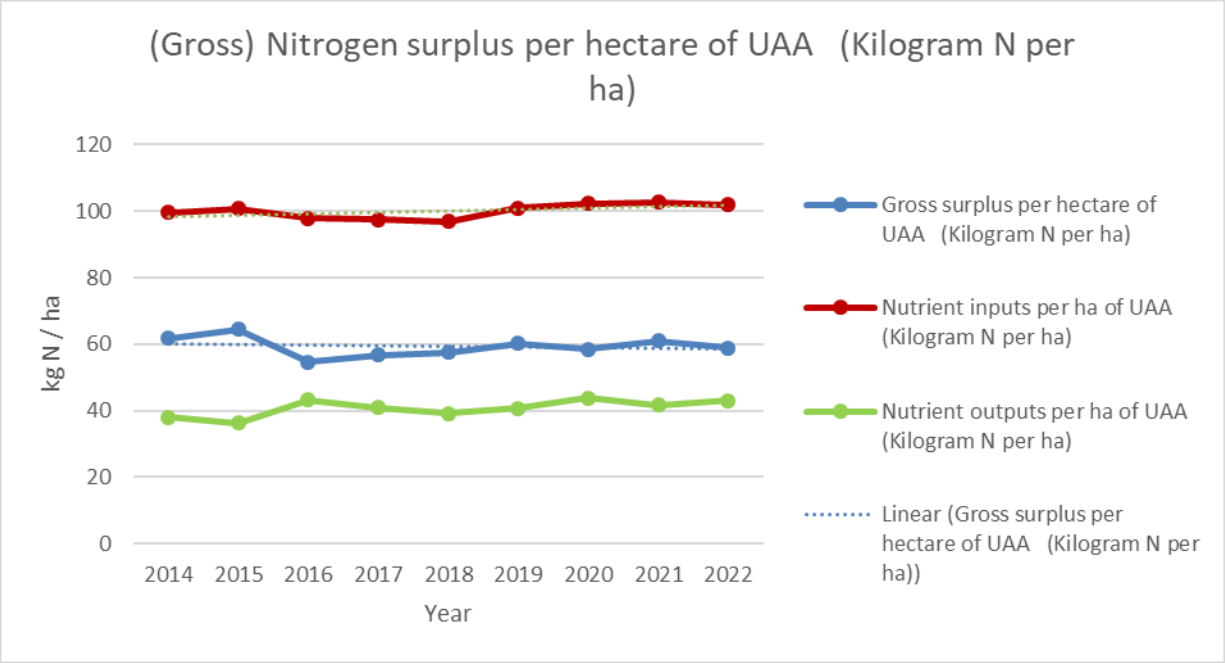
Figure 4-27: GNB results for Kosovo, 2014-2022



4.6.1.3. Potential for Improvements

The following items of the GNB "5 steps" (see ch. 3.1.1) could be worked on in the future to improve the result of the Gross Nitrogen Balance:

- Step 2. Livestock manure: Nitrogen Excretion coefficients (per animal category) (kg N/head per year): Development of economy-specific nitrogen excretion coefficients Nex (amount of Nitrogen excreted per livestock category per year).
- Step 3. Nitrogen fixation by legume crops: Development of economy-specific biological fixation coefficients (kg N/ha per year): Development of amount of Nitrogen fixed in the soil per legume crop type and ha.
- Step 4. Crops and Forage: Development of economy-specific nitrogen contents per crop type (kg/t): kg of Nitrogen contained in 1 tonne of crop yield, per crop type.

4.6.2. High Nature Value Farmland (HNVF) in Kosovo

More than 50 % of the land in Kosovo is covered by grassland. In most cases, the pastures and meadows are not artificially fertilized and are used for extensive grazing and hay making. However, the natural and semi-natural grasslands of Kosovo are under threat of being abandoned or intensified, where economically feasible. This would cause a significant loss of

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biodiversity, which is also noticed by the Strategy for Agriculture and Rural Development (Republic of Kosovo, Ministry of Agriculture, Forestry and Rural Development, 2021). According to the EEA, in 2012, 81.5 % of the UAA in Kosovo was estimated to be HNVF (Paracchini, Petersen, Hoogeveen, Bamps, Burfield, van Swaay, 2008, EEA, 2012). This strongly suggests that HNVF is not only occurring on grassland, but also in more arable areas. Given the pattern of agriculture in the Western Balkan generally, it seems likely that HNVF Type 2 with mosaic landscapes is also common in Kosovo. However, it was not possible to receive more information on this.

While the Strategy for Agriculture recognizes the value of the extensive grassland for HNVF and market opportunities, it also makes note that the concept is not defined or recognized yet (Republic of Kosovo, Ministry of Agriculture, Forestry and Rural Development, 2021). For example, extensive grasslands and extensive grazing management are mentioned as potential options for carbon sequestration and climate change mitigation (Republic of Kosovo, Ministry of Agriculture, Forestry and Rural Development, 2021).

Budget is planned to be allocated for the support of extensive grassland management. The strategy outlines that requirements regarding grazing density, management plans and so on have to be developed for this subsidy and suggests a pilot scheme as a starting point. Similarly, it is aimed to support local breeds, starting with a pilot scheme as well (Republic of Kosovo, Ministry of Agriculture, Forestry and Rural Development, 2021).

4.6.2.1. Results

In 2012, the EEA approach estimated that 82 % of the agricultural area in Kosovo is HNVF (EEA, 2012), showing the importance of extensive agriculture. Experts from Kosovo were asked also within EU4Green to contribute to the EEA HNVF, which is currently updated.

The ongoing work by EEA was presented to the local experts at a dedicated workshop with invitation for feedback. The experts were consulted in the selection and detailed inclusion and exclusion of CLC classes (expert rules). For example, CLC class 243 Land principally occupied by agriculture and 321 natural grasslands are fully included in the assessment, while the class 323 sclerophyllous vegetation is only considered to be HNVF in the Continental Zone. Local experts were also asked for their expertise of grazing shares of semi-natural areas. For more information regarding the methodology see chapter 3.1.2. The quantitative results, including the updated HNVF area and share, will be published by EEA in due course.

4.6.3. Proxy-Indicator for Soil Erosion by water: Soil erosion prone crops in Kosovo

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Soil erosion is considered a major environmental problem in Kosovo, as more than 50 % of the land is categorized as medium to excessive soil erosion (SWG, 2018a). In comparison, 56 % of the soil in Kosovo is of poor quality. At least in hilly areas, soil erosion can be considered a main driver of land degradation. In 2020, the Kosovo Environment Agency has produced a soil erosion map, assessing that 60 % of the territory is at risk of erosion. Agricultural land and vineyards are especially vulnerable to erosion (Zdruli, Jones, 2022). Deforestation and little public awareness further accelerates the issue (Vidojevic, 2022).
Currently, there is no erosion management plan. However, in 2018 a soil erosion indicator war established (Vidojevic, 2022).

4.6.3.1. Data sources

First, local experts provided vulnerability values for soil erosion of commonly grown crops. Here, 0 is not vulnerable and 3 is very vulnerable. The assigned values can be found in Table 4-22 below. Other commonly erosion prone crops (e.g. soya, sunflower) are not considered relevant for the crop production in Kosovo according to local experts and are not included. In case of Kosovo, local experts regarded only 2 crops as erosion prone: corn/maize and vineyards. Vegetables and potatoes are grown mainly in flat areas and are thus not considered erosion-prone. For this reason, the analyses only include these two crops. In a second step, the data on growing area, arable land and area of permanent crops was collected from the Kosovo Agency of Statistics[9].

Table 4-22: Vulnerability assessment for soil erosion for chosen crops in Kosovo from 0 (no vulnerability) to 3 (high vulnerability)

VULNERABILITY for soil erosion	Crop	Expert opinion: explanations for the vulnerability against soil erosion
2	**Corn / Maize**	There is a combination of areas where corn in planted so in the cases where the slope is high there is potential for soil erosion compared to flat areas that are considered with less potential for erosion.
0	**Vegetables (incl. Under greenhouse)**	Vegetables in open fields are mainly planted in flat areas and therefore are not considered as vulnerable. Erosion phenomena due to (permanent) irrigation could be evaluated in the future.
1	**Strawberries**	It is considered that strawberry is a low vulnerable crop for soil erosion taking into consideration that most is cultivated in flat areas.
0	**Potatoes**	It is considered that is not a vulnerable crop for soil erosion.
1	**Beans**	Even though beans are cultivated in flat areas it has shallow roots and is irrigated with different system of irrigation.
0	**Pumpkin**	Pumpkins are planted in flat area and in most cased is cultivated together with maize.
3	**Vineyards**	In Kosovo most vineyards are in slope areas and we consider that they are vulnerable for soil erosion.

[9] https://askdata.rks-gov.net/

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4.6.3.2. Results

Given the local assessment, the growing area of corn/maize is the same as the area of erosion prone crops (see Figure 4-28). Similarly, as only vineyards are considered, it is the same area for erosion prone permanent crops. Thus, for Kosovo only one figure is available. Corn is the dominant crop in Kosovo, making up 21 % of arable crops. Percentages for selected arable crops can be found in Figure 4-29. The complete data table for the proxy indicator soil erosion prone crops in Kosovo can be found in the Annex.

Figure 4-28: Area of erosion prone crops in Kosovo from 2006 to 2022, separated by crop type

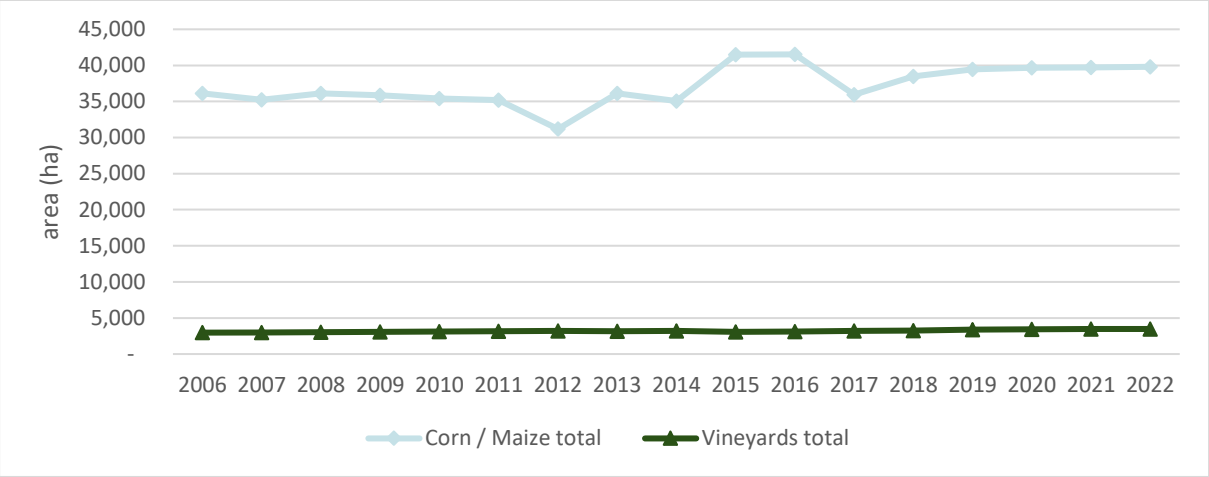

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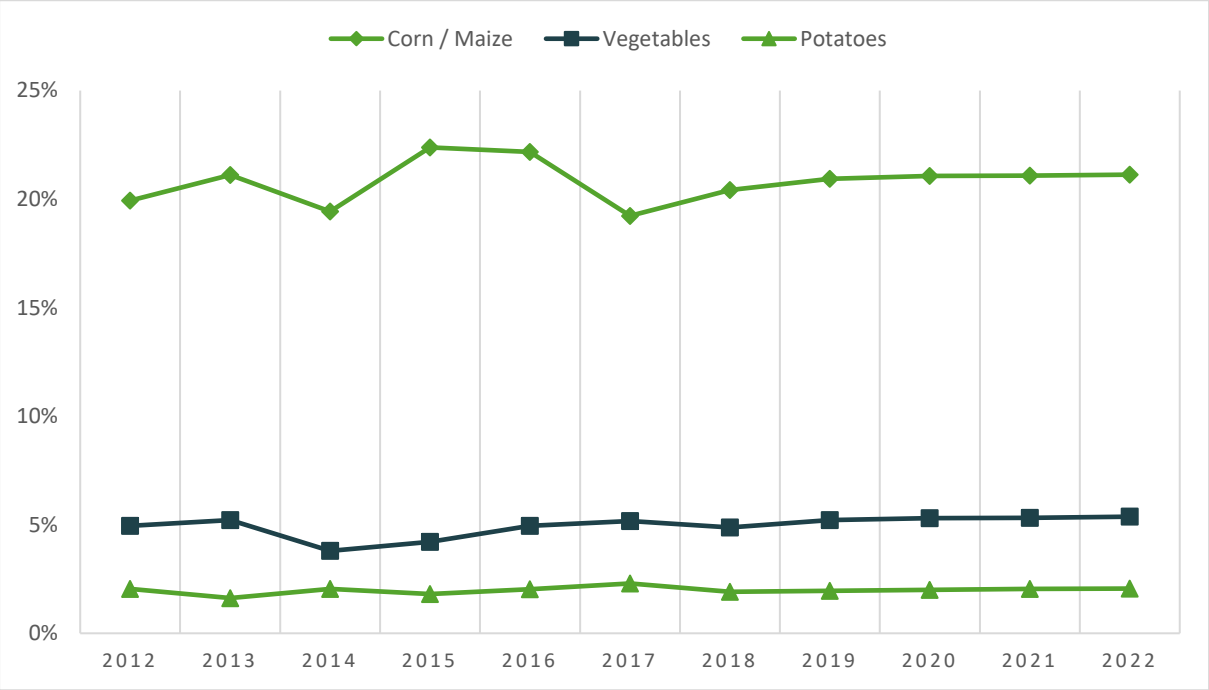
Figure 4-29: Percentage of selected erosion prone arable crops in total arable land; from 2012 to 2022, Kosovo



5. ADDITIONAL AEIS RELEVANT FOR GAWB

Apart from the three core Agri-environmental indicators described in detail in chapters 3 and 4, there was also interest to develop in the future other AEIs. An overview is given in Table 5-1.

Table 5-1 Additional Agri-Environmental Indicators („On-Top" Indicators) of interest for WB6 beneficiaries to be elaborated in the future. Related AEIs at European level are given.

Economy	Additional indicators of interest	PMEF indicators[10] acc. to Reg. (EU) 2021/2115 (European Parliament and the Council of the European Union, 2021)	AEIs acc. to 28 EU AEIs (European Commission, 2006)[11]
ALB	Manure Storage Irrigated Areas Agroforestry	C.18 Irrigable land	AEI 11.3 Manure storage AEI 7 Irrigation

[10] See https://agriculture.ec.europa.eu/system/files/2023-02/pmef-context-impact-indicators_en.pdf
[11] See https://ec.europa.eu/eurostat/web/agriculture/database/agri-environmental-indicators

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BiH	Irrigated Areas Ammonia Emissions Pesticides Use Agricultural Training	C.18 Irrigable land C.47, I.14 Ammonia Emissions C. 49 Pesticides C. 15 Agricultural training of farm managers	AEI 7 Irrigation AEI 18 Ammonia Emissions AEI 6 Consumption of Pesticides AEI 3 Farmers' training level and use of environmental farm advisory services
MKD	Manure Storage Irrigated Areas	C.18 Irrigable land	AEI 11.3 Manure storage AEI 7 Irrigation
MNE	Manure Storage Irrigated Areas Implementation of LAGs Agricultural Training	C.18 Irrigable land R.38 LEADER coverage: Share of rural population covered by local development strategies C. 15 Agricultural training of farm managers	AEI 11.3 Manure storage AEI 7 Irrigation AEI 3 Farmers' training level and use of environmental farm advisory services
SRB	Areas of Natural Constraints (ANC)	C. 20 Areas facing natural and other specific constraints	
XXK	Areas of Natural Constraints (ANC)	C. 20 Areas facing natural and other specific constraints	

Manure storage facilities are often funded under IPARD III, Measure “Investment in physical assets of agricultural holdings”. In addition, indicators such as ”Number of IPARD recipients with support in investments related with manure management” and related target values are laid down in the IPARD III programmes. Thus, data and trends should be available after the current IPARD III period.

The development of **irrigated areas** is strongly linked to Action 50 of the GAWB Action Plan, ”Support investments in … adaptation to climate change measures in agriculture” and would be worth to monitor, together with data on available water resources and water use in agriculture.

Ammonia emissions should be calculated according to International Emission Guidebooks and guidelines (Convention on Long-range Transboundary Air Pollution, UNECE - United Nations Economic Commission for Europe, 1979).

Pesticides use data is relevant for agri-environmental assessments and data availability should be improved step by step, including also some risk assessments.

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Developments of the **Numbers of Agricultural trainings** funded under IPARD III and other programmes could be explored, however, some categorization of training topics should be taken into account.

Agroforestry is a traditional kind of land use in the Western Balkan region, e.g. in Albania agroforestry has been a well-known practice for decades. Mostly, the main elements of agroforestry in Albania included planting forest trees around agricultural land, alongside highways and near agricultural land, alongside irrigation, drainage and embankment canals. In the western part of Albania, there were also cases forest trees being planted in narrow belts in the middle of agricultural land, to reduce wind speed and protect crops. In these agroforestry practices, the most commonly used species was popular, but there were also cases of the use of other species (pine, willow, alder, elm-tree, etc.). In general, the height of the trees in the forest belts ranged from 10-20 meters, while the width of the rows ranged from 20-50 meters. In the EU CAP context this land management method is seen as both enhancing biodiversity and carbon sequestration in agriculture. Therefore, monitoring of state and development of these agroforestry areas seems worthwhile in the future.
Data for **Areas of Natural Constraints (ANC**) had been evaluated in detail for the region of Southeast Europe (Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH., 2017). The included analyses and recommendations for the characterisation and mapping of areas with natural constraints are a good base for the future indicator development.

6. CONCLUSIONS

The Gross Nutrient Balance (GNB) indicator was calculated for nitrogen in all six Western Balkan economies based on the five most important steps of the EUROSTAT methodology (see ch. 3.1.1) and using nitrogen coefficients from Austria and Germany. In general, the results show medium to low GNB surpluses compared to EU Member States as well as stable or decreasing GNB surplus trends. This is positive from an environmental point of view as well as in terms of an assessment of the agricultural nitrogen efficiency in relation to nutrient inputs and outputs. These calculations and results should be interpreted as preliminary and starting points for future efforts to improve data availability and time series for this indicator. The EU4Green Thematic Coordinators for Sustainable Agriculture of all six Western Balkan economies have received the underlying Excel files for future use and to improve the Gross Nitrogen Balance calculations. Some proposals for improvements are given in the dedicated sub-chapters of this report.

The High Nature Value Farmland (HNVF) indicator was developed based on a qualitative literature review and quantitative review conducted in cooperation with the European Environment Agency, using their latest update on the European HNVF-indicator. All WB6 would greatly benefit from an individual HNVF indicator considering their regional and local characteristics, agricultural practices and data availability. Although the European approach offers a good overview and comparability, it often fails to take local peculiarities into account.

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HNVF is still widely practised in all WB6 economies, and an indicator would enable the development of traditional, biodiversity-rich farmland to be tracked. If necessary, measures and subsidies could be put in place in time to prevent local practices from dying out, which could pose a threat to regional biodiversity.

The proxy indicator for Soil Erosion by water *Area of soil erosion prone crops* was calculated for the WB6 based on available datasets. From the outset, the aim was to create the most complete data set possible, based on the available statistics. However, this does not replace a calculated indicator of soil erosion, which is recommended for all WB6 economies. Soil erosion is a significant issue in the region and is expected to worsen due to climate change. Although the proxy indicator *soil erosion prone crops* for all WB6 is almost complete, some data and information on relevant crops is missing and the datasets could be improved further.

Several additional agri-environmental indicators of interest to be developed in the future have been discussed with the Western Balkan beneficiaries. These could be elaborated in the near future to demonstrate improvements in both the GAWB implementation and the impact of the IPARD programmes.

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7. ANNEX

Table 7-1: Corine Land Cover classes. In Green CLC classes chosen for potential HNVF in all environmental zones (Paracchini, Petersen, Hoogeveen, Bamps, Burfield, van Swaay, 2008)

L1 Text	L2 Code	L3
1 - Artificial surfaces	11 - Urban fabric	111 - Continuous urban fabric
		112 - Discontinuous urban fabric
	12 - Industrial, commercial and transport units	121 - Industrial or commercial units
		122 - Road and rail networks and associated land
		123 - Port areas
		124 - Airports
	13 - Mines, dump and construction sites	131 - Mineral extraction sites
		132 - Dump sites
		133 - Construction sites
	14 - Artificial, non-agricultural vegetated areas	141 - Green urban areas
		142 - Sport and leisure facilities
2 - Agricultural areas	21 - Arable land	211 - Non-irrigated arable land
		212 - Permanently irrigated land
		213 - Rice fields
	22 - Permanent crops	221 - Vineyards
		222 - Fruit trees and berry plantations
		223 - Olive groves
	23 - Pastures	231 - Pastures
	24 - Heterogeneous agricultural areas	241 - Annual crops associated with permanent crops
		242 - Complex cultivation patterns
		243 - Agriculture mosaics with significant natural vegetation
		244 - Agro-forestry areas
3 - Forest and semi natural areas	31 - Forests	311 - Broad-leaved forest
		312 - Coniferous forest
		313 - Mixed forest
	32 - Scrub and/or herbaceous vegetation associations	321 - Natural grasslands
		322 - Moors and heathland
		323 - Sclerophyllous vegetation
		324 - Transitional woodland-shrub
	33 - Open spaces with little or no vegetation	331 - Beaches, dunes and sand plains
		332 - Bare rocks
		333 - Sparsely vegetated areas
		334 - Burnt areas
		335 - Glaciers and perpetual snow

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4 - Wetlands	41 - Inland wetlands	411 - Inland marshes
		412 - Peat bogs
	42 - Coastal wetlands	421 - Salt marshes
		422 - Salines
		423 - Intertidal flats
5 - Water bodies	51 - Inland waters	511 - Water courses
		512 - Water bodies
	52 - Coastal waters	521 - Coastal lagoons
		522 - Estuaries

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Table 7-2: Crop area of relevant erosion prone crops in Albania, plus the local vulnerability assessment from 2013 to 2022

		CROP AREA, ha, total									
VULNER-ABILITY to soil erosion	CROP	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
3	Corn / Maize	53 462	55 000	54 610	58 500	58 060	54 115	55 148	56 727	58 288	56 617
2	Vegetables	30 012	30 413	31 084	31 176	31 923	31 689	33 038	33 502	33 506	33 797
2	Strawberries	0	0	0	0	102	111	121	121	120	131
2	Potatoes	9 113	9 570	10 100	9 700	9 948	9 726	10 164	9 701	10 378	9 910
1	White beans	14 192	14 360	14 860	13 700	13 014	13 373	13 550	13 346	13 363	12 993
2	Sunflower	798	686	670	700	502	371	439	542	389	333
1	Soya	300	207	200	28	28	253	219	171	155	239
2	Sugar beet	2 000	1 656	1 316	1 117	952	702	805	837	757	659
2	Fruit trees / Orchards	4 345	8 380	7 421	7 329	3 607	19 958	20 361	20 658	20 682	20 924
2	Fruit trees / Apple	3 838	3 863	4 008	4 230	4 346	4 706	4 761	4 814	4 658	4 730
2	Fruit trees / Plum	2 460	2 272	2 392	2 457	2 492	2 905	2 919	2 932	2 939	2 962
2	Fruit trees / Cherries	1 679	1 877	2 014	2 098	2 075	2 428	2 461	2 482	2 510	2 525
2	Fruit trees / Fig	1 571	1 543	1 543	1 489	1 483	1 511	1 511	1 523	1 518	1 519
2	Fruit trees / Nectarine	1 130	1 064	1 124	1 179	1 191	1 511	1 511	1 523	1 518	1 519
2	Vineyards	9 579	9 625	9 892	10 011	10 695	10 787	10 842	10 964	11 057	11 040
FAOSTAT	area of arable land	617 100	615 600	615 100	620 300	612 000	611 346	610 000	599 600	599 900	598 100
FAOSTAT	area of permanent crops	79 200	80 400	81 000	83 200	84 200	84 654	86 000	87 955	87 630	88 200
FAOSTAT	UAA	1 187 300	1 174 290	1 174 300	1 181 700	1 174 281	1 174 081	1 174 000	1 165 555	1 136 330	1 135 600

Table 7-3: Crop area of relevant erosion prone crops in Bosnia and Herzegovina, plus the local vulnerability assessment from 2011 to 2022

VULNER-ABILITY for soil erosion	crop	Crop area, ha, total										
		2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
2	**Grain maize**	197 018	197 841	190 112	174 878	192 870	191 395	194 642	191 617	191 840	200 500	200 809
2	**Green maize**	25 050	25 635	27 018	28 934	31 887	32 777	33 713	32 525	34 078	35 000	35 050
3	**Vegetables**	27 899	28 569	27 812	25 837	27 738	31 797	27 767	27 621	26 627	33 800	28 604
1	**Strawberries**	1 174	1 291	1 173	1 210	1 259	1 332	1 042	1 288	1 301	1 300	1 379
3	**Potatoes**	37 580	36 897	35 446	34 895	35 582	35 536	34 941	35 159	34 236	39 100	35 181
2	**Grain pea**	9 282	9 310	8 642	8 105	8 311	8 583	7 441	7 197	7 487	7 400	6 966
2	**Soya**	4 047	4 859	4 539	4 808	6 967	6 965	7 508	8 579	9 026	12 700	13 366
1	**Vineyards**	5 617	5 604	5 185	5 416	4 547	4 752	4 440	4 529	4 353	4 400	4 533
3	**Pumpkin**	0	0	0	0	0	0	0	0	0	0	423
3	**Fodder beet**	1 360	1 124	977	2 191	964	934	863	997	816	837	797
3	**Sugar beet**	0	0	0	0	0	0	0	0	0	0	0
FAOSTAT	Total Area of Arable land	1 005 000	1 003 000	1 009 000	1 006 000	1 022 000	1 026 000	1 060 000	1 029 000	1 015 000	1 015 000	1 008 000
FAOSTAT	Total Area of Permanent Crops	102 000	105 000	106 000	106 000	105 000	104 000	107 000	100 000	106 000	107 000	108 000
FAOSTAT	UAA	2 151 000	2 156 000	2 161 000	2 157 000	2 176 000	2 209 000	2 228 000	2 211 000	2 216 000	2 242 000	2 263 000

Table 7-4: Crop area of relevant erosion prone crops in North Macedonia, plus the local vulnerability assessment from 2014 to 2022

VULNER-ABILITY for soil erosion	crop	Crop area, ha, total (Source: MAKSTAT, 2024; MAFWE 2024)								
		2014	2015	2016	2017	2018	2019	2020	2021	2022
2	**Corn / Maize**	30 461	31 651	31 045	31 287	36 340	33 967	31 912	30 224	30 215
1	**Vegetables**	24 417	24 938	24 585	24 670	24 906	25 095	24 829	25 454	25 500
0	**Strawberries**			64						
3	**Potatoes**	13 174	13 360	13 273	13 188	12 403	12 939	12 618	12 306	12 187
2	**White beans**	4 833	4 783	4 817	4 703	4 577	4 504	4 392	4 267	4 244
2	**Sunflower**	5 112	5 542	3 896	4 022	2 346	4 605	4 559	5 050	6 179
3	**Fruit trees / Orchards**	15 000	16 000	18 899	16 000	16 827	16 784	17 095	16 942	16 852
3	**Vineyards**	22 726	22 918	23 192	23 398	23 670	23 996	23 709	23 384	23 047
2	**Pumpkin**									
	Total Area of Arable land	412 000	414 000	416 000	417 000	418 000	419 000	416 000	417 000	416 000
	Total Area of Permanent Crops	38 000	39 000	40 000	40 000	41 000	41 000	41 000	41 000	40 000
	UAA	1 261 000	1 262 000	1 265 000	1 266 000	1 264 000	1 265 000	1 262 000	1 260 000	1 257 000

Table 7-5: Crop area of relevant erosion prone crops in Montenegro, plus the local vulnerability assessment from 2012 to 2022

VULNER-ABILITY for soil erosion	crop	Crop area, ha, total										
		2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
2	**Corn / Maize (for grain)**	444	608	588	569	650	629	628	642	645	639	610
3	**Vegetables, watermelons and melons**	1 275	1 159	1 165	1 188	1 300	1 327	1 424	1 434	1 453	1 454	1 418
1	**Strawberries**	-	-	-	-	-	-	-	-	-	-	15
3	**Potatoes**	1 696	1 798	1 856	1 881	2 138	2 114	2 150	2 154	2 165	2 165	2 254
2	**White beans**	101	103	123	139	94	101	101	99	100	101	106
2	**Orchards - plantations**	779	965	966	971	1 100	1 145	1 334	1 334	1 356	1 373	1 391
1	**Olives**				118	83	89	118	142	142	143	152
1	**Citrus (tangerine)**				128	146	143	154	158	165	168	169
1	**Vineyards**	2 536	2 629	2 697	2 702	2 703	2 708	2 860	2 850	2 838	2 880	2 888
FAOSTAT	Total Area of Arable land	4 429	5 720	5 716	5 812	6 898	6 853	7 104	7 163	7 200	7 205	7 055
FAOSTAT	Total Area of Permanent Crops				4 700	5 010	5 010	5 400	5 400	5 400	6 000	5 550
FAOSTAT	UAA	221 298	222 914	222 890	223 131	230 321	231 405	255 846	256 361	256 808	257 470	257 950

Table 7-6: Crop area of relevant erosion prone crops in Serbia, plus the local vulnerability assessment from 2013 to 2023

VULNER-ABILITY for soil erosion	crop	Crop area, ha, total										
		2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
2	**Maize + maize for fodder**	1 012 752	1 090 020	1 044 273	1 040 621	1 035 563	931 584	999 484	1 032 190	1 053 457	982 980	846 770
3	**Vegetables, strawberries and melons**				37 451				48 097	47 746	47 986	42 437
3	**Potatoes**	50 740	51 987	41 658	40 105	38 472	28 232	34 110	29 676	26 388	24 870	30 341
	White beans	11 931	10 531	12 694	12404	13 181	9 112	9 091	8 512	8 045	8 627	
2	**Sunflower**	188 189	175 366	166 192	200 299	219 338	239 148	219 404	221 149	212 736	251 155	235 905
2	**Soya**	159 724	154 249	184 841	182 362	201 712	196 472	229 372	236 758	237 036	235 275	186 296
3	**Sugar beet**	66 527	64 112	42 123	49 237	53 857	48 125	42 539	37 418	39 411	34 728	38 497
3	**Forage beet**											
2	**Orchards**	163 000	163 000	164 000	164 000	184 000	183 000	184 000	185 000	182 000	184 000	193 000
2	Vineyards	22 000	22 000	22 000	22 000	22 000	18 000	20 000	20 000	20 000	20 000	18 000
FAOSTAT	Total Area of Arable land	2 589 000	2 606 000	2 590 000	2 597 000	2 597 000	2 583 000	2 579 000	2 604 000	2 615 000	2 601 000	2 603 000
FAOSTAT	Total Area of Permanent Crops	187 200	187 000	187 000	187 000	208 000	203 000	206 000	207 000	204 000	205 000	213 000

FAOSTAT	UAA	3 495 190	3 518 249	3 480 374	3 455 998	3 438 130	3 486 908	3 481 567	3 504 290	3 506 075	3 488 752	3 239 374

Table 7-7: Crop area of relevant erosion prone crops in Kosovo, plus the local vulnerability assessment from 2012 to 2022

VULNER-ABILITY for soil erosion	crop	Crop area, ha, total										
		2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
2	**Corn / Maize**	31 181	36 122	35 038	41 492	41 524	35 951	38 453	39 441	39 684	39 710	39 797
0	**Vegetables (incl. under greenhouse)**	7 734	8 926	6 846	7 807	9 266	9 677	9 180	9 833	9 991	10 019	10 118
1	**Strawberries**	52	148	201	203	175	175	234	235	236	238	242
0	**Potatoes**	3 198	2 777	3 695	3 353	3 795	4 290	3 606	3 688	3 771	3 854	3 884
1	**Beans**	2 954	3 648	3 959	2 945	3 317	3 406	2 845	2 888	2 904	2 914	2 941
0	**Pumpkin**	671	1 005	1 354	551	1 017	2 270	2 255	2 502	2 577	2 612	2 628
3	**Vineyards**	3 219	3 159	3 201	3 068	3 117	3 199	3 272	3 367	3 437	3 471	3 472
FAOSTAT	Total Area of Arable land	**156 467**	**171 103**	**180 381**	**185 386**	**187 223**	**186 954**	**188 359**	**188 365**	**188 372**	**188 375**	**188 405**
FAOSTAT	Total Area of Permanent Crops	**7 082**	**8 342**	**6 921**	**7 998**	**8 785**	**9 621**	**11 194**	**12 846**	**13 702**	**13 853**	**14 091**
FAOSTAT	UAA	**277 364**	**296 830**	**413 635**	**410 479**	**415 831**	**416 072**	**418 582**	**420 141**	**420 210**	**420 327**	**420 482**

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