BIOGEA

Testing BIOdiversity Gain of European Agriculture with CAP greening

D2a. Assessment Framework

This research was funded through the 2015-16 BiodivERsA Co-fund Call for research proposals, with the national funders German Federal Ministry of Education and Research, Spanish Ministry of Economy and Competitiveness, Bulgarian National Science Fund.

Deliverable D2a	***Assessment Framework***
Related Work Package:	WP 2
Deliverable lead:	adelphi
Date v. 1	03.08.17
Author(s):	Katrina Marsden, Marion Jay
Main reviewer(s):	Yanka Kazakova
Contact for queries	marsden@adelphi.de
Start date of the project:	01.12.2016
Duration of the project:	36 months
Website:	www.biogea-project.eu
Abstract	This document presents a common framework for BIOGEA, to assess and evaluate the impacts of changes to the Common Agricultural Policy (CAP) on Green and Blue Infrastructure (GBI) in the agricultural landscape and how the presence, quality and management of GBI influences biodiversity and the provision of ecosystem services (ES). The BIOGEA Assessment Framework can be regarded as a living document which will be refined and developed as the project ideas are tested through the case studies and following feedback from PRDN.

Dissemination level of this document

x	PU	Public: *This document reflects only the author's view. The Executive Agency for Small and Medium-sized Enterprises is not responsible for any use that may be made of the information it contains*.
	RE	Restricted to a group specified by the consortium (including the BiodivERsA Secretariat and Partners)
	CO	Confidential, only for members of the consortium (including the BiodivERsA Secretariat and Partners)

Versioning and Contribution History

Version	Date	Modified by	Modification reasons
v.01	06.07.17	Katrina Marsden	First version sent to all project partners
v.02	27.07.17	Yanka Kazakova	Final review carried out
v.03			
v.04			

Table of contents

List of figures 4
List of tables....4
Glossary 5
1 Introduction....6
1.1 The purpose of this document....6
1.2 Added value of the project 7
1.3 The assessment framework....8
2 What to assess: project definitions....8
2.1 Defining Green and Blue Infrastructure (GBI) 8
2.2 Describing GBI for BIOGEA....9
2.2.1 GBI within policy 9
2.2.2 GBI features 12
2.2.3 GBI aims 13
2.2.4 The question of scale 14
3 How to assess: research approach....16
3.1 The BIOGEA hypotheses and research questions....16
3.2 The ecosystem service cascade model as a conceptual framework 17
3.3 Approach to testing the hypothesis 17
3.3.1 EU-level overview 17
3.3.2 National-level refinement 18
3.3.3 Local level – case studies 19
3.3.4 Analysing the gap between baseline and ideal GBI 20
3.4 Gathering feedback – the Participatory Research and Development Network 21
4 The way forward: exploring the findings with the PRDN....21
4.1 GBI advisory tools....21
4.2 GBI policy recommendations 21
4.3 GBI indicators 21
5 Publication References 22

List of figures

Figure 1. BIOGEA work packages and their main outputs 6

Figure 2. Importance of GBI for EU environmental policies. The BIOGEA policy assessment focuses on how the CAP (especially greening) influences the ability of GBI to produce the necessary ES to meet the aims of these policies. 12

Figure 3. Illustration of the range of scales at which GBI occurs with examples of GBI features and GBI aims at different scales.....15

Figure 4. The research questions and sub-questions, how they relate to the two strands of the GBI definition (GBI features and aims) and the ES cascade model (see below). 16

Figure 5. The cascade of ecosystem services from "GBI features" which result in the fulfilling of "GBI aims". Adapted after: (Haines-Young, Potschin 2010).....17

Figure 6. BIOGEA assessment steps (green) and planned outputs (blue). Link between the assessment steps and hypothesis. 18

Figure 7. Gap between the baseline situation and the ideal situation (enough GBI features to meet the GBI aims) illustrated through each step of the ES cascade model. Examples for illustration only and it is unlikely that the modelling used in BIOGEA will be able to measure changes to such a level of detail. 20

List of tables

Table 1. Overview of studies examining CAP greening, source BIOGEA project.....7

Table 2. Long-list of EU policy instruments (legislation, strategies and action plans) which rely on or influence GBI. Those policies marked in green are those selected for further investigation (see D2b for the selection methodology).....9

Table 3. GBI features included in BIOGEA 13

Table 4. Biodiversity and ES important to GBI 14

Table 5. List of case study areas, characteristics and the main drivers of change. 19

Glossary

Agri-Environment Climate schemes, AEC – programmed measures included in member states' or regional RDPs (and co-financed by the member states) which aim to address environmental and climatic challenges.

Common Agricultural Policy, CAP – the European Union policy to support farming and other rural activities, financed at around €59 billion per year.

Common Agricultural Policy, CAP – Pillar 1 – an area-based payment to enhance the competitiveness and sustainability of the EU agricultural sector, including maintaining food production and environmental security.

Common Agricultural Policy, CAP – Pillar 2 (Rural Development Regulation) - rural areas meet the wide range of economic, environmental and social challenges of the 21st century by supporting Member States in reaching common EU priorities in their rural development programmes (RDPs).

Common Agricultural Policy, CAP Greening - In order to receive 30% of the basic payment, farmers must carry out three broad agri-environment measures: maintaining permanent pasture, dedicating 5% of arable land to Ecological Focus Areas (EFAs), and diversifying arable crops.

Ecosystem Services, ES – range of services provided by natural systems from provisioning, such as the production of food and water; regulating, such as the control of climate and disease; supporting, such as nutrient cycles and crop pollination; and cultural, such as spiritual and recreational benefits.

Green and Blue Infrastructure, GBI – physical features which provide habitat and allow movement of species between different habitats as well as providing a wider range of ES related to a range of environmental policy aims.

Green and Blue Infrastructure, GBI aims – the aims included in environmental policy, such as water quality management, climate adaptation or wildlife protection which can be delivered by GBI.

Green and Blue Infrastructure, GBI features – physical features such as pasture, hedgerows, ponds, bogs, etc.

High Nature Value farming, HNV – farming systems which provide benefits to biodiversity and additional ecosystem services through the nature of the extensive farming used.

Participatory Research and Development Network, PRDN – a network of scientists, decision-makers and stakeholders from the EU to the case study level established through the BIOGEA project and engaged through a range of methods throughout the project lifetime.

1 Introduction

1.1 The purpose of this document

This document presents a common framework for BIOGEA, to assess and evaluate the impacts of changes to the Common Agricultural Policy (CAP) on Green and Blue Infrastructure (GBI) in the agricultural landscape and how the presence, quality and management of GBI influences biodiversity and the provision of ecosystem services (ES).

Agricultural GBI will be examined through policy analysis on the EU, national level and local level, and biological monitoring and modelling in six case study areas in 3 Member States. The case studies in Germany, Spain and Bulgaria pair twinned relatively extensive and intensive landscapes and have been chosen to represent a range of different biogeographic regions and political settings.

Project outputs will include advisory tools for the case study areas and policy recommendations for the CAP reform for the case study countries and the EU-level. Existing biological indicators will be tested and developed to measure impacts of changes on GBI. The outputs of the project will be developed and tested together with a range of stakeholders. Figure 1 shows the BIOGEA work packages and the main planned outcomes.

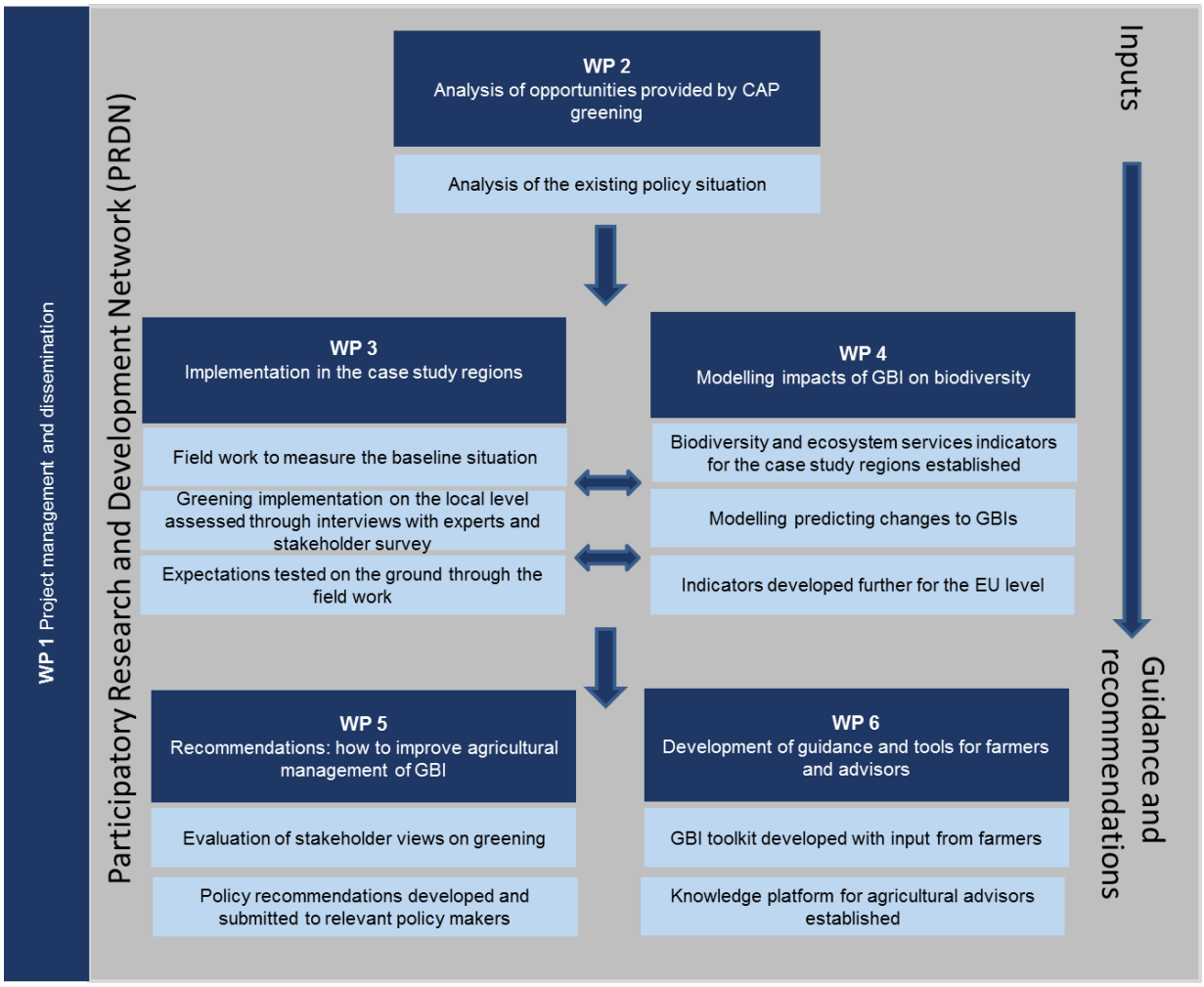


Figure 1. BIOGEA work packages and their main outputs

1.2 Added value of the project

A number of studies already exist focusing on GBI in an agricultural setting. Since the project started, several new studies have also examined the likely effects of recent changes in agriculture policy on habitats and species Table 1.

Table 1. Overview of studies examining CAP greening, source BIOGEA project

Report	Assessment focus					Methods				Features covererd										Findings relevant to GBI
	Biodiv	Water	Climate	Food	Cultural	Literature review	Survey	Case studies	Field work	Permanent pasture	Crop diverse	Agro-forestry	Forest edge strips	SR coppice	Catch crops / cover	Nitrogen-fixing crops	Fallow	Terraces	Landscape features	Buffer strips	
Existing reviews																					
Review of Greening after one year (European Commission 2016a)	x	x	x	x		x				x	x	x	x	x	x	x	x	x	x	x	Few MS have reduced pesticide or herbicide input. Uptake of landscape features low but fallow positive.
Report on the implementation of the EFAs (European Commission 2017)	x	(x)	(x)			x						x	x	x	x	x	x	x	x	x	The EFA area larger than required by legislation (10%). Choices made largely based on administrative simplicity and ease of implementation. Landscape features (and fallow) best for ecosystem services but productive measures greater uptake
Mapping and Analysis of the implementation of the CAP (Ecorys et al. 2016)	x	x	x	x		x		x		x	x	x	x	x	x	x	x	x	x	x	Member States choices similar to one another. The strongest focus of measures is on food production.
Benefits of landscape features for arable crop production (EIP-AGRI 2016)				x		x	x												x		Little information available on ecosystem services beyond biodiversity. Farmers lack advice on EFA implementation.
EFA choices and their potential impacts on biodiversity (Underwood, Tucker 2016)	x					x									x	x	x		x		Non-productive measures are most valuable for biodiversity but uptake of these measures is lowest.
Adding some Green to the Greening (Pe'er et al. 2016)	x					x	x					x	x	x	x	x	x	x	x	x	The measures with the greatest benefits for biodiversity have the lowest uptake. Win-wins are possible e.g. fallow land agricultural and wildlife benefits.
Planned research (2017-18)																					
Evaluation of the payment for agricultural practices beneficial for the climate and the environment under the CAP (European Commission)	x	x	x	x	x	x	x	x				x	x	x	x	x	x	x	x	x	
Understanding Farmer Uptake: What measures are most promising to deliver on supporting biodiversity and ecosystem services in the next round of the CAP? (Eklipse)	x	x	x	x	x	x	x					x	x	x	x	x	x	x	x	x	
"Rapid evidence assessment" for the impacts of the CAP on the economy, society and the environment for BirdLife, the EEB and NABU (Pe'er, et al.)	x	x	x	x	x	x	x					x	x	x	x	x	x	x	x	x	

The majority of existing work, however, is based on literature reviews of research carried out for the main part in Northern and Western Europe. BIOGEA's case studies in Germany, Bulgaria and Spain will add to this body of research by collecting field data on GBI and testing how GBI has changed in the recent years. The inclusion of Spain and Bulgaria will allow exploration of the extent to which the findings of previous studies apply in a Southern and Eastern European setting and add information on extensive high nature value (HNV) farming systems which tend to have higher levels of already existing GBI.

In addition to collecting new data, BIOGEA will build on existing information, make links between ongoing initiatives on the EU level and in the case study member states, between scientists from different disciplines, policy-makers and stakeholders. The project's Participatory Research and Development Network (PRDN) will aid peer-to-peer learning for scientists and stakeholders, gather information from a range of different sources and assist the development of policy recommendations as well as integrative advisory tools which can also be used after the end of the project.

1.3 The assessment framework

The BIOGEA project brings together researchers from different disciplines as well as engaging stakeholders in the PRDN. It is therefore important that the research is joined up through a clear conceptual framework. This document provides that framework.

In this deliverable, we present:

What we are assessing

- The definition of GBI used;
- How it is described and included within policy.

How we are assessing

- The hypothesis and research questions;
- The ecosystem cascade model as a conceptual framework for the project;
- How we test the hypothesis

How we use the findings

- Working together with the PRDN to produce the outputs

The BIOGEA Assessment Framework can be regarded as a living document which will be refined and developed as the project ideas are tested through the case studies and following feedback from PRDN. An adaptive approach to addressing the research questions is adopted to allow adjustment to local needs and the specific research interests in the case study areas, and to react to new policy developments. The assessment framework will therefore be further developed and updated over the course of the project.

2 What to assess: project definitions

2.1 Defining Green and Blue Infrastructure (GBI)

The term Green Infrastructure (GI) or, where aquatic ecosystems are included, Green and *Blue* Infrastructures (GBI), has been rapidly adopted into policy documents but can have a variety of meanings (Wright 2011). In the European Commission's GI Strategy, it is defined as follows:

> *"a strategically planned **network** of natural and semi-natural areas with other environmental features designed and managed to deliver a **wide range of ES**. It incorporates green spaces (or blue if aquatic ecosystems are concerned) and other physical features in terrestrial (including coastal) and marine areas. On land, GI is present in rural and urban settings." (European Commission 2013)*

This definition includes the two key elements of GBI, its connectivity ("network") and its multifunctionality (delivery of a "wide range of ES") (Baró et al. 2016). This two-pronged approach has also been adopted by the European Environment Agency (EEA) in their efforts to map GBI. In this case, they have described GI as 1) core habitat for threatened species and the corridors between core habitats and 2) areas which are capable of providing multiple ecosystem services (EEA 2014).

Thus GBI can be described both as:

1. physical "**features**" such as pasture, hedgerows, ponds, bogs, etc. which provide habitat and allow movement of species between different habitats

But also as:

2. a means of providing ES to reach particular "**aims**" included in environmental policy, such as water quality management, climate adaptation or wildlife protection.

The BIOGEA project adopts this two-tier approach to defining GBI. The research questions are therefore examined through two strands of investigation looking at "**GBI features**" and "**GBI aims**". The "features" and "aims" are defined further below.

2.2 Describing GBI for BIOGEA

The project definition of GBI should be policy relevant and is therefore focused on GBI and ES as described in policy.

2.2.1 GBI within policy

To assess the effects of policy on GBI, the most "GBI relevant" EU policies were defined (developed further in the policy analysis in deliverable D2b). These were divided into two categories:

1. Policies with a significant influence on GBI
2. Policies with a significant reliance on GBI for meeting their aims

In reality many policies both influence and rely on GBI; for example, the CAP influences GBI through encouraging particular farming practices but also relies on GBI to meet its environmental aims; biodiversity policy relies on GBI to provide habitats and ecosystem services and also aims to increase the amount of GBI. Nonetheless, the incentives attached to the policies allow them to be categorised as having greater influence or reliance: the CAP's environmental aims are based on existing environmental policy and environmental policies relies to a large extent on the funding provided through the CAP to reach their aims on agricultural land.

Table 1 shows the long list of policies which influence and rely on GBI and their main objectives. From this long list, the policies most likely to inpact on land use and GBI and those with the clearest inclusion of GBI in their aims were selected for further investigation.

Table 2. Long-list of EU policy instruments (legislation, strategies and action plans) which rely on or influence GBI. Those policies marked in green are those selected for further investigation (see D2b for the selection methodology)..

Subject area	Political instrument	Objective
Biodiversity	Biodiversity Strategy	By 2020, biodiversity loss and the degradation of ecosystem services is halted, and restored as far as possible.
	GI Strategy	Promote the development of GI by creating an enabling framework for nature-based solutions.
	Invasive Alien Species Regulation	Seeks to address the problem of invasive alien species in a comprehensive manner so as to protect native biodiversity and ecosystem services and impact on humans
	Birds Directive	Protect all wild bird species naturally occurring in the EU.
	Habitats Directive	Conserve rare, threatened or endemic animal and plant species naturally occurring in the EU.

Subject area	Political instrument	Objective
Climate and energy	Climate and energy package for 2020	Sets targets for GHG emissions, renewables and efficiency to 2020.
	Climate and energy framework for 2030	Sets targets for GHG emissions, renewables and efficiency 2021-2030. LULUCF included.
	Renewable Energy Directive	EU to fulfil at least 20% of its total energy needs with renewables by 2020.
	Climate Change Adaptation Strategy	To make Europe more climate-resilient and enhance the preparedness and capacity to respond to the impacts of climate change.
Water	Water Framework Directive (WFD)	To achieve good status for all waters in Europe by preventing further deterioration, promoting sustainable water use, enhanced protection and improvement of aquatic systems, reduction of pollution, mitigating the effects of floods and droughts.
	Floods Directive	To reduce and manage the risks that floods pose to human health, the environment, cultural heritage and economic activity.
	Nitrates Directive	Protect water quality by preventing nitrates from agricultural sources from polluting ground and surface waters and by promoting good farming practices.
Land use	CAP pillar 1	Enhance the competitiveness and sustainability of the EU agricultural sector.
	CAP pillar 2	Help rural areas meet economic, environmental and social challenges.
	Forestry Strategy	Ensure and demonstrate sustainable forest management providing the basis for a competitive bio-based economy.
	Soil Thematic Strategy	Protect soil, while using it sustainably, through prevention of further degradation, preservation of soil function and restoration of degraded soils.
Grey Infrastructure	Trans-European Network (transport)	Aims to close the gaps between Member States' transport networks, remove bottlenecks that still hamper the smooth functioning of the internal market and overcome technical barriers.

Policies with a significant influence on GBI

Agriculture has been a main driver for the loss of biodiversity over the last century through intensification of existing farmland and conversion of natural land into cropland. Recent reviews of biodiversity and water policies found that agricultural practices are the most significant barriers to their targets being met (European Commission 2015a), (Milieu et al. 2016), (European Commission 2015b).

The CAP consists of two pillars: pillar 1 (the basic payment) which is an area-based payment to enhance the competitiveness and sustainability of the EU agricultural sector, including maintaining food production and environmental security. Pillar 2 (the rural development fund) helps rural areas meet the wide range of economic, environmental and social challenges of the 21st century by supporting Member States in reaching common EU priorities in their rural development programmes (RDPs)[1]. All member states must include agri-environment-climate (AEC) measures in their RDPs which aim to address environmental and climatic challenges. In the last round of CAP reform, an attempt was also made to further "green" pillar 1 of the CAP to include similar measures to AEC and to further justify its environmental credentials. In order to receive 30% of the basic payment, farmers must carry out three broad agri-environment measures: maintaining permanent pasture, dedicating 5% of arable land to Ecological Focus Areas (EFAs), and diversifying arable crops. A wide range of exceptions and flexibility for implementing the measures has been allowed.

Initial overviews (see Table 1) suggest that a high percentage of farmers do not need to carry out the measures, as many of the measures adopted are those which farmers would carry out anyway (European Commission 2016). Little new GBI is being created (Underwood und Tucker 2016), and most valuable measures for biodiversity are the least attractive to farmers (Pe'er et al. 2016). In addition, few member states have made an attempt to encourage farmers to work together to meet regional objectives with the EFAs (European Commission 2017). While member states have tended to focus most on the aim of food production through the CAP (Ecorys et al. 2016), most assessments focus on biodiversity and little is known about what other ES are provided (EIP-AGRI 2016).

Policies with significant reliance on GBI for meeting their aims

If they are to meet their policy aims, many EU environmental policies require changes to agricultural land management and in particular, improved GBI to support particular habitats and species and to provide ES. There is often specific mention of GBI, included in the more recent policy instruments, (e.g. the Biodiversity Strategy (2011) has an aim to establish green infrastructure; and the Water Blueprint (2012) requires the development of guidance and targeting of funding towards Natural Water Retention Measures (NWRM), described in the blueprint as a type of green infrastructure). In older policy instruments, different terminology is used but the concept of connecting habitats through GBI features to deliver better environmental results remains important. Article 10 of the Habitats Directive (1992), for example, requires the protection of features connecting protected sites and article 4 of the Nitrates Directive (1991) requires the establishment of a code of good agricultural practice which can include specific land management measures to reduce run-off.

Figure 2 illustrates the inclusion of GBI in environmental policy. It is limited to the areas of water, biodiversity and climate for which strong legislative frameworks exist, however GBI also contributes to a number of social and economic policies including food and fibre production, health and welfare and rural development.



[1] Member States must address at least four of the following priorities: knowledge transfer and innovation, enhancing viability and competitiveness of all types of agriculture, promoting food chain organisation, animal welfare and risk management in agriculture, restoring and preserving ecosystems related to agriculture and forestry, promote resource efficiency in the agriculture, forestry and food sectors, promoting social inclusion and economic development in rural areas

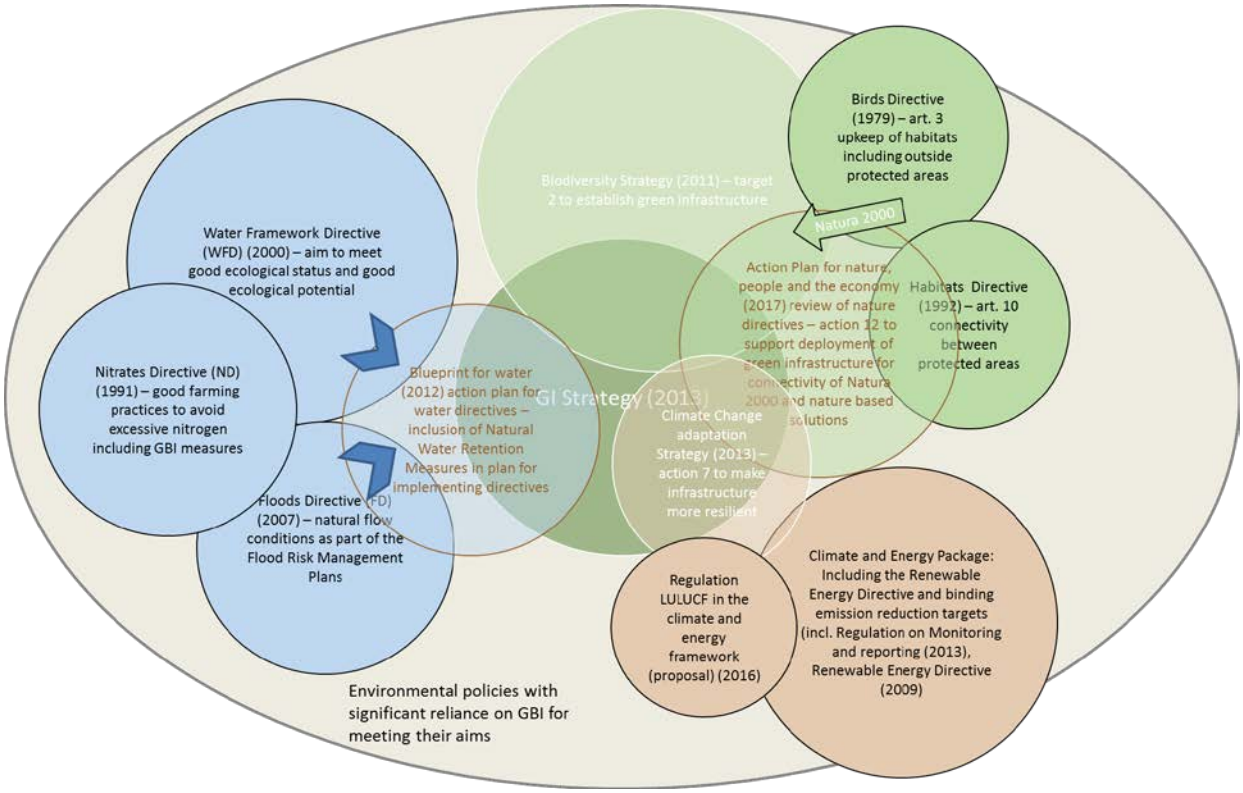


Figure 2 Importance of GBI for EU environmental policies. The BIOGEA policy assessment focuses on how the CAP (especially greening) influences the ability of GBI to produce the necessary ES to meet the aims of these policies.

2.2.2 GBI features

The building blocks of GBI have been described as part of the European Commission's work on the GI Strategy[2]. To examine the impacts of agricultural policy on GBI in a consistent way, a list of GBI features is needed to be agreed for the project. For BIOGEA, GBI features were selected that are:

1. Located in agricultural landscapes;
   and
2. Described in the policy instruments identified above (those policies with the greatest influence or greatest reliance on GBI).

Table 2 shows the GBI features selected for examination on the EU level and how they are included in the EU policies relevant to GBI. The list of GBI features may be adapted in the case study regions if it is found that particular features included are irrelevant or that it is important to distinguish between sub-categories of features for the local setting.

[2] Features identified include pasture, non-intensive woodland connected with farmland, ponds, bogs, rivers and floodplains, local nature reserves, water protection areas, landscape protection areas, Natura 2000 sites, High nature value farmland and multi-use forests, hedgerows, stone walls, small woodlands, ponds, wildlife strips, riparian river vegetation, transitional ecosystems between cropland, grassland and forests.

Table 3. GBI features included in BIOGEA

Policies influencing GBI / Policies relying on GBI									
Policy instruments	**CAP Pillar 1**					**Pilllar 2**	**Environmental policy**		
	EFA	**permanent grassland**	**Arable diversification**	**cross-compliance**	**agricultural land**	**RD**	**WFD / FD**	**Nitrates Directive**	**Nature Directives**
Policy aims	**Enhance the competitiveness and sustainability of agriculture**					**Help rural areas meet challenges sustainably**	**Good water quality / reduced flooding**	**Protect water quality**	**Favourable Conservation Status**
GBI elements (field to farm scale)									
Smallscale landscape elements									
Terraces	x			x	x	x			x
Isolated trees	x			x	x	x			x
Trees in line	x			x	x	x			x
Trees in groups and field copses	x			x	x	x			x
Ponds	x			x	x	x	x		x
In field elements (productive)									
Maintain permanent grasslands and pastures		x			x	x	x		x
Areas with short rotation coppices	x				x	x			
Agroforestry / orchards	x				x	x			x
Areas with catch crops or green cover	x		x		x	x	x	x	
Areas with nitrogen fixing crops	x		x		x	x	x	x	
Sowing a winter soil cover	x		x		x	x	x	x	
Land lying fallow	x		x		x	x			
Connectivity features									
Buffer strips	x				x	x	x		x
Hedges and wooded strips	x			x	x	x			x
Field margins	x			x	x	x			x
Ditches	x			x	x	x	x		x
Traditional stone walls	x			x	x	x			x
Strips along forest edges (no production)	x				x	x			x
Maintain / manage bank					x	x	x		x
Maintain / manage natural elements									
Wetland		x			(x)	x	x		x
Floodplane		x			(x)	x	x		x
Bog or moor		x			(x)	x	x		x
Environmentally sensitive pastures		x			x	x	x		x

2.2.3 GBI aims

As mentioned above, GBI can be described not only as physical features but also as a means of reaching environmental policy targets through the provision of a range of ecosystem services (the multifunctional aspect of GBI). Within the project, the term GBI "aims" is adopted to mean a range of aims from high level environmental policy targets to local development goals which rely upon the maintenance and establishment of GBI for their success. Table 2 and Figure 2 above, already gives an overview of the policies of greatest relevance to GBI and their main aims. The CICES framework[3] has been used to give a first description of the most relevant ES services for meeting these aims (Table 4).

In BIOGEA, ESs will be further reviewed when specific biodiversity and ES indicators are established for different agricultural systems. This will be done by linking specific biodiversity components to specific ESs (e.g. bee diversity and pollination, or plant diversity and carbon sequestration).

[3] The Common International Classification of Ecosystem Services (CICES) https://cices.eu/ was used as a basis for examining ES. The services selected here are those most relevant to the policies examined.

Table 4. Biodiversity and ES important to GBI

Class	Description of ecological function	CICES v4.3 group	Inclusion in EU policy
Biodiversity	Habitat maintenance / (re)creation	Lifecycle maintenance, habitat and gene pool protection	Nature directives, biodiversity strategy, GI strategy
	Species protection	Lifecycle maintenance, habitat and gene pool protection	
	Landscape connectivity	Lifecycle maintenance, habitat and gene pool protection	
Regulation of water quality and quantity	Regulation of surface and groundwater flows	Mediation of liquid flows – Hydrological cycle and water flow maintenance	Water Framework Directive (WFD)
	Improved water infiltration	Mediation of liquid flow – Flood protection	Floods Directive
	Reducing / increasing effect of nitrate leaching	Mediation of mass flows	WFD, Nitrates Directive
Climate regulation	Carbon sequestration	Atmospheric composition and climate regulation	Climate and Energy Package (including proposal for including LULUCF in accounting)
	GHG emissions	Atmospheric composition and climate regulation	
	Storm protection	Mediation of mass flows	Climate Adaptation Strategy
Food production	Biomass	Biomass	Common Agricultural Policy
	Pollination and seed dispersal	Lifecycle maintenance, habitat and gene pool protection	Nature directives, biodiversity strategy
	Biological control	Pest and disease control	Nature directives, biodiversity strategy,
	Maintenance of soil fertility	Soil formation and composition	Common Agricultural Policy, Soil Action Plan
Cultural Heritage	Spiritual and aesthetic experience	Intellectual and representational interactions with ecosystems	No relevant instruments on EU level
	Recreation and tourism	Physical and experiential interactions with ecosystems	

2.2.4 The question of scale

Both GBI strands are relevant on a range of scales. GBI features can be envisaged on the small-scale: patches in an urban setting or to break-up grey infrastructure (e.g. green bridges) to regional scale elements that give a landscape more “porosity” allowing movement of species through intensive agricultural or forest landscapes. For agricultural GBI, both scales are important: on a smaller scale GBI features are managed by individual farmers at a field level, but these may

fulfil the desired functions and support ecosystem service delivery only when linked on a regional scale.

Similarly, GBI aims on international or national level (high level policy targets) can be broken down to the regional and local level (local goals) so that they support the delivery of ES and of reaching environmental policy aims. The GBI aims on the EU level will be quite general (e.g. halting the loss of species and habitats, reaching good ecological status of water bodies). On lower governance levels, however they will be more specific (e.g. targeting individual species and habitats, reducing nitrogen leaching by a specific amount).

The project analysis is carried out on a range of scales (see Figure 3). GBI features are assessed firstly on the small-scale by looking at individual features (local level) and analysed further at the case study level through the field work (small-scale first). On the other hand, the GBI aims are examined firstly on the higher (EU) level and then their translation into national policy and implementation in the case study areas is looked at in more detail (large-scale first).

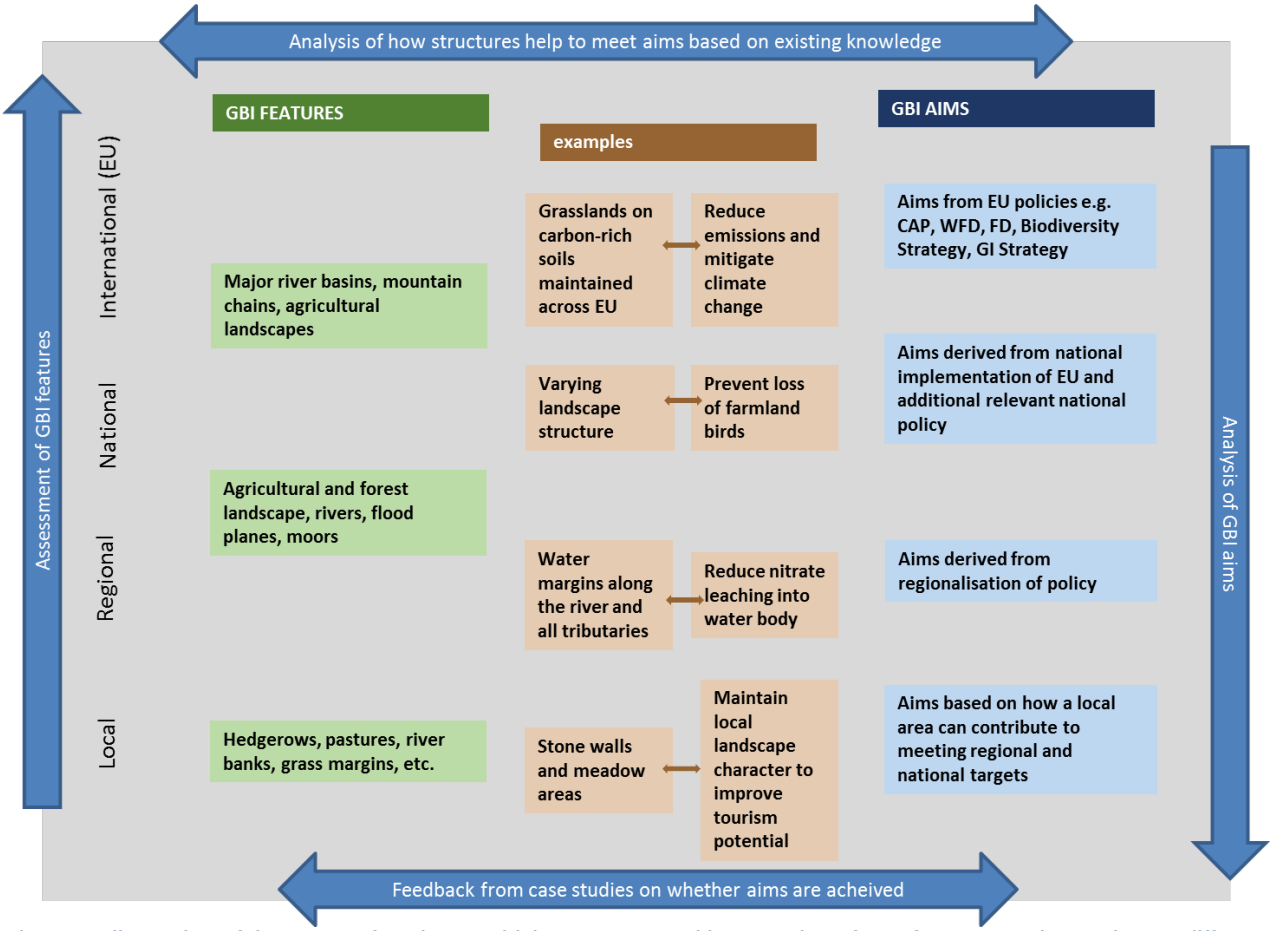


Figure 3. Illustration of the range of scales at which GBI occurs with examples of GBI features and GBI aims at different scales.

3 How to assess: research approach

3.1 The BIOGEA hypotheses and research questions

BIOGEA aims to test a number of hypotheses based on current knowledge of GBI and the CAP greening. These are as follows:

- *Hypothesis 1a*: The impact of CAP greening on GBI provision varies considerably depending on the local conditions including choices made on CAP implementation agricultural practice, biogeographical setting and external change drivers (Díaz und Concepción 2016).

- *Hypothesis 1b:* Greening measures are likely to be most effective in areas farmed at intermediate intensities. In a highly intensively farmed landscape, individual measures are likely to have little impact due to the lack of already existing landscape features providing GBI. In a highly complex landscape, such as that provided by some High Nature Value (HNV) farming systems, they are likely to have little additional impact, or even negative impacts on species dependent on open, farmed land (Concepción et al. 2012; Díaz und Concepción 2016).

- *Hypothesis 2*: The impact of changes in GBI on ES can be measured through existing biodiversity indicators; however, these must be better targeted at local conditions to be effective. The situation regarding access to relevant existing data will vary in different EU countries.

- *Hypothesis 3*: Engaging stakeholders in the PRDN to understand policy changes and develop advisory tools will improve the effectiveness of the tools and ensure policy recommendations can be better implemented on the ground.

These hypotheses will be tested by examining the research questions shown in Figure 4, which are based around the main research question: *How does CAP-greening influence GBI and how does this affect the ability of GBI to provide biodiversity and ES.*

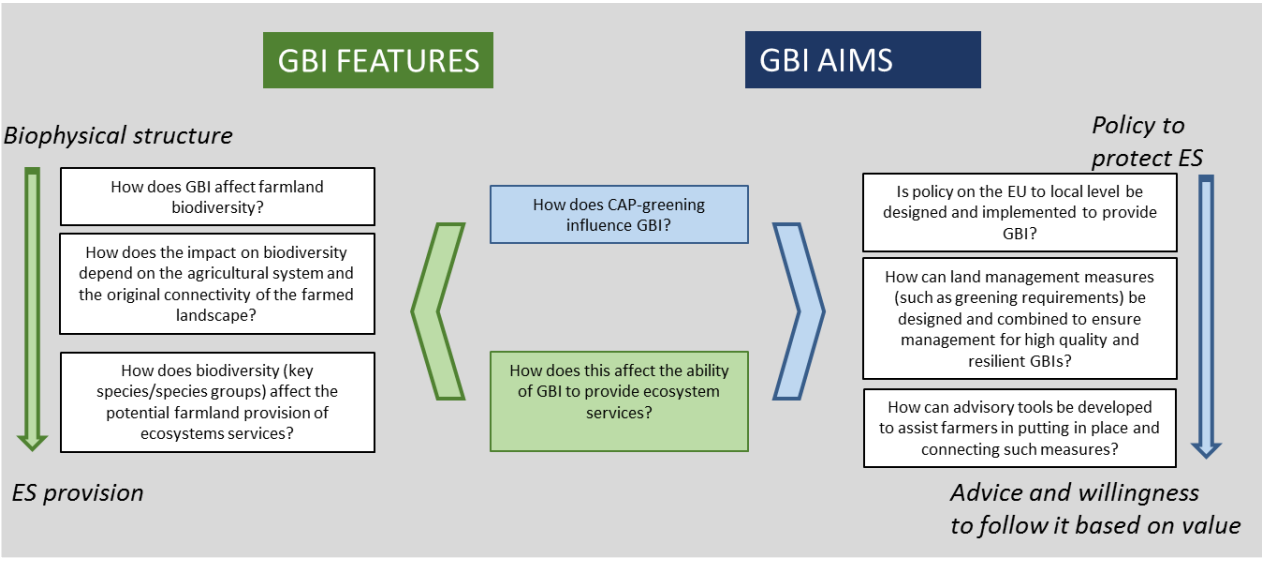


Figure 4. The research questions and sub-questions, how they relate to the two strands of the GBI definition (GBI features and aims) and the ES cascade model (see below).

3.2 The ecosystem service cascade model as a conceptual framework

An adapted version of the ES cascade model (Haines-Young und Potschin 2010) has been adopted as the conceptual framework under which the BIOGEA hypotheses will be tested (Figure 5). Within this, the division into the two GBI strands (GBI features and GBI aims) will remain, representing the biophysical aspects of GBI and the socioeconomic aspects of GBI. The model illustrates well how the strands are connected and the feedbacks that exist between the biophysical and socio-economic systems.

The cascade model shows how biodiversity and ecosystems provide benefits to humans through the flow of ecosystem services which are sourced from the individual features (habitats and species), progress through their ecosystem functions (how they impact on the surrounding ecosystem or wider environment) to the "aims" assigned to these functions by policy (the provision of ES and the related benefits to humans). In turn, the way people value GBI, will influence their approach to addressing the pressures on GBI. An important aspect not included in the original model is looking not only at *what* the pressures and benefits are, but *who* benefits from the ecosystems and *who* is placing pressure on them.

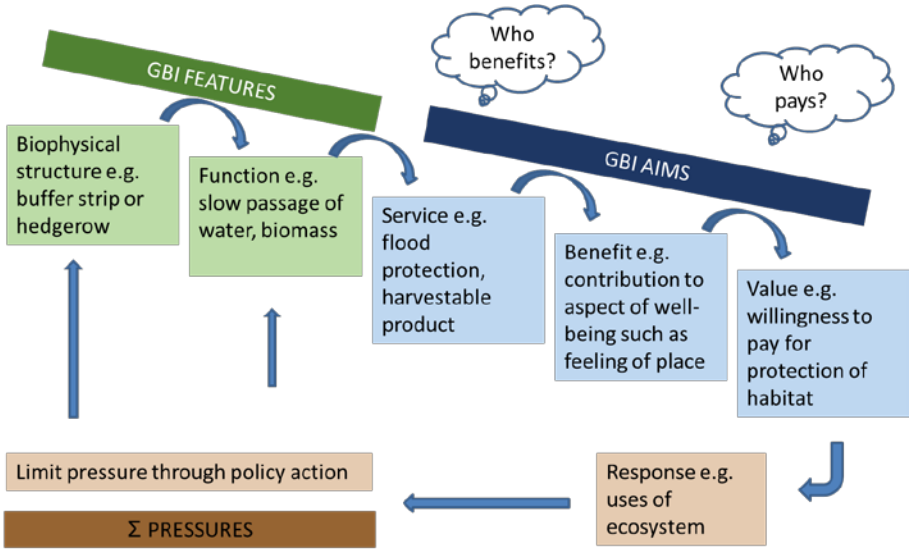


Figure 5. The cascade of ecosystem services from "GBI features" which result in the fulfilling of "GBI aims". Adapted after: (Haines-Young, Potschin 2010)

3.3 Approach to testing the hypothesis

3.3.1 EU-level overview

Figure 6 illustrates how the hypotheses will be tested through the GBI strands (features and aims). This shows on the one hand, the large-scale to small-scale evaluation of GBI aims (from EU level targets to local level potential for delivering national targets) and on the other hand the assessment of the function of each smaller-scale GBI feature firstly by means of a literature review followed by testing through the field work. The feedback loops (local to EU level) in which the findings in the case study areas will be used to generate EU-level GBI indicators and policy recommendations are illustrated.

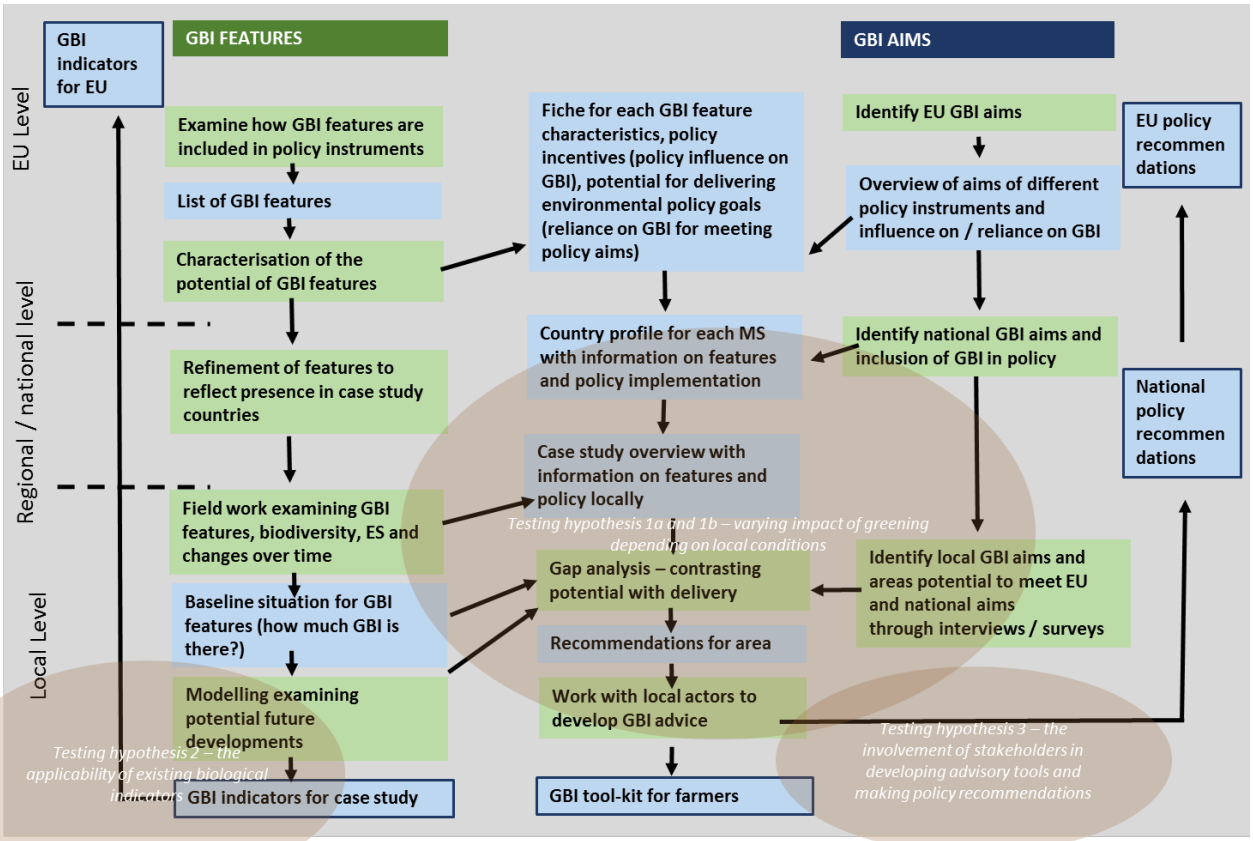


Figure 6 BIOGEA assessment steps (green) and planned outputs (blue). Link between the assessment steps and hypothesis.

In order to gather information and present it in a structured manner, the two strands are brought together in the form of "fiches" produced for each of the identified GBI features. These include a general description of the GBI feature, the ES it can deliver (under what circumstances), how it contributes to EU policy objectives (the GBI aims) and what it's uptake is (initially on the EU level).

The information included in the fiches will be tested by the PRDN at an EU-level expert workshop to ensure that they include the most relevant information currently available. Nonetheless, it is expected that at this level, the information will be imperfect and, in particular, is likely to include information gathered mainly from studies in north and west Europe which make up the bulk of the peer-reviewed literature in the area.

3.3.2 National-level refinement

Following development of the generalised GBI fiches, these will be refined on the national level for each of the participating member states (Germany, Spain and Bulgaria) to produce Country Profiles for GBI. The case study countries have been chosen to represent a variety of EU biogeographic conditions (Mediterranean, central European and Eastern European), governance systems (federal to central) and socio-economic conditions (including both new and old member states).

The list of GBI features will be refined to include those that are available in a particular member state. The GBI aims will also be adjusted for the country. A national-level policy overview will look

at the translation of EU policy into national policy, the national implementation choices, management requirements and uptake of optional management measures. Any additional national policies with significant impacts on land use will also be included in this review.

The country profiles will be tested by the PRDN through convening national-level round tables or working groups consisting at least of experts from the different ministries covering the policies selected for analysis.

3.3.3 Local level – case studies

The greatest level of collection of detailed new data, however, will be at the case study level where an overview of the situation for each case study area will be produced. The case study areas have been chosen to represent a variety of EU farming systems; in each area paired High Nature Value areas, risking abandonment, and intensive areas, risking intensification, have been chosen (see Table 4).

Table 5. List of case study areas, characteristics and the main drivers of change.

Member State	Area	Type of farming	Change drivers
Germany	Albstadt	Extensive mixed pasture and arable farming	Intensification and abandonment
	Tauberbischofs-heim	Fairly intensive arable	Intensive arable management with pressure on biodiversity and water resources
Spain	Iberian Dehesa in Estramadura	HNV wood pasture - extensive	Abandonment and Intensification (loss of semi-natural features).
	Dry cereal cropland in Castilla y Lyon and Castilla la Mancha	Extensive arable farming	Intensification (loss of semi-natural features) and aridification. Locally reafforestation with pines
Bulgaria	Western Stara Planina	Extensive pasture, forests, small patches arable	Abandonment and conversion to forestry, climate change leading to fewer days of snow cover and higher incidence of flood events
	Plovdiv region	Arable, pasture, permanent crops, forests	Intensification to monocultures. Industrialisation and urbanisation including water pollution, tourism pressures.

GBI features will be examined in the case study areas through field work to assess the baseline and examine how GBI features have been affected by policy-driven changes to land use and what the impacts are on key species or species groups representing biodiversity and other ES are. The approach taken in each area will depend to some extent on the availability of already-existing baseline information. For the Bulgarian cases, for example, two field surveys are planned over the course of the project as no baseline information would otherwise be available. In Germany, data was collected in a previous project and a follow-up survey is planned. In Spain, baseline data is

also available but the field survey techniques used previously were different and the activities will be adapted in order to allow comparison with the baseline. The data collected through the project will be complimented by the use of large existing databases on species distributions and habitats as well as landscape feature maps to expand the results beyond the particular area under consideration.

The GBI aims, initially identified on the basis of the EU and national level policy reviews, will be refined to produce local GBI aims which will depend on the socio-economic and biophysical conditions in the area. For example, in an HNV area in Bulgaria, there may be high potential to deliver habitats and species if particular farming practices are maintained as well as high potential for cultural services. In a more intensively farmed area in Germany, the challenge may be more to reduce nitrate leaching from agriculture.

The aims will be discussed and refined with the PRDN through the use of interviews with experts as well as surveys and learning-labs with farmers and conservationists working in the area.

3.3.4 Analysing the gap between baseline and ideal GBI

Figure 7 illustrates how the gap between baseline (existing GBI features) and ideal situation (GBI aims) in the case study areas will be assessed. Based on the information collected in the case study areas, modelling will be used to measure the gap and suggest means (recommendations for changes in practice) to close it.

The incentives needed to encourage this change in practice will be discussed with the PRDN on the different governance levels. This will help to make recommendations for where changes in policy on the EU level are needed but also where more effort should be put into the national interpretation of policy or local implementation including the advice provided to farmers.

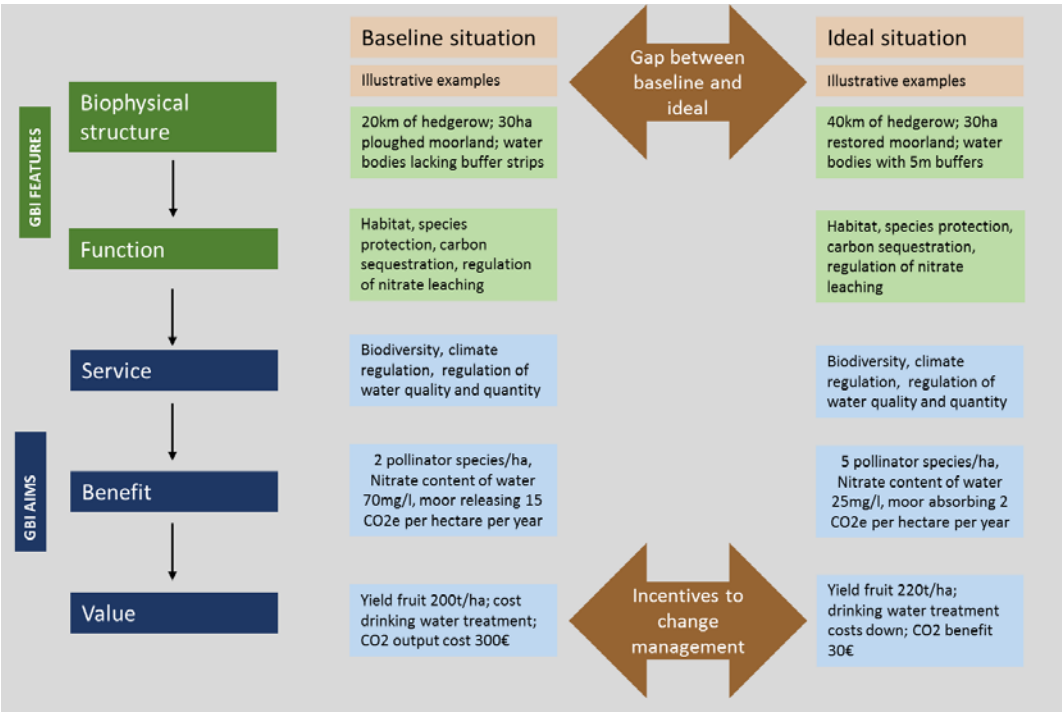


Figure 7. Gap between the baseline situation and the ideal situation (enough GBI features to meet the GBI aims) illustrated through each step of the ES cascade model. Examples for illustration only and it is unlikely that the modelling used in BIOGEA will be able to measure changes to such a level of detail.

3.4 Gathering feedback – the Participatory Research and Development Network

At each governance level and in each of the regions under consideration, stakeholder engagement in the project work will be sought as described above through the PRDN. The aim of engaging stakeholders is to improve the credibility, relevance and legitimacy of the results, ensuring the information is collected from a wide range of sources including those directly affected by policy change. The work of the PRDN throughout the project is described in more detail in the Outreach Plan (D1c).

4 The way forward: exploring the findings with the PRDN

The project outcomes will be targeted at a variety of different stakeholders involved in the PRDN as described briefly above. The tools used to engage stakeholders throughout the life of the project are described in more detail in the Outreach plan (D1c).

The aim of BIOGEA is to create products which can be developed further following the end of the project and be used more widely in implementing the reformed CAP after 2020 to provide more benefits from GBI. For this reason, there will be a clear focus on the future of agricultural policy and testing options for the next CAP.

It is hoped that through the PRDN it will be possible to engage stakeholders in proactively testing future implementation options. The working relationships established through the project should continue after its lifetime to allow different interest groups to work together to increase ES and biodiversity provided by GBI. The key outputs hoped for are described briefly here.

4.1 GBI advisory tools

Already existing tools and new formats for providing advice will be tested with the PRDN through local learning labs. The aim will be to identify the tools most appropriate to the farming systems under consideration i.e. the tools used may vary between the case study areas. A variety of options would be tested on the local level in order to make recommendations which can also be implemented in other locations with similar conditions. Collaboration between advisors would also be encouraged by bringing the project findings together in a knowledge platform to encourage exchange of information.

4.2 GBI policy recommendations

The work with the PRDN through the workshops, round tables and local meetings will allow exploration of new options for policy reform and help to test recommendations and potential alterations to the CAP. Recommendations will be made both for local level implementation of measures and also the EU level. The recommendations will be tested at the end of the project with the PRDN at an EU level workshop.

4.3 GBI indicators

Existing biological indicators will be tested in the case study areas to examine how well they measure GBI aims. A list of indicators, appropriate for each case study will be produced and this will be scaled-up to the national and finally the EU level. The indicators should help with measuring the impacts of policy and advice on GBI and allow better assessment of policy changes.

5 Publication References

Baró, F.; Bugter, R.; Gómez-Baggethun, E.; Hauck, J.; Kopperoinen, L.; Liquete, C.; Potschin, M. (2016): Green Infrastructure. In: Potschin, M. and K. Jax (eds): OpenNESS Ecosystem Service Reference Book. EC FP7 Grant Agreement no. 308428. Online verfügbar unter www.openness-project.eu/library/reference-book.

Concepción, Elena D.; Díaz, Mario; Kleijn, David; Báldi, András; Batáry, Péter; Clough, Yann et al. (2012): Interactive effects of landscape context constrain the effectiveness of local agri-environmental management. In: *Journal of Applied Ecology* 7 (Suppl 2), no-no. DOI: 10.1111/j.1365-2664.2012.02131.x.

Díaz, Mario; Concepción, Elena D. (2016): Enhancing the Effectiveness of CAP Greening as a Conservation Tool. A Plea for Regional Targeting Considering Landscape Constraints. In: *Curr Landscape Ecol Rep* 1 (4), S. 168–177. DOI: 10.1007/s40823-016-0017-6.

Ecorys; IEEP; Wageningen (2016): Mapping and Analysis of the Implementation of the CAP. In: *DG Agriculture*.

EEA (2014): Spatial analysis of green infrastructure in Europe (EEA Technical report No 2/2014).

EIP-AGRI (2016): EIP-AGRI Focus Group: Benefits of landscape features for arable crop production.

European Commission (2013): Green Infrastructure (GI) — Enhancing Europe's Natural Capital.

European Commission (2015a): COM(2015) 478 The mid term review of the EU Biodiversity Strategy to 2020, zuletzt geprüft am 01.04.2017.

European Commission (2015b): The Water Framework Directive and the Floods Directive: Actions towards the 'good status' of EU water and to reduce flood risks, zuletzt geprüft am 21.06.2017.

European Commission (2016): Review of Greening after one year. SWD (2106) 218 final.

European Commission (2017): Report on the implementation of the ecological focus area obligation under the green direct payment scheme. COM(2017) 152 final.

Haines-Young, R.; Potschin, M. (2010): The links between biodiversity, ecosystem services and human well-being. In: Raffaelli, D. & C. Frid (eds.): Ecosystem Ecology: a new synthesis. In: *BES Ecological Reviews Series* (CUP, Cambridge), zuletzt geprüft am 21.04.2017.

Milieu; IEEP; ICF (2016): Evaluation Study to support the Fitness Check of the Birds and Habitats Directives.

Pe'er, Guy; Zinngrebe, Yves; Hauck, Jennifer; Schindler, Stefan; Dittrich, Andreas; Zingg, Silvia et al. (2016): Adding Some Green to the Greening. Improving the EU's Ecological Focus Areas for Biodiversity and Farmers. In: *CONSERVATION LETTERS* 24 (2), S. 38. DOI: 10.1111/conl.12333.

Underwood, Evelyn; Tucker, Graham (2016): Ecological Focus Area choices and their potential impacts on biodiversity.

Wright, Hannah (2011): Understanding green infrastructure. The development of a contested concept in England. In: *Local Environment* 16 (10), S. 1003–1019. DOI: 10.1080/13549839.2011.631993.