Setting a relevant framework to assess AnaEE's impact

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Introduction: a systemic approach to impact assessment

The aim of AnaEE is to understand the **functioning and behaviour of ecosystems under anthropic pressures** such as climate change, land use and management practices, pollution, biodiversity loss, etc., to study their adaptation, and to identify possible mitigation measures regarding correlated risks.

Ecosystem services are connected to everyday life, and research performed using AnaEE services have an **impact on socio-economic services**, such as food production and quality, materials, pollutant release, and recreational services. These services are closely connected to the One Health and Climate challenges.

Assessing this impact in a measurable way is however challenging, considering its inscription in a **multi-level impact chain**, that fundamentally involves mediations between AnaEE's research activities and its final impacts.

The aim of the present document is to clarify this issue by **specifying the positioning of AnaEE in the chain of actors generating impact in the field of food, health, agriculture and environment**. It helps explain what AnaEE's impact consists of, beyond the initial picture that can be provided by standard impact indicators.

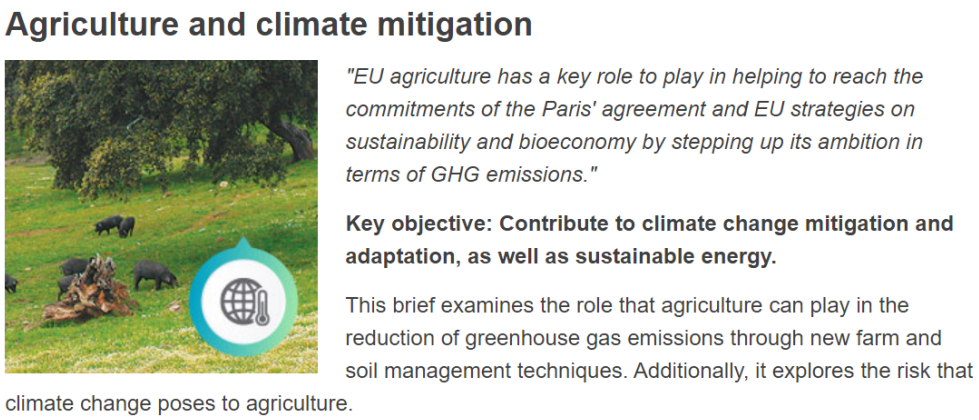
The main argument is that as a **network of platforms which enables the scientific modelling of complex ecosystems across Europe**, AnaEE is an essential element in the set of actors which contribute to safer, healthier and more sustainable management of food, health, agriculture and environment.

Indeed, **research on ecosystems** is placed at a strategic crossroads between food, health and environment issues. It is therefore concerned with sectors of activity with a massive impact on health, economic sustainability and environmental sustainability at the European scale. Actors in this field may be positioned at different stages of the chain, and in particular, AnaEE is positioned as an **upstream link** of the set of actors - for this precise reason, it is an **essential contributor to the massive impact** that results from their convergence and coordinated action.

The following paragraphs propose a **detailed characterization of AnaEE's contribution to this impact chain**.

1. Which impact are we talking about?

AnaEE's strategic positioning is directly relevant to the **objectives of the common agricultural policy 2021-2027**, which identified adaptation as a priority:



Presentation of Common Agricultural Policy specific objective: Agriculture and climate mitigation[1]

The **coordination of agricultural policies** has been a pillar of European policy for decades. The priorities are constantly evolving, as indicated for instance by recent concerns on food security, health, preservation of biodiversity and sustainability of ecosystems in the face of climate change.

Such coordinated policies need to be **informed by adequate upstream and downstream research**, that may allow to tackle and anticipate current and future challenges related to Common Agricultural Policies, in a way that can be transversal enough to cover all the items within the chain of value and impact linked to the agri-food sector.

The scope of impact for such coordinated policies is massive at a European scale. According to the study of the EEA, *EEA's report on Climate Change Adaptation in the Agriculture Sector in Europe*, the agricultural sector thus has major impacts on **health, job and environment:**

> *Agricultural land accounts for **40% of total EU land**. Agriculture and food-related industries and services provide over **44 million jobs** in the EU, and **22 million people are directly employed** in the sector itself*[2].

[1] https://ec.europa.eu/info/food-farming-fisheries/key-policies/common-agricultural-policy/future-cap/key-policy-objectives-future-cap_en#nineobjectives
[2] https://www.eea.europa.eu/publications/cc-adaptation-agriculture

Beyond the strictly economic aspect, this sector is currently deeply involved in environmental issues of **resource management** (the sector consumes more than 50% of the water used in Europe), **pollution** ("the largest contributor total EU non-CO2 emissions", - ammonia, nitrates) and is of course massively impacted by **climate change** issues, which it impacts in return (EEA's report mentioned above estimates that climate change could lead to "up to 16% loss in EU agriculture income by 2050").

Beyond the "preventive" aspect (mitigation of environmental and economic risks), agriculture, forestry, and more generally ecosystem management, are also key to a set of "**positive services**" for the climate, with an unambiguous added-value for communities. To mention a few examples, forests or peatlands are carbon sinks; adapted agricultural methods allow to store carbon (e.g. charchoils amendments) and can be used as effective, low-cost, measures to fight global warming, while providing additional revenues to farmers. Better agricultural practices result in a gain in biodiversity, better quality of food, and again increased revenues.

The coordination of agricultural policies thus benefits from a **coordination of scientific infrastructures** which can provide policy-makers with the necessary inputs in terms of ecosystems basics, as well as interrelated issues such as biodiversity, nutrient cycles, soil and water quality, which are key factors in food production and environmental health.

2. AnaEE within the chain of actors

Direct impact attribution is always complex, and in the case of an upstream research infrastructure such as AnaEE, quantifying the "number of jobs" or "direct economic impact" might prove difficult. However, AnaEE, as a coordinated and distributed upstream research infrastructure, is a **key contributor to the production of this systemic impact**.

In fact, addressing such challenges as those described above can only be achieved through the **collaboration and coordination of many actors**, from industry and agricultural producers and consumers, to policy makers.

As a **research infrastructure enabling the study of plant growth and processes in various ecosystems**, AnaEE is an **essential contributor** to these objectives. Indeed, AnaEE is one element leading to a set of societal and environmental improvements in a diversity of fields:

- changing the way that **food is produced and consumed**;
- changing the way we **use and care for ecosystems**;
- promoting a general view on **how to improve health and sustainability**;
- contributing to **carbon storage and biodiversity recovery**.

AnaEE may thus not be the ultimate link of the chain that generates this impact, but it is an **essential piece of the puzzle**, as it provides a better understanding of the functioning of complex ecosystems, as well as better models and prototypes of new practices and modes of food production and land management.

The role of AnaEE in this chain is unique, since AnaEE is a **one of its kind distributed experimental RI**:

- because it covers the **whole span of European ecosystems** in complementary platforms, including freshwaters;
- because these platforms allow conducting **comprehensive experiments**, supported by service centres that further strengthen AnaEE research and increase its impact.

As stressed by the IPCC in its report on "*Long-term Climate Change: Projections, Commitments and Irreversibility*":

> ***Projections of climate change are uncertain**, first because they are dependent primarily on scenarios of future anthropogenic and natural forcings that are **uncertain**, second because of **incomplete understanding and imprecise models of***

> ***the climate system*** *and finally because of the existence of* ***internal climate variability***[3].

AnaEE's unique experimentation framework offers pioneer and impactful solutions to these uncertainty issues, by **testing solutions in different scenarios of future climatic conditions**.

Currently, there are **no such existing infrastructures** neither in Europe, nor in the world. Other infrastructures take advantage of distributed multi-site facilities, but they focus on long-term observation rather than experimentation, while AnaEE allows for **concrete manipulations, experimentations, testing** in new or potential environments, extrapolations, thus offering unique possibilities in terms of **risks anticipation and mitigation**.

The following steps of the discussion will show:

- the steps that AnaEE is taking to ensure that it reaches its full impact;
- the indicators which it will monitor to adapt its actions;
- the instruments that it installed to ensure the essential inscription of its research actions within the impact chain.

3. Spheres and categories of impact

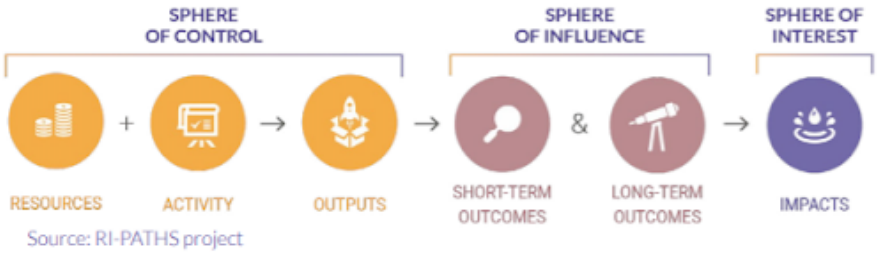
An interesting starting point to define AnaEE's relevant impact framework can be the inputs provided by the **RI-Paths**[4] project, funded in the context of the H2020 Programme, that aims at developing a methodology to characterize the **socio-economic impact of research infrastructures** and their related financial investments.

Based on the assumption that there can't be a unique impact framework as a "one-size-fits-all" for research infrastructures, RI-Paths concretely proposes an **interactive toolkit** through which each RI may **build its own evaluation framework** or "pathway", based on its profile, mission and objectives.

In this context, RI-Paths distinguishes **3 spheres of impact**, from the most direct to the most indirect one: the **sphere of control**, the **sphere of influence**, and the **sphere of interest**.

[3] http://www.climatechange2013.org/images/report/WG1AR5_Chapter12_FINAL.pdf
[4] https://ri-paths.eu/

Figure 2: Impact pathway logic



Source: RI-PATHS project

+ **Sphere of control** covers everything that the Research Infrastructure's team can control and for which it is fully responsible. It includes activities and the direct outputs from these activities.

+ **Sphere of influence** covers effects outside the direct control of the Research Infrastructure's team which depend on how RI users or stakeholders react to the results produced. However, they remain at arm's length as the Research Infrastructure interacts directly with the user and stakeholder groups in question and can seek to influence their behaviour.

+ **Sphere of interest** covers the lasting impacts and structural changes manifesting in the economy and society. Socio-economic impacts are highly context-driven and hence outside the direct control of the Research Infrastructure, yet this sphere is exactly the main focus of an impact assessment.

RIs' 3 spheres of impact - RI Paths project

Correlatively, the 13 "impact pathways" identified within the RI-Paths framework can be grouped into **3 categories**: enabling science, problem-solving, science & society:

1. Impacts as a result of Research Infrastructures pursuing their primary mission – **enabling science**
2. Impacts as a result of Research Infrastructures interacting for **problem-solving**
3. Impacts through Research Infrastructures shaping the fabric of **science and society**

Categories of impact - RI Paths project

Based on these conceptual guidelines, we may therefore seek to identify how AnaEE behaves with respect to these respective categories. This analysis results in the following matrix:

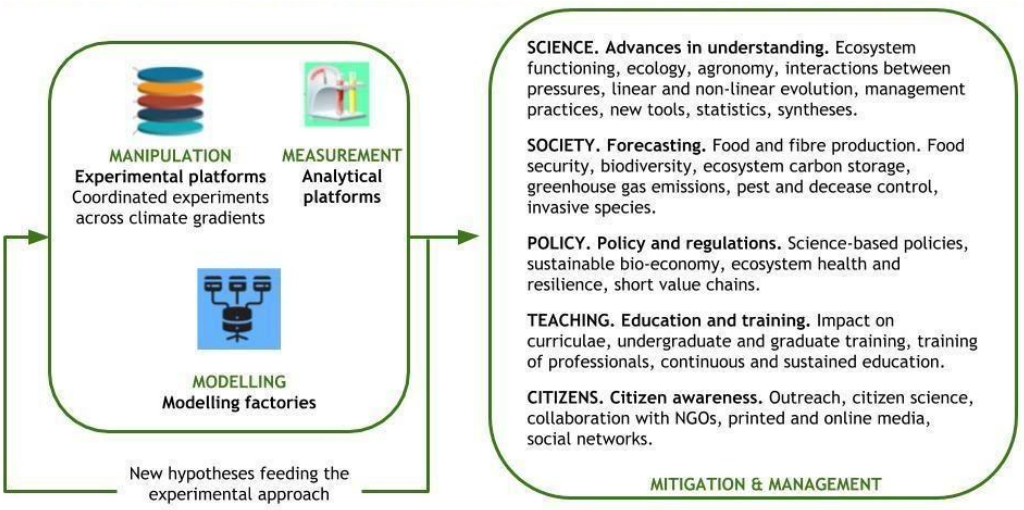
		AnaEE's Sphere of control	AnaEE's Sphere of influence	AnaEE's Sphere of interest
Enabling science	P1 – Publication-citation-recognition			
	P2 – Employment, operations and standardised procurement			
	P3 – Technology transfer and licensing			
	P4 – Learning and training through joint development of instruments and tools			
	P5 – Learning and training by using RI facilities and services			
	P6 – Training and higher education cooperation			
Problem-solving	P7 – Interactive problem-solving for the private sector (industry)			
	P8 – Addressing societal and public-sector challenges			
	P9 – Provision of specifically curated/edited data			
Shaping of science and society	P10 – Changing fundamentals of research practice			
	P11 – Creating and shaping scientific networks and communities			
	P12 – Promoting engagement between science, society and policy			
	P13 – Communication and outreach			

AnaEE's impact through the matrix of RI-Paths spheres and categories

This table might give a feeling that AnaEE's impact is primarily focused on its **sphere of control**, i.e. to what it controls directly based on the way it organizes its activity, namely:

- accessibility and quality of the infrastructures for the scientific community;
- training of students and technical staff;
- accessibility to industrial and agricultural partners;
- outreach towards policy makers and the public at large.

This is linked to **measurable KPIs** which directly document AnaEE's activity and are provided in detail in AnaEE's Scientific and Technical Document. In fact, those are the one represented in the following figure, and associated to many of AnaEE's KPIs:



AnaEE's experimental approach: Manipulation, Measurement, Modelling, Mitigation & Management - From AnaEE's Scientific and Technical document

However, if we try to characterize concretely what enters respectively into AnaEE's **sphere of influence** and into its **sphere of interest**, we understand that these aspects are key to AnaEE's activity, even though they may be more difficult to capture through standard impact indicators.

What is in AnaEE's sphere of influence	• Innovation in the practices of food production and land management • Law regulating industry and consumers' practices in the areas of food production / consumption and land management • Policies and practices for the reduction of GHG and pollutant emissions, carbon storage, and biodiversity recovery • Tracing interactions between AnaEE's research community and the industry/agricultural sector on the one hand, policy makers on the other hand
What is in AnaEE's sphere of interest	• Overall quality and sustainability of the food production system • Overall quality and sustainability quality of the land management system • Overall contribution to climate and biodiversity objectives ⇒ This kind of overall indicators is being monitored by bodies such as the European Environment Agency.

4. Structuring its place in the impact chain: AnaEE's instruments

It is important to stress how AnaEE is positioned as an upstream link of the impact chain, but on the other hand, it is also key to valorize the **positive and concrete instruments** it has installed to **guarantee the reality of its impact**, beyond its mere sphere of control.

In fact, the overall strategy of AnaEE in terms of societal impact will be positively taken care of by a dedicated structure, the **Interface and Synthesis Centre (ISC)** that will be responsible for the overall integration of the results obtained by AnaEE. It will in particular:

- prepare synthesis and opinion papers on behalf of AnaEE;
- watch for emerging societal needs, and answer to demands from the society, economy, and

policy makers;
- be also responsible for the training and outreach.

In coordination with the Communication officer of the Central Hub, the ISC will also develop activities aimed at **scientific dissemination** (publication of articles, organization of conferences…) and recruit an expert in scientific communication.

AnaEE's ISC thus covers a wide span of actions ensuring the outreach of its activities, towards a complete set of target profiles:

- organising scientific prospective studies and lobbying for research programs;
- setting-up project building capacities;
- elaborating outreach material directly related to AnaEE's results;
- organising worldwide ecosystem science syntheses;
- elaborating societal scenarios and innovation needs beyond AnaEE's results;
- feeding the Interface and Synthesis Centre section of the AnaEE portal;
- providing recommendations and position papers for policy makers and regulators.

In addition, AnaEE will take part in several working groups and institutional structures orientated towards a coordination action in the field of agriculture, food and health:

- a **collaboration with other European RIs**, both in the Health and Food domain and the Environment domain of the ESFRI roadmap. Being a member of the Life Science RI cluster, and participating in the Health and Food domain of ESFRI, the objective is to study innovative solutions for a sustainable intensification of agriculture by integrating the study of plant phenomics, physiology, ecosystems' functioning and agro-ecology. In the Environment domain, AnaEE is an active participant of ENVRI, the community of environmental infrastructures;
- a collaboration with **EMPHASIS** to bring innovative solutions for a sustainable intensification of agriculture by integrating the study of plant phenomics (EMPHASIS) and agroecology (AnaEE);
- a participation in **all major ecosystems-related conferences, workshops and corollary research events** discussing new developments in the fields of environmental and biodiversity studies.

In terms of **support to public policies**, AnaEE is in a perfect position to play two related roles:
- it can act as a place where scientists meet and discuss about further infrastructure and equipment development for a better, more coherent use of resources;
- it can be a reference point for policy makers to get public policy advice based on state-of-the-art research.

By relying in particular on the activities of the ISC, AnaEE will thus provide **expert public policy makers with advice on improved management and methodologies for sustainable agriculture and ecosystem management**, and with **mapping decision support tools** for early detection of the most vulnerable areas and ecosystems, enabling them to take early action.

Lastly, an **annual Stakeholder Outreach Day** will be organized in conjunction with the Assembly of members. AnaEE will provide key input regarding the development of long-term strategies and policies.