



**From research to solutions**

**AGRICULTURE - FOOD - ENVIRONMENT**



*In this booklet, Aarhus University, INRAE and Wageningen University & Research highlight a number of EU-funded research and innovation projects that have created and continue to create impact by contributing to solutions to real-life problems. Impact from research takes time and may not be visible immediately, however, in each case, the projects are generating knowledge, tools, methods and approaches that are developed with key stakeholders in order to ensure that they are providing fit-to-purpose, actionable results. Within the domains of agriculture, food & bioeconomy and the environment, the urgently needed transformation to more resilient systems is highly dependent on two-way interactions with a range of stakeholders. Therefore, a co-creation approach as taken in these projects, allows research to respond to stakeholder needs and thereby to find immediate relevance on the ground.*

*Additionally, it is our experience and approach that interactions between researchers and stakeholders from the value chain such as farmers, companies, policymakers, NGOs and consumers start to generate impact even before the collaboration is*

*fully developed into a project. As soon as interaction starts and exchanges on needs and concerns as well as knowledge-based approaches are identified, the value chain as a system starts to change. Thus, whilst this leaflet focuses on completed research projects and their outcomes, it is an important plea from the community that integrated, collaborative interaction is what is needed to drive change as it initiates this change from the outset of the collaboration. Climate change, loss of biodiversity and pressure on natural resources are threatening human populations and the planet. They call for appropriate solutions and raise new questions for research. To meet these challenges, and because the issues are highly interdependent, research and expertise on the environment, agriculture and food should be mobilised in a coordinated way. If the booklet presents research projects dealing with three main themes – agriculture, food & bioeconomy, and environment – this is for simplicity reasons and this in no way detracts from the complexity of the research questions.*





# TABLE OF CONTENTS

## Agriculture

P. 5

Solutions for sustainable weed management

P. 6

Towards climate-neutral and resilient farms

P. 7

The digital transformation of the European agri-food sector

P. 8

Reducing pesticides for crop protection: a holistic and collaborative approach

P. 9

Breeding for more efficient and resilient sheep and goat farming

P. 10

Solutions for improving the welfare of poultry and pigs

P. 11

## Food/Bioeconomy

P. 13

Circular bio-based business models for rural communities

P. 14

Solutions to reduce food waste and food losses along production and supply chain

P. 15

## Environment

P. 17

Innovative approaches to protecting Europe's forests from biological invasions

P. 18

How nature's capacity and qualities solve urban interlinked societal challenges

P. 19

Safeguarding Waters in the Nordic-Baltic Region

P. 20



# AGRICULTURE



## TOWARDS HIGH-PERFORMING, RESILIENT AND INCLUSIVE FARMING SYSTEMS

Aiming for multi-performance agriculture means addressing not only productivity, but also the living conditions and livelihood of farmers, the economic competitiveness of businesses, animal welfare, sustainable use of natural resources, land-use planning, and access for all to healthy, diversified food.

A range of levers to achieve this is explored, including:

- Plant and animal breeding,
- Diversification of crop and livestock systems,
- Management of health risks and epidemics,
- Stimulation of plant and animal immunity,
- Responsible use of digital tools and technologies,
- Circular use of natural resources (soil, water...),,
- Spatial dynamics that encourage positive links between towns and rural areas





## SOLUTIONS FOR SUSTAINABLE WEED MANAGEMENT

*IWMPRAISE – Integrated Weed Management PRActical Implementation and Solutions for Europe*

The IWMPRAISE project advanced Integrated Weed Management (IWM) in Europe by using field demonstrations and stakeholder involvement. It showed that adopting IWM improves the agronomic and environmental sustainability of cropping systems and boosts their resilience to external pressures.

### SOLUTIONS AND IMPACTS

By developing, testing and validating management strategies tailored to four contrasting cropping systems, representative of typical European agriculture, the project has developed knowledge, techniques and practical tools to manage weeds:

- Quantification and solutions to socio-economic and agronomic barriers to **IWM adoption**;
- Optimized suite of novel alternative weed control methods, resulting in a robust 'toolbox' of validated **IWM techniques**;
- Assessed **IWM strategies** in terms of agronomic performance, environmental benefits, and economic sustainability;
- Results and practical tools widely disseminated to end users across Europe.

The IWMPRAISE project developed a **framework to help reduce reliance on herbicides** by promoting Integrated Weed Management (IWM). IWM takes a long-term, eco-friendly approach using diverse crops, proper cultivar selection, better soil practices, targeted control, and regular monitoring. It's a key step toward more sustainable farming in Europe.

### OUTLOOKS AND FOLLOW-UP

The results of the IWMPRAISE project are now being used to drive broader, more sustainable farming practices across Europe. The Integrated Weed Management (IWM) framework developed by IWMPRAISE laid the foundation for a more comprehensive system: **Integrated Crop Management (ICM)**. Unlike traditional pest control approaches that focus on a single issue in a single crop, ICM looks at managing weeds, pests, diseases, and nematodes across multiple crops and over several years.

The ICM framework is now being applied in follow-up projects with governments, advisors, and farmers to design cropping systems that reduce pesticide use. Promoted through the EU project IPMWORKS, farmer

networks across Europe are testing and sharing ICM practices, supported by training materials and tools that help scale sustainable agriculture beyond the initial hubs.



Mechanical weed management - (c) Bertrand NICOLAS / INRAE

**EU policy/strategy:** Farm to Fork Strategy, Directive on the Sustainable Use of Pesticides (SUD)

**Programme:** H2020 | Societal Challenges - Food security, sustainable agriculture and forestry, marine, maritime and inland water research, and the bioeconomy

**Budget:** 7.1 M€

**Duration:** 2017 - 2022

**Coordination and partners:** Aarhus University (coord.), INRAE, Wageningen University & Research and 38 other partners (research organisations, academics, private entities)

**Research theme:** Agriculture

**Keywords:** agroecology, herbicides, rps, tillage, organic farming



This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement N. 727321



**ClieNFarms**  
Climate Neutral Farms

## TOWARDS CLIMATE-NEUTRAL AND RESILIENT FARMS

*ClieNFarms – Climate Neutral Farms*

The ClieNFarms project aims to **co-develop and upscale systemic locally relevant solutions to reach climate-neutral and climate-resilient sustainable farms**. Based on 20 demonstration case studies covering a diversity of production systems (crops, orchards, vineyard, vegetable, cattle and dairy products), ClieNFarms partners are **co-designing solutions with farmers and the related ecosystem** (research, advisors, finance, manufacturing, public policies) across Europe and New Zealand in a **living lab-type structure**, via the "creative arenas" approach.

### SOLUTIONS AND IMPACTS

The tools created by ClieNFarms are designed to be used directly by farmers, advisors, policymakers and companies. The resources developed include:

- A **catalogue of climate solutions**, field tested and scientifically referenced, to help farmers reduce their impact on the climate,
- A **scaling toolbox providing tailor-made support** for various stakeholder profiles (politicians, investors, farmers, project leaders, etc.) to foster the dissemination of

innovations,

- A **platform for calculating carbon allowance on farms**, designed to meet the emerging requirements of carbon certification (Carbon Removals and Carbon Farming – CRCF)
- **Training and educational content** available to professionals and the general public (online mini-courses, interactive videos) to help disseminate awareness of agriculture's role in tackling climate change.

**ClieNFarms is also helping to inform public authorities** by providing a series of thematic policy briefs on the levers to achieve carbon neutrality in agriculture.

### OUTLOOKS AND FOLLOW-UP

While still in progress, ClieNFarms is preparing for the next step. The **solutions developed will be integrated into an open resource centre (data hub)**, designed to widely disseminate the tools, protocols and guidelines. The project is also **related to other European initiatives such as Climate Farm Demo and Climate**

**Smart Advisors**, and is looking forward to follow-up projects in forthcoming calls for proposals under the European research framework programmes.



Vineyard farm - (c) Laurent GUICHARDON / INRAE

**EU policy/strategy:** EU Green Deal, Farm to Fork Strategy, Carbon Removals and Carbon Farming (CRCF) Regulation

**Programme:** H2020 | Societal Challenges - Food security, sustainable agriculture and forestry, marine, maritime and inland water research, and the bioeconomy

**Budget:** 14 M€

**Duration:** 2022 - 2025

**Coordination and partners:** INRAE (coord.), Wageningen University & Research and 31 other partners (research organisations, academics, private entities)

**Research theme:** Agriculture

**Keywords:** climate change, carbon neutrality, living labs, GES, farming, agri-food system



This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement N. 101036822





## THE DIGITAL TRANSFORMATION OF THE EUROPEAN AGRI-FOOD SECTOR

*SmartAgriHubs – Connecting the dots to unleash the innovation potential for digital transformation of the European agri-food sector*

SmartAgriHubs project created a network of Digital Innovation Hubs (DIHs) to boost the adoption of digital solutions in the agri-food sector by consolidating, activating and extending the existing ecosystem. Aligned with the EU Green Deal objectives, the project aimed to integrate technology and business support in a local one-stop-shop method involving all regions and stakeholders in Europe.

### SOLUTIONS AND IMPACTS

SmartAgriHubs (SAH) established a **network of over 300 DIHs** across Europe, which are still active. Through the Synergy Portal, this network continues to facilitate and accelerate digital innovation within the agri-food sector.

During the project period, SAH contributed to the **development of more than 80 new digital solutions** covering areas such as precision farming, supply chain digitalisation, AI & Data Analytics.

The project also played a key role in transforming consumer engagement by **enhancing transparency and trust in the food supply chain**. In giving consumers access to information on food origin and

sustainability, and promoting personalised, data-driven nutrition, SAH enabled more informed and responsible food choices.

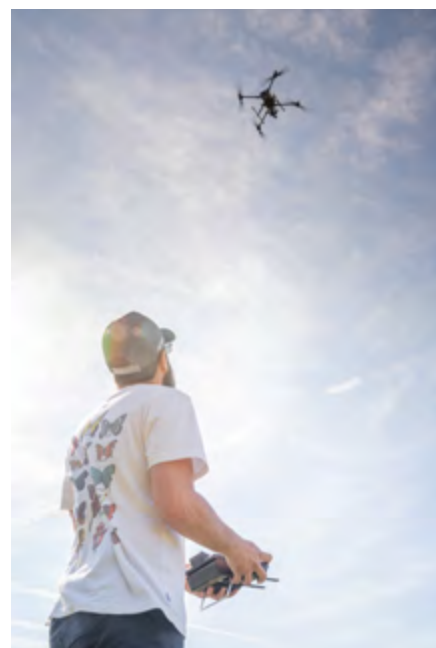
On top of this, SAH made a significant economic impact by **driving digital transformation in the agricultural sector**. It helped digitalize over 2 million farms across Europe, improving efficiency and productivity.

On a political level, SAH facilitated discussions on critical issues such as **data governance, AI in farming, and digital ethics**, significantly influencing the direction of future EU agricultural policies. It has also launched GAIA - **the Gender Alliance for Innovation in Agriculture** which aims to tackle inequalities in agriculture and is dedicated to supporting the 4<sup>th</sup> agricultural revolution in Europe, by supporting inclusive and sustainable solutions.

### OUTLOOKS AND FOLLOW-UP

Many DIHs are currently participating in follow-up projects in Horizon Europe and about 20 of them were promoted to a **European Digital Innovation Hub**

**(EDIH) with a seal of excellence** within the Digital Europe programme. The whole ecosystem is gathering annually during the Synergy Days, a spin-off of SAH that has become a leading event in Europe, where global players and projects meet and create synergies to accelerate digital innovation in agri-food. The concept is now being copied at a local level with national synergy days.



Drone measurements - (c) Baptiste HAMOUSIN / INRAE

**EU policy/strategy:** Digital Transformation in the European agri-food sector

**Programme:** H2020 | Societal Challenges - Food security, sustainable agriculture and forestry, marine, maritime and inland water research, and the bioeconomy

**Budget:** 22.4 M€

**Duration:** 2018 - 2022

**Coordination and partners:** Wageningen University & Research (coord.) and 113 other partners (research organisations, non-profit organisations, private entities)

**Research theme:** Agriculture

**Keywords:** Digital Innovation Hubs, Smart Farming, Digital Agriculture, Food Security, Business Innovation, Innovation Experiment Competence Centres, Smart Specialization Strategy



## REDUCING PESTICIDES FOR CROP PROTECTION: A HOLISTIC AND COLLABORATIVE APPROACH

*IPMWORKS – An EU-wide farm network demonstrating and promoting cost-effective IPM strategies*

The IPMWORKS project aims to **promote the adoption of Integrated Pest Management (IPM) strategies to reduce pesticide use while maintaining farm profitability and productivity**. It is based on a holistic field-tested approach involving an EU-wide network of 250 demonstration farms in 22 hubs covering the 5 main agricultural sectors: arable field crops, vineyards, orchards, greenhouse horticulture, and outdoor vegetable and ornamental crops.

### SOLUTIONS AND IMPACTS

By designing a **methodology based on local peer-to-peer learning and joint efforts**, led by "Hub coaches" and inspired by the experience of DEPHY farms in France and European projects (such as AGRI-DEMO, PLAID, NEFERTITI), IPMWORKS has enabled farmers to adopt a **holistic approach to IPM, structured around five pillars:**

1. Agricultural landscapes with diverse semi-natural habitats (flowers strips, beetle banks...)
2. Cropping systems designed to decrease pest/weed/disease pressure (crop rotation, soil tillage...)
3. Preferential use of non-chemical control options (biocontrol,

mechanical weeding...)

4. Optimised decision making to avoid unnecessary treatments ("IPM decisions" tool)
5. Increased efficiency of treatments (patch spraying, equipment...).

Surveys carried out on the demonstration farms reveal that **the holistic approach significantly reduces the use of pesticides, without impacting yields, workload or profitability, while maintaining or even improving the economic performance of farms**.

In addition, through hearings, exhibitions and a meeting with 93 members of the European Parliament, **IPMWORKS played an active role in the debate on the Sustainable Use Regulation (SUR), providing tangible, scientifically-based evidence in support of a sustainable reduction of the use of pesticides**.

### OUTLOOKS AND FOLLOW-UP

**A COST action is under consideration** to extend and broaden the scope of the European network on IPM. In addition, the **'PESTI-score' concept, an indicator on the impact of pesticides in agricultural**

**production chains**, inspired by the Nutri-score, could ultimately become an information tool for consumers, promoting producers engaged in reducing inputs and guiding public policies on food quality, health and trade.



Field demonstration - (c) IPMWORKS



**EU policy/strategy:** Farm to Fork Strategy, Directive on the Sustainable Use of Pesticides (SUD)

**Programme:** H2020 | Societal Challenges - Food security, sustainable agriculture and forestry, marine, maritime and inland water research, and the bioeconomy

**Budget:** 6 M€

**Duration:** 2020 - 2025

**Coordination and partners:** INRAE (coord.), Aarhus University, Wageningen University & Research and 28 other partners (farmers networks, research organisations, academics, private entities, training organisations)

**Research theme:** Agriculture

**Keywords:** pesticides, demonstration farms, IPM, multi-actor approach, agroecology





## BREEDING FOR MORE EFFICIENT AND RESILIENT SHEEP AND GOAT FARMING

SMARTER – SMALL RuminanTs breeding for Efficiency and Resilience

The SMARTER project has developed **innovative breeding strategies to improve the resilience and efficiency (R&E)** of sheep and goat farms. The aim is to reduce the use of inputs (concentrates, antibiotics) and greenhouse gas emissions, while maintaining productivity, profitability, health and animal welfare. This project covered 46 European breeds on 5,000 farms, representing around 70% of the livestock populations concerned.

### SOLUTIONS AND IMPACTS

As part of an agroecological approach, the project has produced a number of tangible tools for livestock farmers, breeders and agricultural advisors, including:

- **Genomic prediction and modelling tools** to select resilient animals (health, longevity, adaptation to stress) and efficiency (making the most of local resources, reducing greenhouse gas emissions)
- A **unique international genomic database**, including 12,000 sheep and 6,000 goats
- **New genetic indices for traits:** feed efficiency, functional longevity, disease resistance and greenhouse gas emissions

- **R&E phenotyping recommendations** issued in the ICAR\* guidelines covering 31 phenotypes compiled in 6 manuals: feed efficiency, greenhouse gas emissions, health, longevity, juvenile survival and behaviour

The project has also led to the **development of the first European and international genetic evaluation network for small ruminants**, including collaboration and logistics agreements for major breeds such as the Saanen goat and Manech, Texel and Suffolk sheep.

### OUTLOOKS AND FOLLOW-UP

The SMARTER project paved the way for **new initiatives, such as the Grass to Gas and Phenopasto projects**, which focus on resilience and reducing greenhouse gases in livestock farming. **The project is playing a role in meeting society's expectations on sustainability**, by reducing the environmental impact of livestock farming while ensuring animal health and welfare. Drawing on breeding innovation and transnational cooperation, SMARTER reflects Europe's ambition for a more resilient, collaborative agriculture based on

knowledge sharing.

\* ICAR (International Committee for Animal Recording – The global standard for livestock data)



Basco-béarnaise breed in Pyrenees mountains -(c) Stéphan Gabrielli



Suffolk breed -(c) TEAGASC

**EU policy/strategy:** Farm to Fork Strategy, Animal Breeding Regulation (2018)

**Programme:** H2020 | Societal Challenges - Food security, sustainable agriculture and forestry, marine, maritime and inland water research, and the bioeconomy

**Budget:** 7.6 M€

**Duration:** 2018-2023

**Coordination and partners:** INRAE (coord.) and 26 other partners (research organisations, academics, private entities - cooperatives, breeding organisations, technical centres, farmers' associations)

**Research theme:** Agriculture

**Keywords:** breeding, animal health and welfare, resilience, efficiency, greenhouse gas emissions



This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement N. 772787



## SOLUTIONS FOR IMPROVING THE WELFARE OF POULTRY AND PIGS

PPILOW – PPIlow Poultry and PIg Low-input and Organic production systems' Welfare

The PPILOW project aims to improve the welfare of pigs and poultry in low-input outdoor and organic farms. It is based on a multi-actor approach involving stakeholders throughout the production chain: farmers, scientists, citizens, consumers and public policy decision-makers.

### SOLUTIONS AND IMPACTS

By bringing together a wide range of stakeholders, including 9 national groups of practitioners in 9 countries, the project has developed innovative breeding and selection strategies and techniques to:

- avoid mutilation (castration of piglets, beak trimming of laying hens)
- prevent the culling of day-old male chicks
- encourage positive behaviour;
- improve the health and robustness of pigs and poultry in outdoor conditions increasing the risks due to temperature variations, pathogens and predators

**Two smartphone applications** have been developed and extended to support farmers in their self-assessment of animal welfare: **Piglow®** app, for monitoring the welfare

for low-input outdoor and organic pigs, and **EBENE®** extension, which assesses animal welfare according to various criteria relating to feed, the environment, animal health and behaviour.

The consortium has also developed a **multicriteria One Welfare assessment method** to evaluate practices such as the use of dual-purpose breeds, allowing to keep both males and females for meat and egg productions, in a sustainable perspective.

In addition, **partnerships with industry advances towards the design of adapted farrowing huts for outdoor sows and piglets**, as well as the identification of biomarkers for organic chickens for chicken breeding strategies and knowledge about outdoor design for farmers.

### OUTLOOKS AND FOLLOW-UP

The project supports the transition towards high-quality organic and low-input farming. It addresses important ethical issues for consumers (e.g. castration or culling of male chicks), integrating the '**One Welfare**' concept, which links animal welfare, human well-being and sustainability.

The results of the PPILOW project are now being re-used in a variety of European initiatives, including the ROAM-FREE (use of PIGLOW), INTAQT (use of meat quality data) and BroilerNet (practice of on-farm hatching). Knowledge transfer is supported by platforms such as the **EU Farm Book** and the **CAP network (EIP Agri)**.



Outdoor poultry -(c) Gilles VASSEUR DELAITRE / INRAE

**EU policy/strategy:** Farm to Fork Strategy, EU animal welfare legislation

**Programme:** H2020 | Societal Challenges - Food security, sustainable agriculture and forestry, marine, maritime and inland water research, and the bioeconomy

**Budget:** 10 M€

**Duration:** 2019 - 2024

**Coordination and partners:** INRAE (coord.) Aarhus University, Wageningen University & Research and 22 other partners (research organisation, academics, private entities and citizen or producer associations)

**Research theme:** Agriculture

**Keywords:** animal welfare, organic farming, one Welfare approach, low input systems



This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement N. 816172





## FOOD & BIOECONOMY



### BUILDING SUSTAINABLE, HEALTHY AND ACCESSIBLE DIETS FOR ALL

Supporting the transition to healthy, sustainable and affordable diets for all, while strengthening Europe's food sovereignty and ensuring the competitiveness of the agri-food sector is a huge challenge. To achieve this, food systems should be considered as a whole. Research into the transformation of food systems involves collective and interdisciplinary approaches, from production to consumption, through the adaptation of our practices, behaviour and diets.

Therefore, we are investigating several research areas are investigated, including:

- The role of microorganisms in food and health
- Healthy nutrition throughout life
- Informing, empowering and protecting consumers
- Encouraging more sustainable industrial processes and responsible eating habits







## CIRCULAR BIO-BASED BUSINESS MODELS FOR RURAL COMMUNITIES

*GO-GRASS – Grass-based circular business models for rural agri-food value*

The GO-GRASS project aimed to **create new business opportunities in rural areas by harnessing the potential of grasslands and green fodder**. It focused on European grasslands, which cover vast areas and provide essential ecosystem services such as carbon sequestration, biodiversity enhancement, and water quality protection. GO-GRASS sought to strengthen the bioeconomy by delivering innovative, cost-effective solutions and reducing the EU's dependence on imported nutrients and fossil fuels.

### SOLUTIONS AND IMPACTS

GO-GRASS project demonstrated the **untapped potential of grasslands to support the circular bioeconomy** by transforming residual biomass into sustainable raw materials and business opportunities for rural communities. Four operational pilots were developed in Denmark, Germany, Sweden, and the Netherlands, showcasing small-scale, **replicable solutions based on local resources and needs**, including:

- **Animal bedding** converted into fertilizer, biogas, and heat
- **Biochar** used as a soil amendment
- **Grass fibres** for paper and sustainable packaging
- **Organic proteins** from grass juice

and fibre pulp, used in feed for pigs, poultry, and ruminants, or processed into biomaterials and biofertilisers

Beyond rural development, the project aimed to reduce dependency on imported soy protein by promoting grass as a sustainable, local protein source for both feed and food.

GO-GRASS also created **nine digital tools** to support rural entrepreneurs, trainers, and advisors—helping them turn grass-based ideas into profitable businesses and gain a competitive edge in sustainable innovation. These include an **online decision-support tool** to assess the viability of grass-based projects, and the **G2G Business Plan Writer**.

Furthermore, the project identified **key policy measures to scale up grassland-based value chains**, such as incentivising land conversion, supporting the use of surplus grass, and promoting ecosystem services. It also **emphasised the need for dedicated funding and R&D** to accelerate the deployment of grass-based innovations.

### OUTLOOKS AND FOLLOW-UP

GO-GRASS paved the way for the **EU Green Biorefinery Network**, a Europe-wide initiative to foster ongoing collaboration between researchers, industries, and rural stakeholders. It directly informed feasibility studies for full-scale plant implementation and supported the market entry of a Danish company now offering **turnkey biorefinery solutions**.

In addition, the **interdisciplinary knowledge transfer** initiated by GO-GRASS continues through the establishment of the European Green Biorefining Network, coordinated by Aarhus University, driving innovation and collaboration towards a more circular and bio-based economy.



Freeze dried grass protein - (c) Julie MELDHEDE KRISTENSEN

**EU policy/strategy:** EU Green Deal, EU Rural Development Policy, EU Farm to Fork Strategy

**Programme:** H2020 | Societal Challenges - Food security, sustainable agriculture and forestry, marine, maritime and inland water research, and the bioeconomy

**Budget:** 1.33 M€

**Duration:** 2019 - 2024

**Coordination and partners:** Leibniz Institute (coord.), Aarhus University and 15 other partners (research organisations, academics, private entities)

**Research theme:** Bioeconomy

**Keywords:** green biorefinery technology, circular agrifood system, biobased economy, grassland-based business opportunities



This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement N. 862674



## SOLUTIONS TO REDUCE FOOD WASTE AND FOOD LOSSES ALONG PRODUCTION AND SUPPLY CHAIN

*REFRESH – Resource Efficient Food and dRink for the Entire Supply chain*

The REFRESH project aimed to tackle food waste by:

1. Developing strategic agreements to reduce food waste with governments, business and local stakeholders in four pilot countries
2. Formulate EU policy recommendations and support national implementation of food waste policy frameworks
3. Designing and developing technological innovations to improve valorisation of food waste

### SOLUTIONS AND IMPACTS

REFRESH developed and implemented **multi-stakeholder Voluntary Agreements (VAs)** in the Netherlands, Germany, Spain, and Hungary. These agreements united businesses, governments, and civil society to collectively reduce food waste.

In the Netherlands, the original VA has evolved into an **independent foundation – Samen Tegen Voedselverspilling (Food Waste Free United)** – since December 2018. It has become the national coordination body for food waste policy and implementation, working along four lines of action: monitoring, business engagement, consumer engagement, and policy. **Its network grew from 25 stakeholders in**

**2019 to over 110 today, covering the entire Dutch food system.**

REFRESH provided **in-depth insights into why consumers waste food**, using behavioural science and economic experiments to identify drivers and test interventions.

**Tools such as FORKLIFT, the Food Waste Monitor and The REFRESH Roadmap** provided clarity on the environmental footprint and cost implications of food waste and its prevention.

The project also developed **innovations to valorise surplus food and waste streams**, mapping over 290 potential by-products for transformation into higher-value uses (e.g. animal feed, bio-based materials). Through targeted tools, metrics, and monitoring instruments, **REFRESH supported behaviour change in retail, food service, and hospitality.**

### OUTLOOKS AND FOLLOW-UP

The project's achievements have laid the groundwork for lasting change across Europe and beyond. The **Voluntary Agreements model** inspired follow-up actions in at least seven additional EU

countries, with **14 agreements active across Europe** as of 2024.

At the policy level, REFRESH contributed directly to the **EU Platform on Food Losses and Food Waste**, co-creating several key outputs, including a food use hierarchy and recommendations on data harmonisation, redistribution, and labelling regulations.

Internationally, **REFRESH's Framework for Action was replicated in China through the launch of the SAVE 12.3 platform**, marking its global relevance.



Fresh food - (c) Marisol BENITEZ / Unsplash

**EU policy/strategy:** EU Food waste Strategy, Waste Framework Directive

**Programme:** H2020 | Societal Challenges - Food security, sustainable agriculture and forestry, marine, maritime and inland water research, and the bioeconomy

**Budget:** 9.4 M€

**Duration:** 2015 - 2019

**Coordination and partners:** Wageningen University & Research (coord.) and 26 other partners (research organisation, academics, industry and NGO's)

**Research theme:** Food

**Keywords:** food waste reduction, waste valorisation, socio-economic modelling, environmental impact



This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement N. 641933





# ENVIRONMENT



## UNDERSTANDING RISKS, SUPPORTING TRANSITIONS AND RESTORING ECOSYSTEMS

Deciphering, measuring and anticipating risks, in order to provide the knowledge and tools needed for adapting to and mitigating global change, while contributing to the restoration of biodiversity and ensuring food security is a priority.

This work is often carried out in co-construction with various stakeholders, leading to solutions with real impact that directly support the Sustainable Development Goals.

Several research areas are investigated, including:

- Supporting the development of bio-based products and renewable energies to decarbonise the economy; alternatives to synthetic plastics and pesticides, the responsible use of digital approaches and technologies,
- Considering regional planning, vulnerability and (in)equity in the face of risks.
- Promoting sustainable management of resources (water, soil, biodiversity, nutrients), tackling pollution, preventing natural risks and implementing Nature-based Solutions to restore ecosystems.







## INNOVATIVE APPROACHES TO PROTECTING EUROPE'S FORESTS FROM BIOLOGICAL INVASIONS

*HOMED – Holistic Management of Emerging Forest Pests and Diseases*

The HOMED project was launched to tackle a growing threat to European forests: the invasion and expansion of non-native pests and pathogens (PnPs), accelerated by climate change and the intensification of global trade. Through a holistic approach encompassing all stages of a biological invasion, the project has enhanced the collective capacity to anticipate, detect and manage these pests, in order to better protect forest ecosystems, biodiversity and the associated ecosystem services.

### SOLUTIONS AND IMPACTS

HOMED has developed a wide **range of tools for prevention, detection, surveillance, control and eradication**, co-designed and tested in collaboration with stakeholders in the forest sector, within Europe and internationally (forest managers, biosafety agencies, public decision-makers, etc.), enabling major breakthroughs:

- Before the arrival of non-native forest pests and pathogens in Europe:
  - A network of sentinel plantations, with the main European tree species planted in the "exporting" continents (Asia, America, Africa) in order to identify insects and fungi capable of using them as new host trees
  - A prototype light trap to be installed in

containers in order to catch potential invading insects during shipping

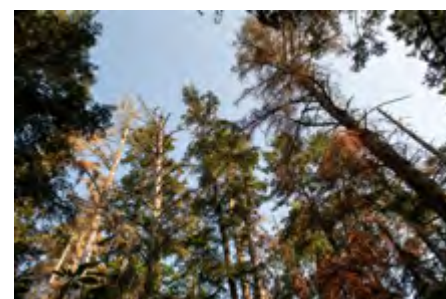
- At the arrival in European countries:
  - Generic traps, with a combination of attractants, to catch non-native beetles at airports and seaports
  - A spatially explicit model to identify the main areas at risk of non-native forest pests establishment in Europe
  - Rapid, on site, forest pathogen identification tools based on DNA analyses
- Post arrival:
  - Identification of factors in the success or failure of eradication campaigns
  - Using remote sensing combined with AI image analysis to monitor pest damage in forests.
  - Using pollen trap networks, combined with molecular analyses, for the surveillance of invasive forest pathogens
  - Spatially explicit models to predict the spread of non-native forest pests
  - New biological control methods for non-native forest pests and pathogens
- A decision support system designed to help forest managers select the best options (eradication, containment, control) depending on the pest type and invasion stage.

By combining advanced technological

innovations with a strong operational base, HOMED has provided actors in the field with the tools needed to respond more efficiently to new invasions, and has laid the foundations for sustainable European cooperation in forest biosecurity.

### OUTLOOKS AND FOLLOW-UP

The HOMED project provides **key scientific recommendations, tools and analyses for forest biotic risk management** in a climate change context, and has supported the implementation of EU plant and animal health policies, such as the **EU Plant Health Act**. Its results continue to feed into European policies and legislation, contributing in particular to achieving the objectives of the **EU Forestry Strategy 2030** and preparing for the implementation of the future **EU Forest Monitoring Framework**.



✓ Romagnat forest - (c) Bertrand NICOLAS / INRAE

**EU policy/strategy:** EU forest strategy for 2030, EU biodiversity strategy for 2030, EU Plant Health Law

**Programme:** H2020 | Societal Challenges - Food security, sustainable agriculture and forestry, marine, maritime and inland water research, and the bioeconomy

**Budget:** 5.7 M€

**Duration:** 2018 - 2022

**Coordination and partners:** INRAE (coord.), Wageningen University & Research and 20 other partners (research organisations, public bodies, forest managers and institutional players involved in forest management and monitoring)

**Research theme:** Environment

**Keywords:** forestry, ecosystem, multi-actor approach, invasive non-native pests and pathogens, biodiversity



## HOW NATURE'S CAPACITY AND QUALITIES SOLVE URBAN INTERLINKED SOCIETAL CHALLENGES

*REGREEN – Fostering nature-based solutions for equitable, green and healthy urban transitions in Europe and China*

The REGREEN project aimed to **foster the integration of Nature-Based Solutions (NbS) to help urban systems address interconnected challenges** such as pressures on public health and well-being, inequalities, vulnerability to climate change and the degradation of natural ecosystems. Through a multi-actor approach—bringing together urban planners, citizens and businesses – centred on six Urban Living Labs, the project has helped accelerate the transition to equitable, healthy, and green urban environments across Europe and China.

### SOLUTIONS AND IMPACTS

REGREEN introduced pioneering and innovative **methods for de-paving, land-use planning, and resilience thinking**—particularly the "peoplesheds" concept—and developed a typology of NbS supported by ecosystem service evidence and modelling tools. This work directly influenced policy in the Paris region (France), where **REGREEN's GIS tool** (Geographic Information Systems) – l'outil REGREEN – helped **shape the Master Plan for Île-de-France** and led to

the creation of the agency Île-de-France Nature. By 2024, 53 depaving projects were approved.

Six ecosystem models to quantify NbS benefits were also developed to quantify benefits such as air pollution and flood reduction, now integrated into the **City Explorer Toolkit in Aarhus, Denmark**. In Croatia, the *Renaturing Cities* report was launched at a national workshop and widely disseminated to local authorities.

The project also proposed sustainable business models and a **Decision Support Tool** to support long-term NbS implementation.

### OUTLOOKS AND FOLLOW-UP

The REGREEN project has delivered a set of practical, transferable solutions to accelerate the implementation of nature-based solutions (NbS) in cities. Its planning methods, training materials, and digital tools are already being reused in several European cities to address specific challenges. These tools provide concrete support for public policies, cities and businesses, ensuring

a long-term implementation of nature-based solutions and helping to meet the challenges of climate change and biodiversity loss.



✓ Gonesse (Paris region), a constructed wetland - (c) SIAH



✓ Child hanging in rope at Alnarp Landscape Laboratory - (c) Lars BRUNDIN / REGREEN

**EU policy/strategy:** EU Nature Restoration Regulation, Adaptation Strategy, Green Infrastructure Strategy, UN Sustainable Development Goals

**Programme:** H2020 | Societal Challenges - Climate action, Environment, Resource Efficiency and Raw Materials

**Budget:** 5.3 M€

**Duration:** 2019 - 2024

**Coordination and partners:** Aarhus University (coord.) and 20 other partners (research and knowledge institutions including relevant municipalities)

**Research theme:** Environment

**Keywords:** urban, biodiversity, nature-based solutions, nature restoration, ecosystem services, nature-based education, planning, Urban Living Labs, business models for NbS







## SAFEGUARDING WATERS IN THE NORDIC-BALTIC REGION

*NORDBALT-ECOSAFE – Nitrogen and phosphorus load reduction approach within safe ecological boundaries for the Nordic-Baltic region*

The Nordic-Baltic region faces critical challenges in achieving good ecological status for freshwater, coastal, and transitional waters. Despite reductions in nutrient loadings, eutrophication remains a serious issue in the Nordic and Baltic region –now further intensified by the pressure from climate change. NORDBALT-ECOSAFE develops new methodologies for quantifying nitrogen and phosphorus sources and pathways and defines safe ecological boundaries that reflect both local and regional conditions.

The project's objectives address key gaps in understanding the spatial variability of nutrient pollution, its ecological consequences, and the feasibility of achieving long-term nutrient load reductions under climate change.

### SOLUTIONS AND IMPACTS

NORDBALT-ECOSAFE applies a **state-of-the-art catchment model (SWAT+)** to six representative river basins across the Nordic-Baltic region. This model helps quantify nutrient sources and losses under different land use and climate scenarios. A key innovation is **the development of harmonised ecological boundary values for water quality indicators**. These

integrate biological responses, climate change effects, and historical nutrient trends to guide adaptive river basin management.

Six policy briefs disseminate actionable results to policy makers and stakeholders. Those results are:

- Safe ecological boundaries for nutrients in different river and lake types in the region with an analysis of the impact of climate change on boundaries
- A **classification framework for implementation of nature-based solutions (NBS) and an online river basin management support system** linked to the SWAT+ catchment model
- **High-frequency sensor data** from rivers in four countries is publicly accessible online, supporting **real-time monitoring and stakeholder engagement** and the value of sensor monitoring is demonstrated
- Climate-related trade-offs in applied nutrient reduction measures
- The project also introduces an **element stoichiometry from the local to river basin scale**
- Efficient and just agricultural **policy**

**design and governance methods applied** in the Nordic-Baltic region

### OUTLOOKS AND FOLLOW-UP

NORDBALT-ECOSAFE is actively engaged with two sister projects, NAPSEA and NEW-HARMONICA, and has co-hosted a joint session at the LUWQ2025 conference 3-6<sup>th</sup> June in Aarhus. Together, they aim to **scale the results to broader European contexts and contribute to long-term, cross-national nutrient management**.

The SWAT+ model, policy briefs, international papers and guidance documents are already being integrated into national and regional decision-making processes.



✓ Sensor stations - (c) NORDBALT-ECOSAFE

**EU policy/strategy:** Water Framework Directive, Biodiversity Strategy for 2030, the Farm to Fork Strategy, Zero Pollution Action Plan

**Programme:** Horizon Europe | Cluster 6 - Food, Bioeconomy Natural Resources, Agriculture and Environment

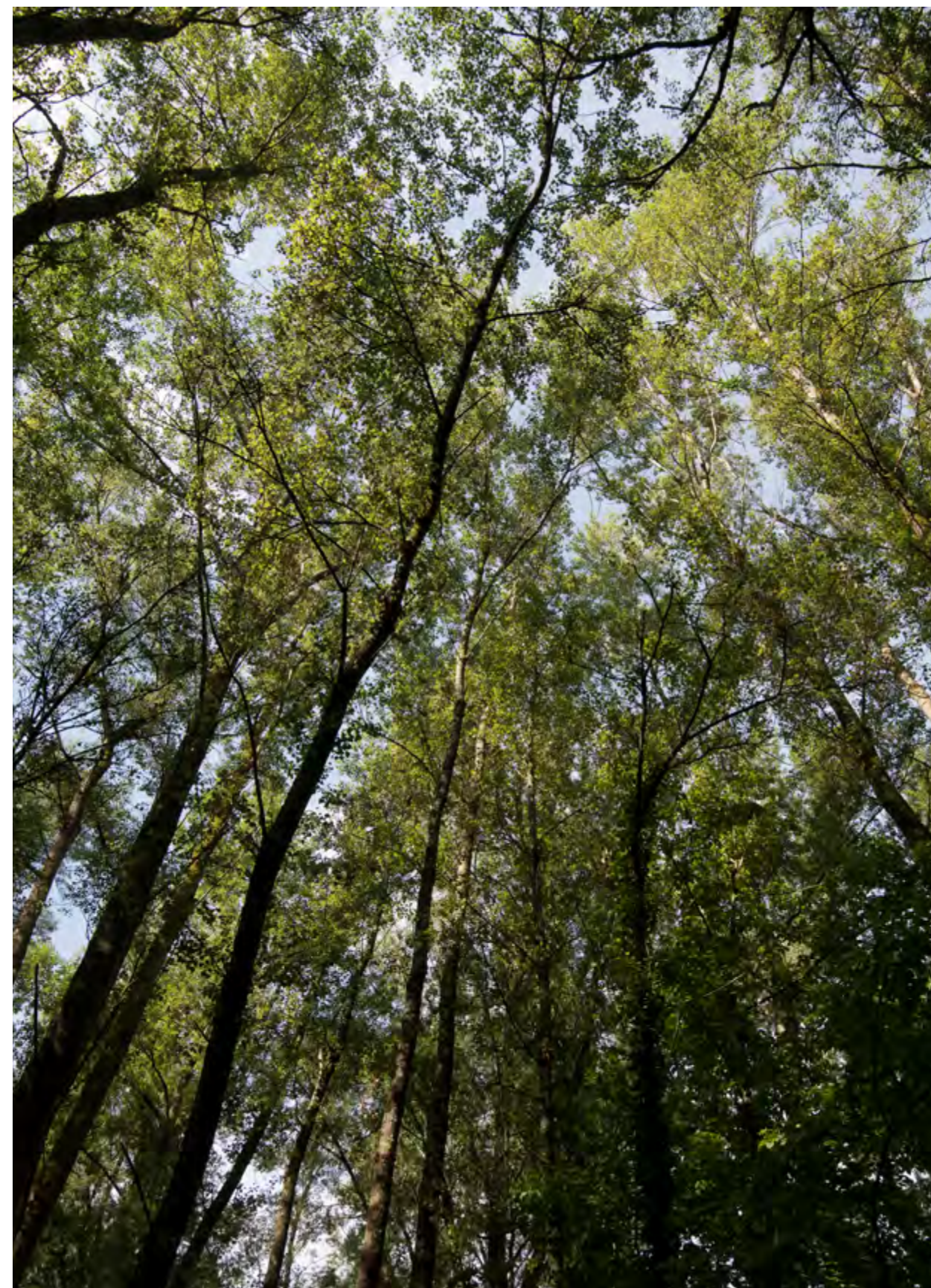
**Budget:** 2 M€

**Duration:** 2022 - 2025

**Coordination and partners:** Aarhus University (coord.) and 7 other partners (research organisations and academics)

**Research theme:** Environment

**Keywords:** nutrient pollution, ecological boundaries, river basin management, nature-based solutions, SWAT+, EU Green Deal, Zero Pollution



This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement N. 101060020





AARHUS UNIVERSITY

Aarhus University (AU), founded in 1928, is a leading public research university in Aarhus, Denmark. Known for its vibrant campus life and strong academic traditions, AU fosters groundbreaking research and transformative learning across discipline.

It hosts around 38,000 students, including 1,900 PhD candidates and over 4,000 international students.

The university is known for its research excellence and transformative education and consists of five faculties, 27 departments, and 30+ research centers. With 11,500 employees and a €1.0 billion turnover, it produces over 7,000 peer-reviewed publications annually. Its alumni include Nobel laureates and influential figures across academia, industry, and government.

Aarhus University plays a global leadership role in agri-food research, promoting sustainability, food security and resilience. Its research aligns with the UN Sustainable Development Goals and provides thought leadership on global challenges such as climate change, health, digitalization, and sustainable food and agriculture.

Furthermore, AU serves as a key advisor to Danish authorities ensuring that national policies are informed by robust scientific evidence.



The French National Research Institute for Agriculture, Food, and Environment (INRAE) is a major player globally in research and innovation on agriculture, food and the environment. The institute brings together a community of over 10,000 people, including 8,000 permanent staff and more than 2,500 project-funded contractors each year, working across more than 270 research, service, and experimental units located in 18 centers throughout France.

Internationally, INRAE is among the top research organisations in the agricultural and food sciences, plant and animal sciences, as well as in ecology and environmental science. INRAE's goal is to be a key player in providing the knowledge base supporting the necessary acceleration of agricultural, food and environmental transitions, to address the major global challenges.

Faced with a growing world population, climate change, the depletion of resources and declining biodiversity, the institute plays a major role in building sustainable solutions with its research and development partners, helping farmers and all actors in the food and forestry sectors to succeed in these transitions.



**WAGENINGEN**  
UNIVERSITY & RESEARCH

Wageningen University & Research is a collaboration between Wageningen University and the Wageningen Research foundation.

#### **'To explore the potential of nature to improve the quality of life'**

That is the mission of Wageningen University & Research. Over 7,000 employees, 13,564 students, more than 2,400 PhD's and over 150.000 participants to WUR's Life Long Learning from more than hundred countries work everywhere around the world in the domain of healthy food and living environment for governments and the business community-at-large.

The strength of Wageningen University & Research lies in its ability to join the forces of specialised research institutes and the university. It also lies in the combined efforts of the various fields of natural and social sciences. This union of expertise leads to scientific breakthroughs that can quickly be put into practice and be incorporated into education. This is the Wageningen Approach. Collaboration with other parties such as government, business and NGOs is indispensable.

The scientific quality of Wageningen University & Research is affirmed by the prominent position we occupy in international rankings and citation indexes.

#### **The domain of Wageningen University & Research consists of three related core areas:**

- Food, feed & biobased production
- Natural resources & living environment
- Society & well-being





AARHUS UNIVERSITY

INRAE



WAGENINGEN  
UNIVERSITY & RESEARCH