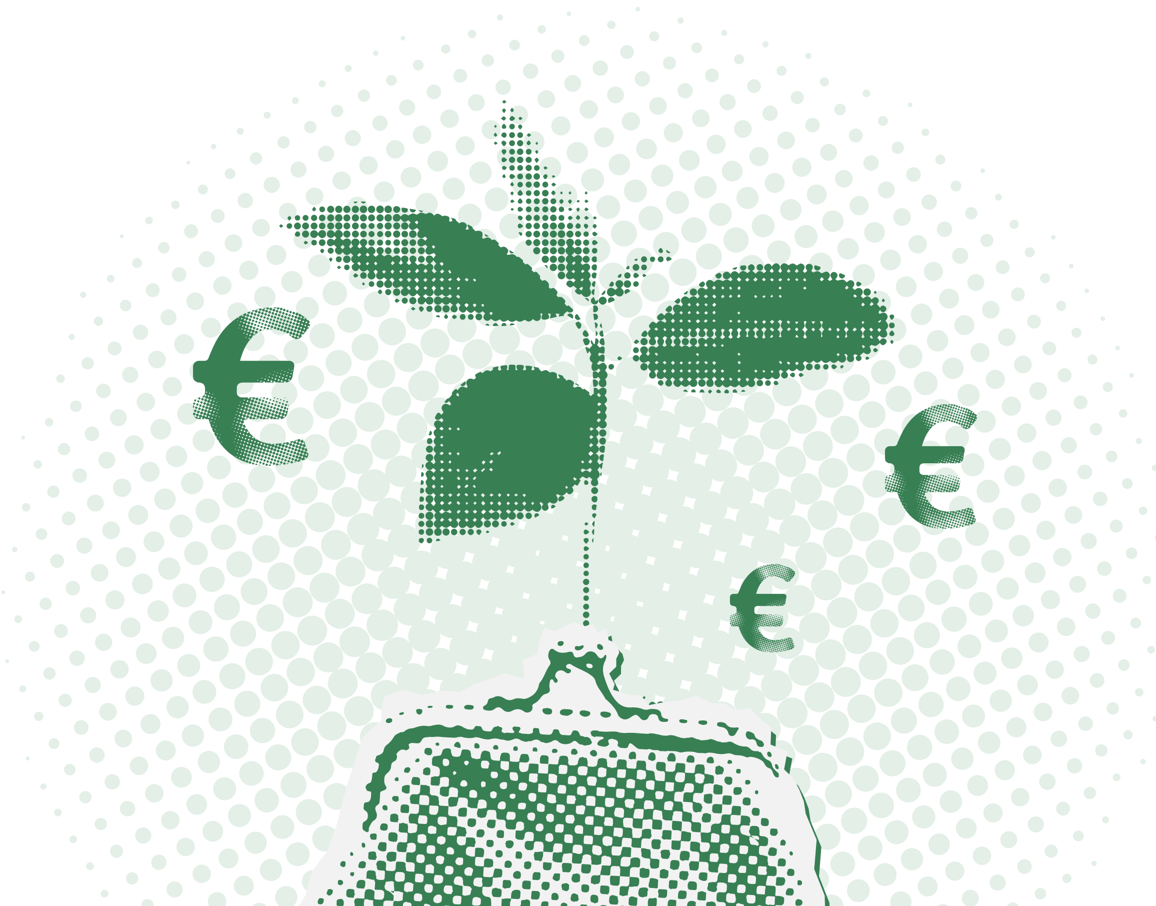
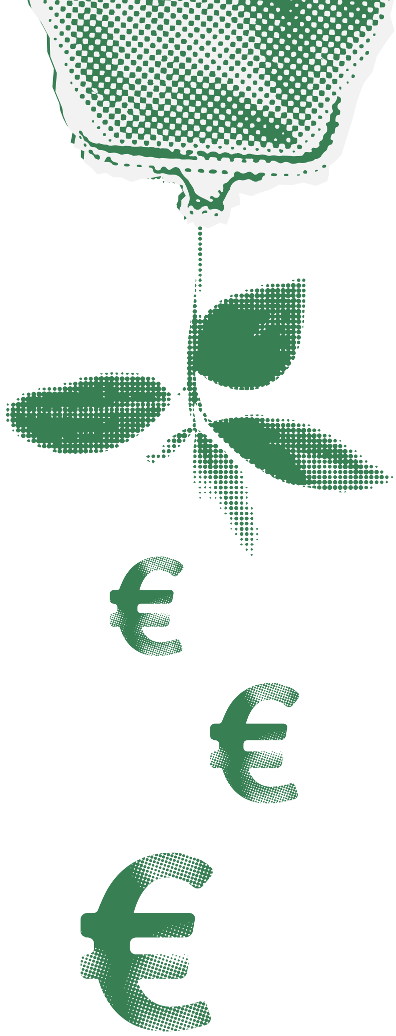
Plants for the Future
European Technology Platform

TRENDS IN EUROPEAN PUBLIC INVESTMENT IN PLANT BREEDING R&I

FROM FRAMEWORK PROGRAMME 7 TO HORIZON EUROPE (2007-2024)





Published in Brussels, by 'Plants for the Future' European Technology Platform

November 2024

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Edited by Plants for the Future ETP

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EXECUTIVE SUMMARY

Since the mid-1980s, the European Framework Programmes (FPs) have been the main funding tool for European Research and Innovation (R&I). The priorities of each FP reflect strategic goals, with the agrifood sector receiving significant attention due to its role in meeting growing global food demands, but also due to its economic, cultural and social impact. This report analyses funding trends, project outcomes, and factors influencing R&I in plant breeding from FP7 through Horizon 2020 and the first half of Horizon Europe, providing a comprehensive overview of the impact of these initiatives.

FUNDING ALLOCATION TO PLANT BREEDING DECREASED DESPITE INCREASED CHALLENGES AND OVERALL BUDGETS

Despite an overall **increase in the budgets of the FPs of 42%** in the last 20 years (from FP7 to Horizon Europe), **funding for R&I in plant breeding** has grown only modestly and **is expected to increase by 9%** by the end of Horizon Europe, should the trends from the first half persist. This is despite the total funding of Agrifood subprogramme, the main subprogramme funding R&I in plant breeding, having increased by 277% during the same time. **R&I in plant breeding has therefore experienced a decrease in the proportion of total FP funds allocation** over the past 20 years, with the most substantial drop observed already in Horizon 2020.

FUNDING FOR R&I IN PLANT BREEDING DECLINING IN ERC AND MSCA SUBPROGRAMMES

In addition to the 'topic-oriented' **Agrifood subprogramme**, the 'non-oriented, bottom-up' **European Research Council (ERC)** and **Marie Skłodowska-Curie Actions (MSCA) subprogrammes**, together account for **94% of the funding dedicated to R&I in plant breeding**. Since FP7, the ERC subprogramme has seen an increase of 63%, while the MSCA subprogramme has only seen an increase of 13%. Despite this, both subprogrammes are experiencing **a decrease in funding for R&I in plant breeding, with expected reductions of 8% for ERC and 63% for MSCA compared to FP7**, if the current trends from the first half of Horizon Europe persist.

While the purpose of this study was not to identify the reasons for these decreases, **it would be wise to investigate this further, to identify the root causes and ensure they are addressed before they impact the R&I cycle.** For example, in the case of the MSCA subprogramme, which is a non-oriented training programme, this decrease should be of special concern to all participants in the sector of plant breeding R&I, as it could be an indication of future limitations for securing a highly-skilled research workforce in the sector of plant breeding R&I.

BIGGER CONSORTIA WITH STAGNANT BUDGETS RESULT IN REDUCED FUNDING PER PARTNER

Plant breeding-related projects funded under the Agrifood subprogrammes were found to have increased in consortium size from an average of 17 partners per project in FP7, to 21 partners in Horizon Europe. Despite this increase in consortium size, the average budget per project has remained stable (between €5.5 and €5.9 million), as well as the average length of projects (4-5 years). This has therefore **resulted in a decrease in average funding allocated per partner, within in a consortium, and limits the possibility of longer term projects.** As plant variety development can take anywhere from 8 to 25+ years, depending on the species and the starting point, the limited project budgets do not allow longer projects that would enable the implementation of research outcomes within the lifetime of the project.

RESEARCH CALLS LIMIT THE USE OF PLANT BREEDING INNOVATION

Plant breeding innovation methods, such as New Genomic Techniques (NGTs) and Genetic Modification (GM), saw an increase in their uptake from being used in 24% of plant breeding-related projects in FP7, to 37% in Horizon 2020. Interestingly, NGTs seem to be replacing GM in plant breeding-related projects, but **a combination of regulatory uncertainty for NGT plants and restrictions in the research call texts since Horizon 2020, have resulted in a loss of momentum for plant breeding innovation**. According to the first half of Horizon Europe the use of plant breeding innovation, such and NGTs and GM, are back to FP7 levels, with the use of GM being almost completely absent.

PRIVATE SECTOR ENGAGEMENT SHOULD BE BOOSTED TO FACILITATE IMPLEMENTATION OF PROJECT RESULTS

Private sector partners have played an increasingly significant role in EU R&I in plant breeding, with their participation rising from 29% of partners in FP7, to 35% in the first half of Horizon Europe. Private sector partners often provide their in-kind contributions in addition to their valuable expertise, yet in multi-partner projects (i.e., Agrifood subprogramme) they tend to receive a smaller share of funding than public sector partners. **Across the entire Horizon 2020 FP, the private sector accounted for 28% of participants.** However, **for plant breeding R&I, private partners only accounted for 20% of project partners**, suggesting that there is still room for improvement to ensure the private sector is involved in EU level R&I in plant breeding.

LOOKING AHEAD

Plant breeding alone accounted for 67% of agricultural productivity gains in the last 20 years [1]. Plant breeding has the potential to address a wide range of challenges across the agrifood value chain – such as contributing to more sustainable agrifood systems, ensuring food and nutritional security, reducing food loss and waste, and supporting a circular bioeconomy – as well as a number of environmental issues – such as increasing and protecting biodiversity, adaptation to and mitigating of climate change, ensuring clean and sufficient water, promoting healthy soils, providing renewable energy, and many more. However, for plant breeding to fully contribute to all this and more, increased investments in R&I will be essential. **The EU urgently needs to develop a dedicated mechanism to support R&I in plant breeding in a strategic and coordinated way across the entire EU, while ensuring the implementation of research outcomes by promoting partnerships and collaborations between the public and private sectors.**

Plants for the Future welcomes the latest Strategic Plan for Horizon Europe, which identified plant breeding as a key strategic research area **[2]**, as well as the focus on plant breeding innovation in the Strategic Dialogue on the Future of Agriculture **[3]**. The recent report on the future of European competitiveness underscores the necessity of a proactive and open approach to innovation, and more strategic investment in R&I **[4]**, particularly focusing on addressing the innovation gap.

In order for the EU plant breeding R&I sector to support the EU Green Deal goals for more competitive, resilient and sustainable agrifood systems, the **following recommendations** should be implemented for the second half of Horizon Europe and for FP10:

Increase funding allocation for R&I in plant breeding, covering all TRLs, by implementing a dedicated, strategic EU-wide coordinated mechanism to support R&I in plant breeding, ensuring close collaboration between the public and private sectors, to ensure maximum impact

Promote more opportunities for R&I in plant breeding in Pillar 3 subprogrammes Innovative Europe and Widening participation and spreading excellence

Promote, or at least do not restrict, the use of plant breeding innovation in plant breeding-relevant calls, so that Europe does not fall behind its global competitors

Increase funding for the MSCA subprogramme to ensure training for the next generation of highly skilled and competitive researchers in plant breeding R&I

Provide adequate funding to research calls to enable longer-term plant breeding-related projects, thereby ensuring research outcomes can be fully exploited within the lifetime of the project, or through dedicated research calls aimed at the continuation of successful projects

Attract more participation of the private sector in plant breeding-related projects by reducing administrative burden and ensuring sufficient funding

[1] Noleppa, S., & Cartsburg, M. (2021). The socio-economic and environmental value of plant breeding in the EU and selected EU Member States. HFFA Research.

[2] European Commission (2024). Horizon Europe Strategic Plan 2025-2027.

[3] Report on the Strategic Dialogue on the Future of EU Agriculture (2024).

[4] EU Commission (2024). The future of European competitiveness - A competitiveness strategy for Europe.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

GLOSSARY

Biologicals	Refer to biologically derived products or biobased solutions used to manage plant pests and diseases (biopesticides, microorganisms, ...).
Feeding trials	Involve assessing the effectiveness of newly bred crops by evaluating their impact on livestock. These trials measure various factors such as feed conversion rate, digestibility, and overall nutritional value to determine the success and suitability of the crop as animal feed.
New Genomique Techniques (NGTs)	Include new plant breeding methods, or precision breeding methods, that were developed after 2001 (e.g., TALENs, CRISPR, ZFNs), and are regulated differently from conventional breeding methods.
Plant breeding	Includes the spectrum of activities from fundamental research of biological processes, experimental and applied research, to the development of new varieties.
(Plant breeding) lines	Distinct populations of plants that have been selectively bred and maintained through multiple generations and exhibit consistent characteristics. These lines are used in breeding programmes to develop new cultivars or improve existing ones by combining desirable characteristics.
Plant cultivar	Cultivated variety, plant variety produced through cultivation.
Plant variety	Plants selected from within a species with a common set of characteristics.

INTRODUCTION

Since 1984, the European Framework Programmes (FPs) have served as the primary EU funding instruments for Research and since 2014 (FP8, i.e., Horizon 2020) for Research and Innovation (R&I). Initially referred to simply as the Framework Programmes with sequential numbering, the eighth edition was rebranded as Horizon 2020, and the ninth as Horizon Europe. The priorities of each FP are determined through a set of strategic plans, which have evolved over time to reflect changing needs and policy goals. Notably, the budget for these programmes has grown significantly over the years, driven in part by the EU's target of investing 3% of its gross domestic product in research and development **[5]**.

The Agrifood subprogramme - currently Cluster 6: Food, Bioeconomy, Natural Resources, Agriculture and Environment in Horizon Europe - is one of the key areas supported by the FPs, making up 4% of the total FP7 budget, 5% of the total Horizon 2020 budget and 10% of the total Horizon Europe budget. At the heart of our agrifood systems lies plant breeding, driving food and nutritional security, and supporting socio-economic and environmental sustainability.

Over the past two decades, plant breeding alone has contributed to almost 67% of EU agricultural productivity gains. Without these advancements, the EU would have become a net importer of key crops such as wheat **[6]**. Since European agriculture increasingly produces more per hectare, it is contributing to global food security and therefore ensuring the availability of food for millions worldwide. However, the effects of climate change, such as weather volatility, droughts and mounting pest pressure, are threatening this. Plant breeding remains an essential tool for adaptation to and mitigation of climate change, while supporting the transition to more sustainable and resilient agrifood systems within the EU and beyond.

On its website dedicated to genetic resources and breeding, the European Commission (EC) emphasises that breeding aims to "create varieties that meet the variety of demands related to quality, resilience, and sustainability" **[7]**. This focus on breeding is essential, particularly in light of the steady increase in food consumption and the projected growth of the global population.

These trends underscore the need for efficient and well-supported agricultural research, with plant breeding recognised as a pivotal component, as highlighted by the Joint Research Centre's report on plant breeding **[8]**. Similarly, the report from the Strategic Dialogue on the Future of Agriculture underscores the importance of fostering innovation in plant breeding to minimise reliance on external inputs, improve resilience and yield, and support future food security **[9]**. Additionally, the recent report on European competitiveness calls for a proactive and open approach to innovation, and more strategic investment in R&I, particularly focusing on addressing the innovation gap **[10]**. This recognition is further reflected in the strategic plan for the second half of Horizon Europe, which identifies plant breeding as a key strategic area of research, requiring more focus in the domain of agriculture **[11]**. All of these factors make this report timely.

There are currently no studies available that investigate the extent, result and funding dedicated to projects specifically focused on research and innovation (R&I) in plant breeding. While the Directorate-General for Agriculture and Rural Development (soon to be the

[5] European Commission (2024). Report from the Commission to the European Parliament and the Council: Ex post evaluation of Horizon 2020, the EU framework programme for research and innovation.

[6] Noleppa, S., & Cartsburg, M. (2021). The socio-economic and environmental value of plant breeding in the EU and selected EU Member States. HFFA Research.

[7] European Commission (2024). Genetic Resources and Breeding Website.

[8] Van Elsen, A., Ayerdi Gotor, A., Di Vicente, C., Traon, D., Gennatas, J., et al. (2013). Plant breeding for an EU bio-based economy: The potential of public sector and public/private partnerships. [Research Report] Auto-saisine.

[9] Report on the Strategic Dialogue on the Future of EU Agriculture 2024.

[10] European Commission (2024). The future of European competitiveness Part A | A competitiveness strategy for Europe.

[11] European Commission (2024). Horizon Europe strategic plan 2025-2027. Publications Office of the European Union.

Directorate-General for Agriculture and Food) recently released a factsheet on Genetic Resources and Breeding, as part of their AgriResearch series [12], this informative sheet offers only a limited overview. The methodology and purpose of this factsheet was not intended to provide a comprehensive overview of how funding for R&I in plant breeding has developed over the years within the FPs.

This report adopts a detailed and outcome-oriented approach, focusing on R&I in plant breeding, which covers everything from fundamental research of biological processes, experimental and applied research, to the development of new plant varieties. The primary objectives are to identify trends in EU funding for R&I in plant breeding from FP7 to the first half of Horizon Europe (June 2024). It investigates three main areas, as outlined below.

Funding trends for R&I in plant breeding, including developments related to funding within relevant subprogrammes under which most plant breeding-related projects were funded.

Project profile trends, focusing on changes in target Technology Readiness Levels (TRLs), project budgets, duration and consortia size. Additionally, the impact of **collaboration between public and private sector partners** on project goals and outcomes, is also assessed.

Plant breeding innovation trends, determining the level of promotion and use of different breeding methods - from conventional to New Genomic Techniques (NGTs) and Genetic Modification (GM) – in the different plant breeding-related projects.

[12] DG AGRI (2023). Agriresearch Factsheet. Genetic Resources and Breeding.

METHOD

Initially, all relevant funding mechanisms were identified in FP7, Horizon 2020, and the first half of Horizon Europe (until June 2024), as well as other mechanisms such as ERA CAPS, SUSCROP, CORE-Organic Cofund, Eurostars and many others. The complete list of mechanisms investigated for potential plant breeding-related projects can be found in Annex 1.

The initial information on projects within the FPs was gathered from CORDIS and supplemented with data from available project websites, published studies and reports. Information on other mechanisms was collected from sources such as the ERA LEARN website, the FACCE JPI project wheel, and the databases of the respective funding mechanisms.

Projects were excluded from the selection if they met any of the following criteria:

- Limited to national funding;
- Focused exclusively on model plant species;*
- Limited to genetic resources, algae, or forestry.

In the first step, a search was conducted across all funding mechanism databases using a set of predefined keywords (Annex 2). If a fitting project was identified, its project call or subtopic was further investigated to identify other projects under the same call that could potentially fund R&I in plant breeding. Data was then extracted manually or, in the case of projects found through CORDIS, by using a data scrapping script.

Transparent information was unavailable for projects not found on CORDIS, but located on various other websites, particularly regarding project duration, results, and funding allocated to individual partners.** Project coordinators of such projects were contacted for clarification; however, not all data was made available. Consequently, projects with incomplete information were analysed only partially and are briefly discussed in Annex 3.

The data was analysed using Excel and Python.

As of this study, only the first half of Horizon Europe was completed. The last plant breeding-related project included, signed its consortium agreement in June 2024 and starts in September 2025. Note that some funded projects from the first half of Horizon Europe might not have been publicly available at the time of data collection.

Based on the spending plan, 49.56% of the funds should have been allocated by June 2024 **[13]**. Therefore, where extrapolation of data for Horizon Europe was needed to compare to FP7 and Horizon 2020, it is assumed that the second half will follow a similar pattern. However, this is a simplified and likely imperfect representation of what Horizon Europe projects will look like in 2027 when Horizon Europe concludes. For this reason, the report explicitly notes whenever data has been extrapolated and, in most cases, results are presented as percentages relative to each of the FPs without extrapolation.

All the budgets in this report have been adjusted to 2020 prices to ensure comparability and accuracy, based on the annual inflation rate for the Euro area (see Annex 4 for more details). The choice of 2020 prices aligns with the EC's communication regarding Horizon Europe.

The definitions of the Technology Readiness Levels (TRLs) used in this report are derived from the General Annex of the Horizon 2020 Work Programme **[14]**. Details, definitions and depictions of the full TRL scale are provided in Annex 5.

* Even though research in model plant species is important in plant breeding, it does not necessarily provide agriculturally applicable outcomes, nor does it include concrete breeding activities. Examples include *Arabidopsis thaliana*, *Brachypodium distachyon*, *Medicago truncatula*, *Capsella bursa*, etc.

** This amounted to 35 projects with 185 unique participating partners.

[13] European Commission (2024). Horizon Europe Performance Website.

[14] European Commission (2014). Horizon 2020 – Work Programme 2014-2015 General Annexes. G - Technology readiness levels (TRL).

To compare differently named subprogrammes across the FPs, an equivalence list was created based on descriptions in the respective legislative documents **[15,16,17]**. Given the significant structural changes from FP7 to Horizon 2020, comparing the main themes (pillars, priorities) across the FPs directly would be inaccurate. Annex 1 illustrates the entire structure of all three FPs, with the relevant themes highlighted. The most important themes for funding of R&I in plant breeding are found in Table 1.

Table 1: *The most relevant subprogrammes for plant breeding-related projects and their naming throughout the Framework Programmes and their reference in this report.*

FP7		Horizon 2020		Horizon Europe		In this report
Food, Agriculture and Fisheries and Biotechnology was a part of programme Cooperation	=	Food security, sustainable agriculture and forestry, marine, maritime, inland water research and bioeconomy was a part of Priority 3 Societal Challenges	=	Food, Bioeconomy, Natural Resources, Agriculture and Environment was a part of Pillar 2 Industrial Competitiveness and Global Challenges	=	Agrifood
People Programme	=	Marie Skłodowska-Curie actions was a part of Priority 1 Excellent Science	=	Marie Skłodowska-Curie actions was a part of Pillar 1 Excellent Science	=	MSCA
Ideas Programme	=	European Research Council (ERC) was a part of Priority 1 Excellent Science	=	European Research Council (ERC) was a part of Pillar 1 Excellent Science	=	ERC

[15] European Parliament (2006). Decision No 1982/2006/EC of the European Parliament and of the Council of 18 December 2006 concerning the Seventh Framework Programme of the European Community for research, technological development and demonstration activities (2007-2013).

[16] European Parliament (2013). Regulation (EU) No 1291/2013 of the European Parliament and of the Council of 11 December 2013 establishing Horizon 2020 - the Framework Programme for Research and Innovation (2014-2020) and repealing Decision No 1982/2006/EC. Text with EEA relevance.

[17] European Parliament. (2021). Regulation (EU) 2021/695 of the European Parliament and of the Council of 28 April 2021 establishing Horizon Europe – the Framework Programme for Research and Innovation, laying down its rules for participation and dissemination, and repealing Regulations (EU) No 1290/2013 and (EU) No 1291/2013. Text with EEA relevance.

GLOBAL AND DIVERSE: LANDSCAPE OF PLANT BREEDING R&I

A total of 235 plant breeding-related projects with sufficient information available were identified (see Annex 6 for full list), involving 1,013 unique participants from 74 different countries. The majority of the funding dedicated to R&I in plant breeding (85%) was concentrated within the EU, although there was substantial collaboration with non-EU countries. Partnerships with Switzerland, China, Israel, and the United States were most frequent. However, the remaining 15% of projects primarily focused on Africa and Asia. In Figure 1, the "55 Other Countries" include the remaining EU countries, not explicitly depicted in the pie chart, and other non-EU countries.

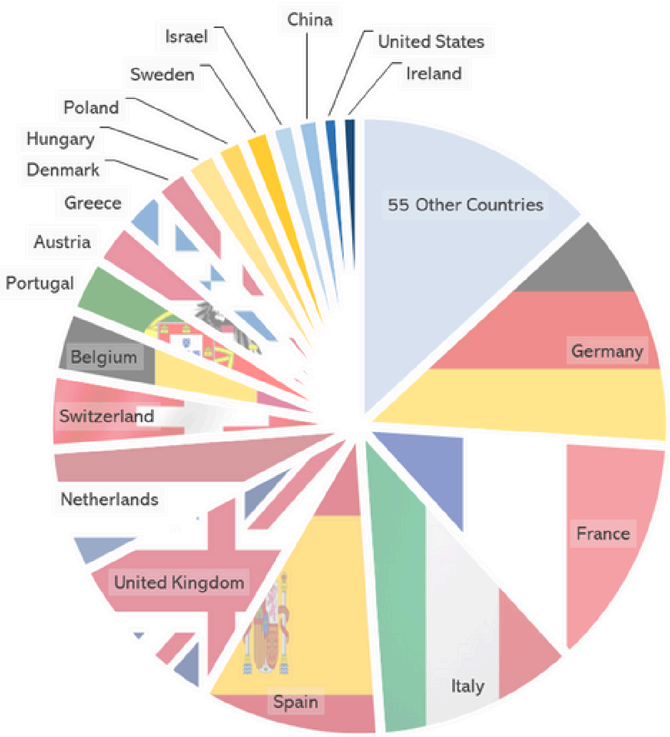


Figure 1: *Participating countries in plant breeding R&I from Framework Programme 7 to the first half of Horizon Europe.*

Participants from Germany are the most frequent beneficiaries of EU funding for R&I in plant breeding: participating in 13% of all plant breeding-related projects — equal to the combined involvement of "55 other countries". Participants from France (12%), Italy (11%), Spain (10%), and the United Kingdom (9%) follow closely (see full list in Annex 7).

The large majority of participants (70%) were involved in only one plant breeding-related project, while a small group of organisations were extremely active: 1% of the participants were involved in 15 or more plant breeding-related projects. INRAE, the French National Research Institute for Agriculture, Food and Environment, has been the most active and participated in a total of 72 plant breeding-related projects (receiving €45.4 million); followed by Wageningen University & Research, which participated in 52 such projects (receiving €28.2 million); and the Spanish National Research Council, which participated in 28 (receiving €23.8 million). Annex 8 outlines the top beneficiary institutions/organisations and their corresponding total funding. Only one private partner, the German plant breeding company KWS, is in the top 1%. KWS participated in 17 plant breeding-related projects since FP7, sharing 8th place with the University of Bologna, though it received significantly less funding (€3.6 million) compared to its public counterpart (€6.6 million). See Annex 8 for more information.

Projects ranged from fundamental research — such as exploring molecular mechanisms, regulating agronomically relevant characteristics, and identifying genes and markers for breeding purposes — to applied research — like developing improved plant varieties, going a step further down the supply chain and producing the first products from the newly bred varieties, either for livestock or human consumption.

FUNDING FOR FRAMEWORK PROGRAMMES INCREASE BY 42%, WHILE FUNDS FOR R&I IN PLANT BREEDING RISE ONLY BY 9%

Not all areas (called programmes in FP7, priorities in Horizon 2020 and pillars in Horizon Europe) increased in funding to the same extent, even though the overall FP budget has steadily increased. Horizon 2020 introduced significant changes to the FP structure, as it merged all support for innovation in one programme and saw the largest relative budget increase (30%, Table 2).

The European Research Council (ERC), Marie Skłodowska-Curie Actions (MSCA), and Agrifood subprogrammes were the most common sources of funding for R&I in plant breeding, accounting for 94% of all identified plant breeding-related projects, with a total of 47 ERC projects (~88 M€), 90 MSCA projects (~47 M€) and 84 Agrifood subprogramme projects (~475 M€). The remaining 6% were funded under the European Innovation Council, Widening participation and spreading excellence and Industrial Leadership subprogrammes (~51 M€). The latter gained importance in Horizon 2020 and continues to be relevant in Horizon Europe.

Horizon 2020 and Horizon Europe saw increases of total funding of 30% and 42%, respectively, compared to FP7 (Table 2). In comparison, funding for R&I in plant breeding increased 4% in Horizon 2020 and is expected to reach 9% by the end of Horizon Europe, if the current trend continues. To gain a better understanding of why a more substantial increase in funding for R&I in plant breeding is not being observed, we delved into the funding trends within the main subprogrammes funding this topic.

The 'non-oriented, bottom-up' subprogrammes that also support R&I in plant breeding, MSCA and ERC, fared differently from FP to FP. MSCA's total budget saw the smallest increase at 13% since FP7, potentially also due to programme restructuring (Table 2). MSCA, which was originally a separate subprogramme called People and is devoted to the training of early-career researchers, was incorporated under the Excellent Science priority in Horizon 2020. In contrast, ERC funding, which similarly transitioned from the separate Ideas subprogramme to a subtopic under Excellent Science, experienced a substantial 63% growth in the total budget over the same period.

However, the overall contribution of the Excellent Science subprogramme to R&I in plant breeding decreased.

Table 2: *Trends in framework programme funding subprogrammes and R&I in plant breeding. Numbers marked with * are projected based on the first half of Horizon Europe available data, assuming the second half will follow the same trend.*

Area	Trend from FP7 to Horizon 2020	Trend from FP7 to Horizon Europe
Total FP Budget	30%	42%
Total Breeding Funding	4%	9% *
ERC Budget	49%	63%
ERC Breeding Funding	4%	-8% *
MSCA Budget	11%	13%
MSCA Breeding Funding	-46%	-63% *
Agrifood Budget	70%	277%
Agrifood Breeding Funding	-7%	12% *

ERC projects related to R&I in plant breeding accounted for 4% more funds in Horizon 2020 compared to FP7, but the trend observed in the first half of Horizon Europe suggests a 12% decrease compared to Horizon 2020. More significantly, the MSCA subprogramme is witnessing the most pronounced decrease. MSCA awards related to R&I in plant breeding in Horizon 2020 accounted for 46% less funds than in FP7, and this downward trend continues in the first half of Horizon Europe.

Since the MSCA is a non-oriented training programme, this decrease should be of special concern to all participants in the sector of plant breeding R&I, both public institutions (universities and research institutes) and private companies, as it could be a harbinger of future limitations for securing a highly-skilled research workforce in the sector.

The most dramatic increase in funding was observed in the Agrifood subprogramme budget (Table 2). This is not entirely unexpected given the expansion of topics and overall budget in the later FPs, compared to FP7. The range of topics have become more extensive, which accounts for the substantial increase in overall funding since FP7. While we cannot expect funding for R&I in plant breeding to increase in the same proportion as the total Agrifood budget, it is noticeable that the increase in funding for R&I in plant breeding is quite minimal in light of these expansions. R&I in plant breeding experienced an initial 7% decrease in funding in Horizon 2020 compared to FP7, and a projected 19% funding increase in Horizon Europe compared with Horizon 2020. That would result in a 12% increase in funding for R&I in plant breeding over 20 years.

As of August 2024, when data for this report was collected, a total of €106 million funding for plant breeding-related projects had been granted within the Agrifood subprogramme.

Although this has not yet surpassed the nearly €178 million from Horizon 2020 or the €191 million from FP7, it is anticipated that, if the current trend continues, the total funding for R&I in plant breeding from this subprogramme could reach around €214 million by the end of Horizon Europe.

Even though the absolute amount of funding for R&I in plant breeding has been increasing, it is important to note that the proportion of total FP funding allocated to R&I in plant breeding has been decreasing since FP7 (Figure 2, right y axis). Indeed in FP7, 0.41% of total FP funds were allocated to R&I in plant breeding, while in Horizon 2020 and Horizon Europe, that proportion decreased to 0.33% and 0.31%, respectively. This decrease might seem insignificant, but if the proportion of FP funds allocated to R&I in plant breeding had been maintained, Horizon 2020 would have dedicated an additional €66 million to R&I in plant breeding, while Horizon Europe would have dedicated an additional €44 million until June 2024. If the current trend for Horizon Europe persists, that would amount to an additional €88 million that could have been dedicated to R&I in plant breeding by the end of 2027.

To understand the differences between subprogrammes and the projects they support, it is crucial to review the profiles of plant breeding-related projects, taking into account not just budgets, but also consortium characteristics and actual results. These aspects are examined in detail in the next section.

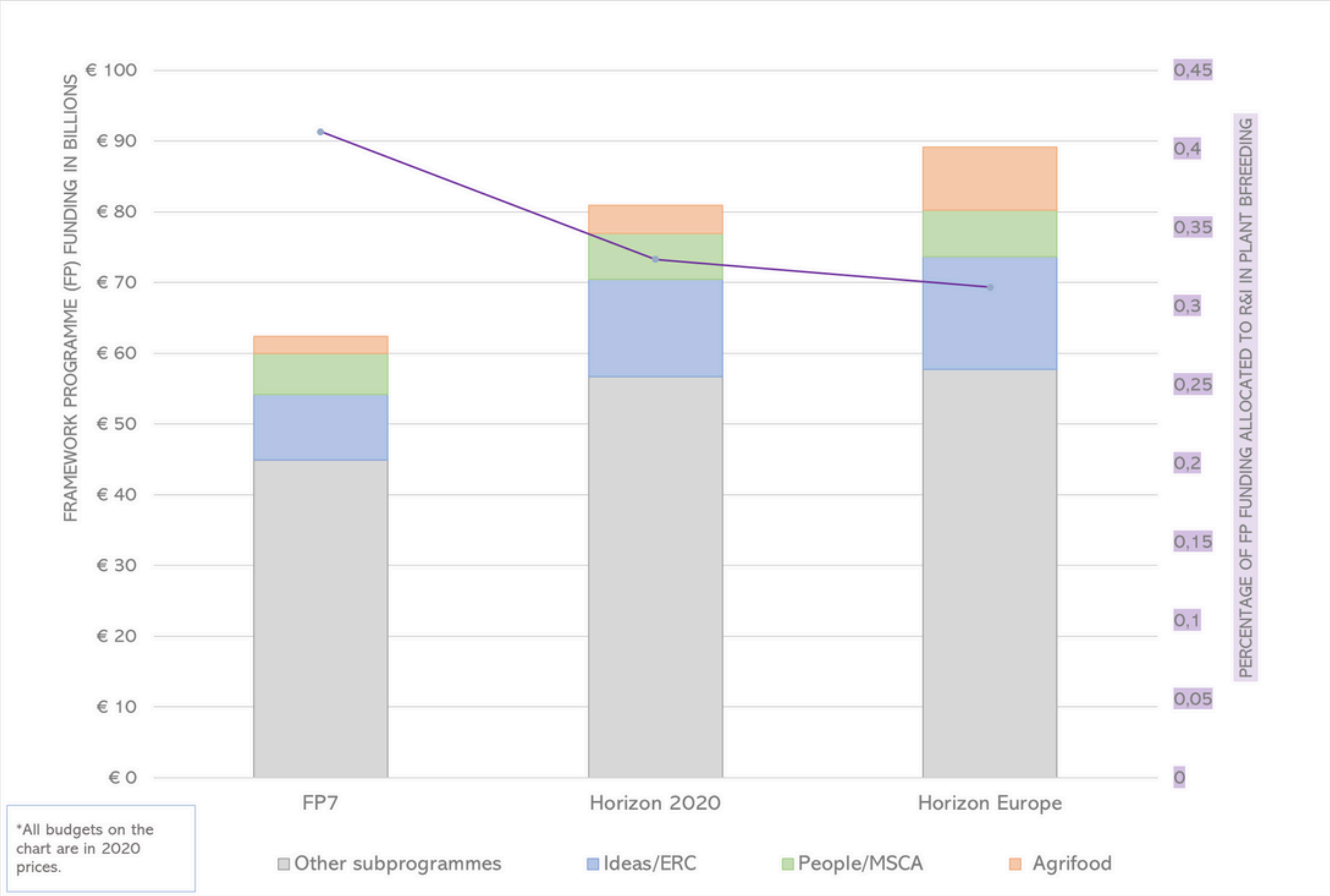


__Figure 2:__ Funding trends for Framework Programmes (FPs) from FP7 to Horizon Europe. Stacked bars represent the total funding amounts for entire FPs (y axis on the left), with plant breeding-related subprogrammes indicated in different colours. The purple line shows the trend of funding allocation to R&I in plant breeding, compared to the entire FP budget (y axis on the right).

LARGER PROJECT CONSORTIA, BUT BUDGETS STAGNATE

BUDGET

The average budgets for plant breeding-related projects across the three FPs, combining projects from ERC, MSCA and Agrifood subprogrammes, showed no significant statistical differences, although FP7 did have the highest average budget, at €3 million. As shown in Figure 3, the median budget in Horizon 2020 was the lowest of the three, suggesting that a small number of high-budget plant breeding-related projects skewed the overall distribution. Of the seven such projects with budgets exceeding €8 million across all FPs, five were funded under Horizon 2020. This is likely due to larger projects typically being funded towards the end of the FPs, so a similar trend might be anticipated by 2027.

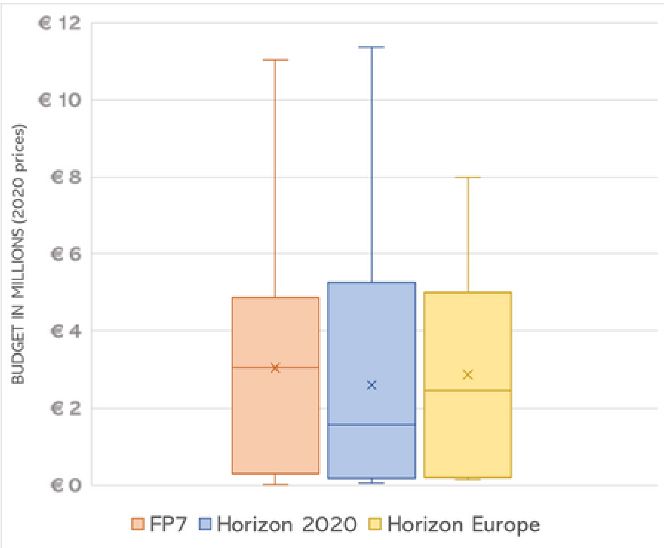


__Figure 3:__ Distribution of budgets for plant breeding-related projects in the three FPs.

Instead of focusing on the overall FPs, Figure 4 examines the key subprogrammes that fund plant breeding-related projects.

The Agrifood subprogramme had the smallest variation in average budgets, ranging from €5.5 to €5.9 million in the three FPs. Thirty-five plant breeding-related projects were funded in FP7, five more than in Horizon 2020. The first half of Horizon Europe funded 19 plant breeding-related projects. This indicates that the average funding per project has remained stable over FPs, but also reflects that this subprogramme does not fund more ambitious and costly projects that could result in higher impacts for the plant breeding sector. In contrast, a few projects funded under other subprogrammes had notably different average budgets. For example, Horizon 2020 funded five plant breeding-related projects under the Industrial Leadership priority, with an average budget of €7.5 million.

With respect to the ERC, the number of funded plant breeding-related projects has increased, from 13 in FP7, to 21 such projects in Horizon 2020 and 13 in the first half of Horizon Europe. However, it is important to note that ERC projects can be of different types: large, single researcher projects (Starting Grants, Consolidator Grants, and Advance Grants, of up to €1.5, €2 and €2.5 million, respectively); smaller projects for proof-of-concept and technology transfer (up to

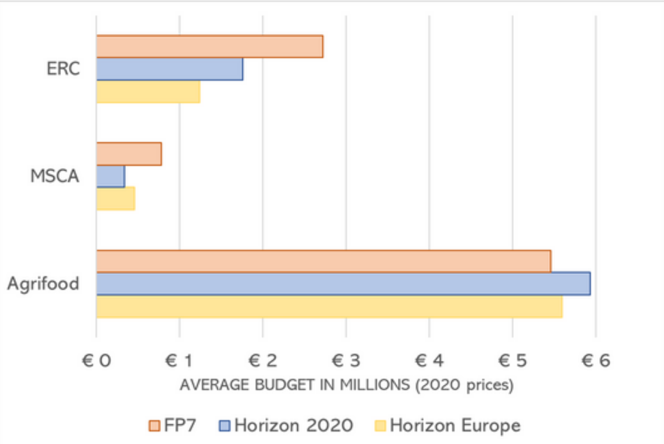


***Figure 4:** Average funding per plant breeding-related project in relevant subprogrammes.*

€150,000); and large projects for a small consortium of researchers (Synergy Grants, up to €10 million). Due to this large diversity, the overall average budgets may not be indicative of trends.

The MSCA subprogramme is the EU instrument devoted to doctoral education and postdoctoral training and, as such, it provides support for R&I plant breeding through the training of researchers in this area. It is articulated through different actions (individual Postdoctoral Fellowships, Doctoral Networks, and also COFUND doctoral and postdoctoral programmes) and, as the ERC, it is 'non-oriented and bottom-up'. In the MSCA subprogramme, the budget of the funded actions or projects correlates with the number of doctoral or postdoctoral researchers that are being trained. It is therefore noteworthy that the overall funding for plant breeding-related projects through MSCA has significantly declined from FP7 to H2020 and HE. In particular, from €27.3 million in FP7 (35 projects, with an average project budget of €780,000, including Doctoral Networks, such as EPITRAITS and CROPLIFE) to €14.5 million in Horizon 2020 (44 projects, €330,000 average) and a projected €17.5 million in Horizon Europe (19 projects, €460,000 average until June 2024). As indicated above, this decrease in the training of highly skilled researchers in the field of plant breeding R&I should be of special concern to the entire sector.

Due to the specificities of the ERC and MSCA subprogrammes, the following sections will mostly focus on the plant breeding-related projects funded under the Agrifood subprogramme.

For an entire overview of average budgets and counts of plant breeding-related projects under each subprogramme, please consult Annex 8.

CONSORTIA

Consortium sizes vary based on the type of calls and expertise needed to deliver the desired goals.

In the Agrifood subprogramme plant breeding-related projects are experiencing a trend towards larger consortia, averaging 17 partners per project in FP7, 22 in Horizon 2020, and 21 in Horizon Europe (Figure 5).

There were also a few large consortia in the Industrial Leadership subprogrammes: Newcotiana and CAPITALISE (21 partners each), CHIC (18 partners) and GAIN4CROPS (15 partners) in Horizon 2020.

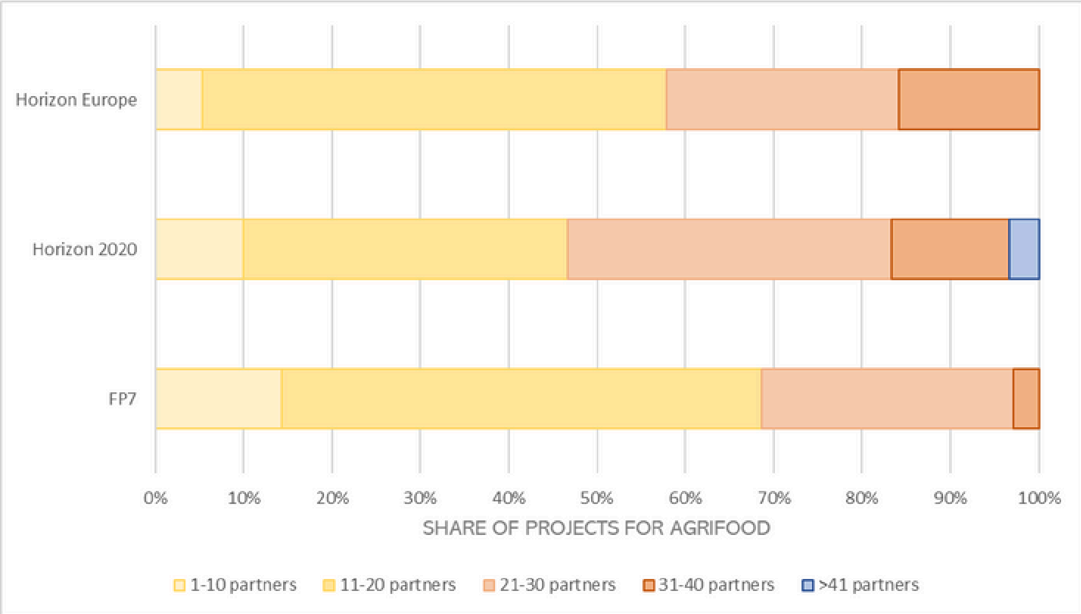


Figure 5: *Consortia sizes for plant breeding-related projects in the Agrifood subprogramme across Framework Programmes.*

DURATION

Although budgets and consortia sizes varied between subprogrammes, the duration of plant breeding-related projects remained relatively stable.

In theory, the Agrifood subprogramme, which allows the proposing consortium to determine project duration, might show greater variation. However, this was not observed, as clear from Figure 6. Most Agrifood-funded plant breeding-related projects were typically 4-5 years long, with an average duration of 4.2 years across all three FPs. Given that the average funding per project remained stable while the size of consortia increased (from 17 in FP7 to 21 in Horizon Europe), the amount of funding available per partner decreased. As a result, it seems unlikely that the available resources could support longer projects.

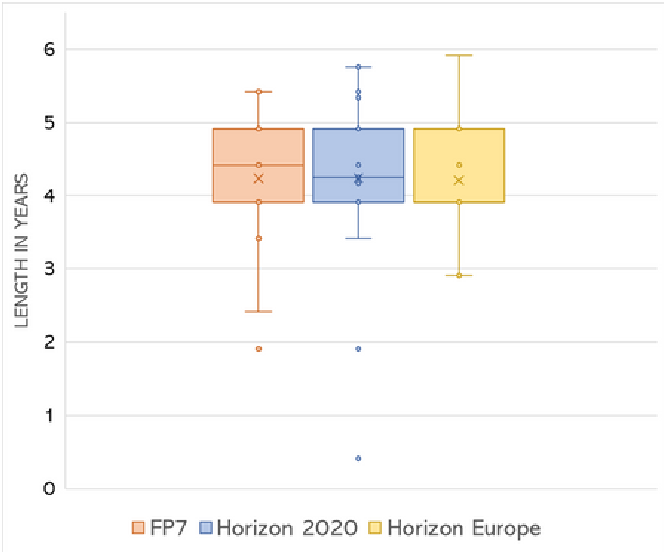


Figure 6: *Duration of plant breeding-related projects in the Agrifood subprogramme across Framework Programmes.*

Duration, consortium size and budget all influence potential project outcomes. One way to assess these outcomes is through Technology Readiness Level (TRL) targets, covered in the following section.

FROM PROJECTS TO MARKET: OUTCOMES AND READINESS

Most often different parts of a plant breeding-related project reach different Technology Readiness Levels (TRLs). For example, projects might cover multiple crop species and include work packages addressing diverse aspects, such as biosafety and awareness-raising, in addition to R&I in plant breeding. Plant breeding-related activities might be part of one or two work packages, while other parts may for example focus on creating training materials for farmers to use the improved seeds. To ensure consistency and comparability, this report concentrates solely on plant breeding-related outcomes and records the highest TRLs described for these activities.

The different funding subprogrammes that support R&I in plant breeding differ substantially in their corresponding TRLs.

The vast majority of MSCA and ERC projects correspond to TRLs 1-4, with the TRL target depending on the type of grants received. Therefore, we will focus on the Agrifood subprogramme, with 70% plant breeding-related projects targeting TRL 5 or above (Figure 7).

The distribution of TRLs among the plant breeding-related projects under the Agrifood subprogramme was relatively similar for FP7 and Horizon 2020, with Horizon 2020 being notable for hosting the first two plant breeding-related projects to achieve TRL 9, and no such projects targeting TRL 1 (Figure 7). The two TRL9 projects successfully produced end-products from the bred plant species and tested these products with the intended consumers. So far, data from the Agrifood subprogramme in Horizon Europe suggests a distribution similar to that of FP7, but with an increase of plant breeding-related projects targeting TRLs 5-6.

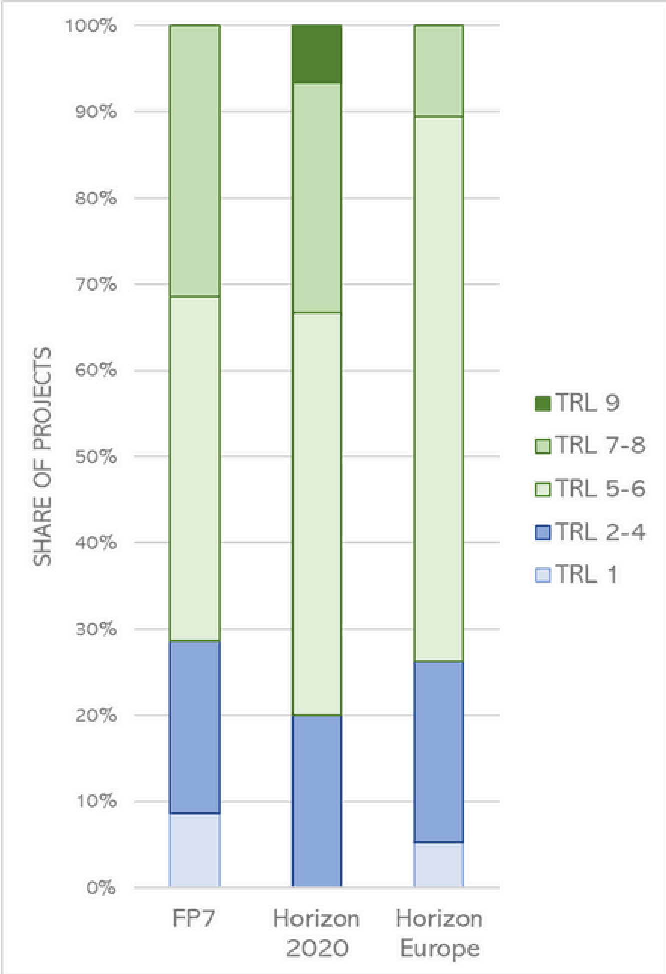


***Figure 7:** Proposed TRLs in plant breeding-related projects in the Agrifood subprogramme across Framework Programmes.*

Additionally, a few plant breeding-related projects funded under the Industrial Leadership, in the subtopic Biotechnology, in Horizon 2020 reached TRLs between 4 and 8, notably with half of their consortia consisting of private partners.

Within the low TRL ranges (1-4), there is a lot of variation in terms of project outcomes: many focus on improving plant breeding methodology. This includes activities such as genotyping and phenotyping as initial steps, GWAS studies and the development of tools tailored to improve specific characteristics, or regulatory networks in the chosen species.

Low TRL (1-4) plant breeding-related projects also focused on the first stages of developing new varieties, typically testing them on a smaller scale in laboratory settings.

[Figure 8](#) displays the average budgets for plant breeding-related projects from all subprogrammes targeting specific TRLs, with bubble sizes representing the number of relevant projects, which are also noted beside the bubbles.

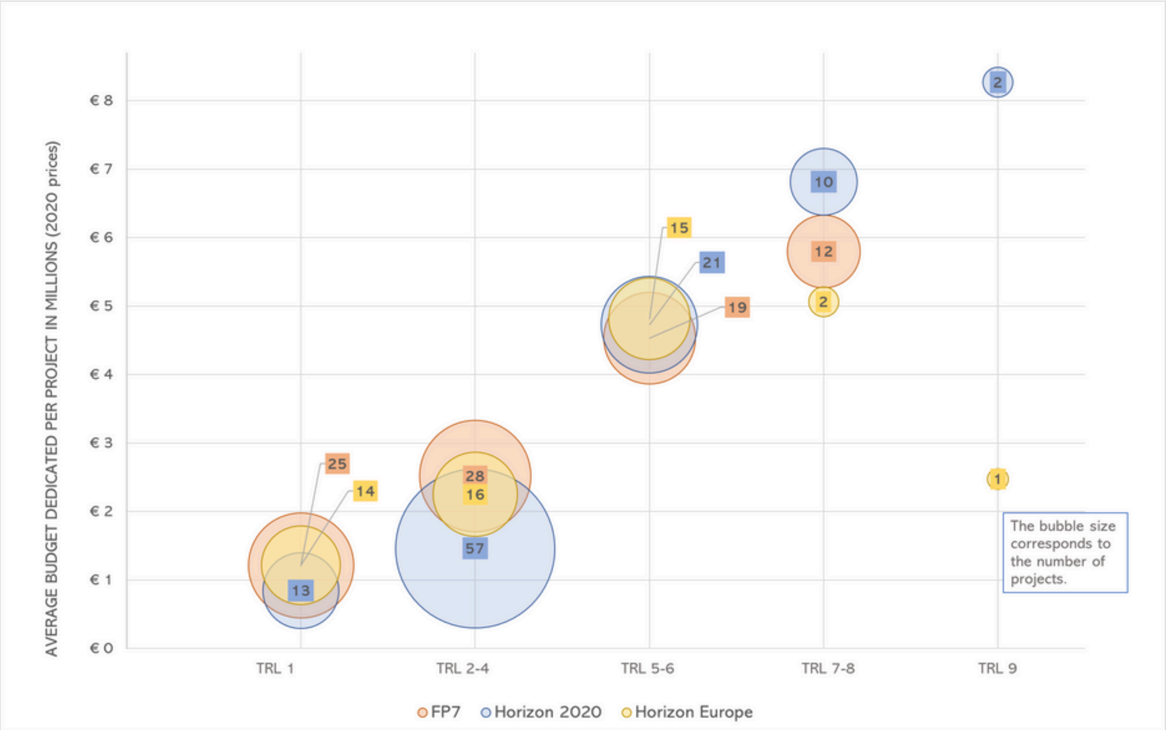


***Figure 8:** Average budget allocated to plant breeding-related projects at different Technology Readiness Levels (TRLs).*

On average, plant breeding-related projects targeting higher TRLs — especially those in the TRL 5-6 range — showed very similar budget allocations across the different FPs. Plant breeding-related projects focusing on fundamental and experimental research (TRL 1 and TRL 2-4, respectively) during Horizon 2020, received lower budgets than similar projects in the other two FPs. In addition, a clear correlation between project budget size and target TRLs could be observed, suggesting that reaching higher targeted TRLs requires a bigger financial investment, compared to reaching a lower TRL.

It is important to recognise that comprehensive data on outcomes, particularly for Horizon Europe, remains limited. Moreover, the descriptions of some projects lack detail, which means these TRL estimations could change as more information becomes available in the coming years.

Since many projects are still ongoing and data available online is likely not updated regularly, this TRL distribution should therefore be regarded as provisional.

Additional details on TRL distributions can be found in Annex 5.

Achieving high TRLs often requires a wide range of expertise that goes beyond the public R&I sector. The next section of this report will examine the key factors influencing the ability of plant breeding-related projects to reach high TRLs and the role of the private sector in these projects.

PRIVATE SECTOR FACILITATES THE IMPLEMENTATION OF PROJECT OUTCOMES

Consortia of plant breeding-related projects are diverse, especially when involving the private sector. Less typical partners include companies from manufacturing industries such as wine and tobacco, mills, breweries, fibre producers, and even tyre and rubber manufacturers. The seed and plant breeding sector, including biotechnology firms, constitute 33% of the private partners involved in plant breeding-related projects (Figure 9). The private research sector follows with 16%, while consultancies and agricultural firms each represent 12%. For further details see Annex 9.

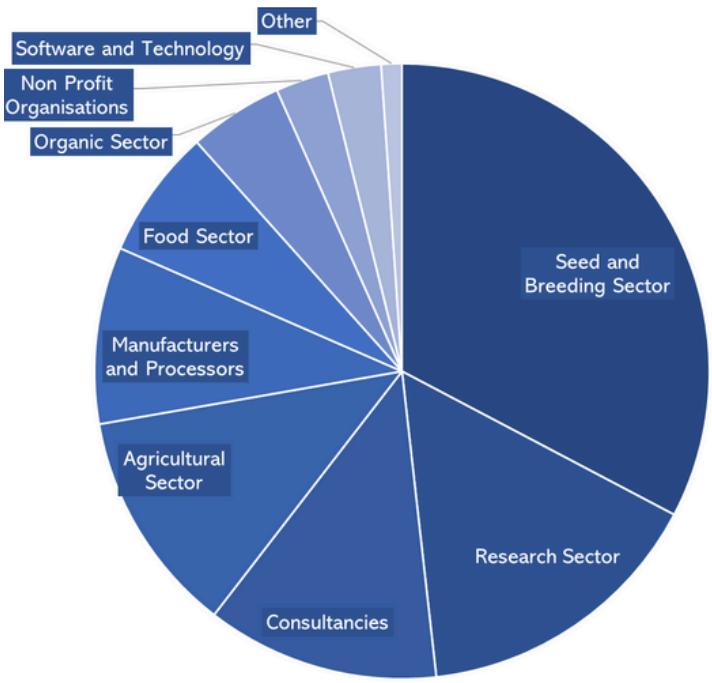


Figure 9: *Categorisation of private sector participation in plant breeding-related projects across Framework Programmes.*

The involvement of private partners in plant breeding-related projects has gradually increased from 41 projects that involved at least one private partner in FP7, to 46 such projects in Horizon 2020 and to 26 projects in the first half of Horizon Europe.

In FP7, private sector partners made up 29% of all participants in plant breeding-related projects, rising to 32% in Horizon 2020, and reaching 35% in Horizon Europe. However, this increase in participation did not reflect a proportional rise in funding for the private sector partners, as illustrated in Table 3. Although the share of funding for private partners has risen, it still lags behind the participation rate. The private sector received 17% of the allocated budget for R&I in plant breeding in FP7, 20% in Horizon 2020, and 22% in Horizon Europe.

		FP7	Horizon 2020	Horizon Europe
Involvement in R&I in plant breeding	Private Partners	29%	32%	35%
	Public Partners	71%	68%	65%
Funding dedicated to plant breeding-related projects	Private Partners	17%	20%	22%
	Public Partners	83%	80%	78%

Table 3: *Involvement and funding of private and public partners in R&I in plant breeding across Framework Programmes.*

Between FP7 and the first half of Horizon Europe, private partners typically received an average of €197,500, whereas public partners received nearly double this amount, averaging €381,600.

Given that private partners often provide in-kind contributions and possess valuable insights into market needs and developments, the report further investigates their impact on project outcomes, particularly in terms of TRLs.

The findings reveal that plant breeding-related projects with at least one private partner tend to target higher TRLs, averaging TRLs 4-5, compared to TRLs 2-3 for such projects without private sector involvement, as illustrated in Figure 10.

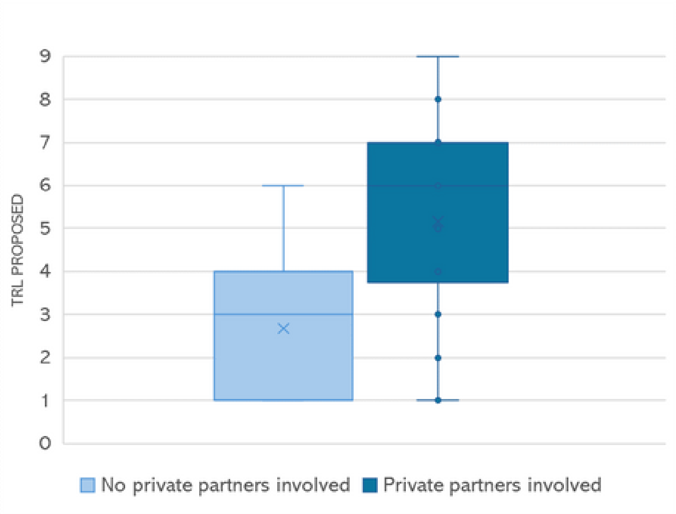


Figure 10: *Distribution of TRLs proposed in plant breeding-related projects across Framework Programmes.*

Private partners were involved across the entire TRL spectrum, from fundamental research (TRL 1) to market-ready outcomes (TRL 9) (Table 4). In plant breeding-related projects targeting TRL 1 and involving private partners, the consortia consisted of 4% private partners on average. However, the proportion of private partners increased significantly in projects targeting higher TRLs, as shown in Table 4. For TRLs 7 and above, private partner involvement averaged 35-42% of the consortium.

TRL proposed	Average share of private partners in consortium
TRL 1	4%
TRL 2-4	16%
TRL 5-6	29%
TRL 7-8	35%
TRL 9	42%

Table 4: *Average participation of private partners in consortia targeting specific TRLs in plant breeding-related projects across Framework Programmes.*

When modelling the effects of budget, consortium size, and percentage of private partners, the latter exhibits the strongest correlation with high TRLs. Surprisingly, budget size has only a subtle effect on TRLs, though it remains statistically significant. In Annex 5 scatter plots of the correlations are available.

Thus, while multiple factors contribute to targeting high TRLs, private sector involvement emerged as a key factor that enables projects to achieve market-oriented outcomes. However, it is important to acknowledge that it is not possible to determine whether the involvement of private partners directly results in higher TRLs or if the higher target TRLs attracts more private sector involvement.

In Horizon 2020, nine plant breeding-related projects were identified that involved only private partners and targeted TRLs between 2 and 5. Eight of these projects had a single private partner, while one had two. Most of these projects were relatively small, with funding ranging from €50,000 to €180,000, except for one larger project funded at approximately €2.6 million. These projects were funded under Agrifood (2 projects), MSCA (4 projects) and Industrial Leadership (3 projects under Innovation in SMEs) subprogrammes.

EXPANDING CROP DIVERSITY

In addition to different TRLs, plant breeding-related projects adopt varied approaches and methods and focus on a range of plant species. The shifting focus within projects reflects the evolving priorities emphasised in each FP, including changes in the emphasis on specific groups of plant species.

Plant breeding-related projects frequently involve multiple plant species, with results developed to varying extents for each species. Over the funding periods, the FPs have increasingly aimed for more diverse representation of plant species, as clearly illustrated in Figure 11.

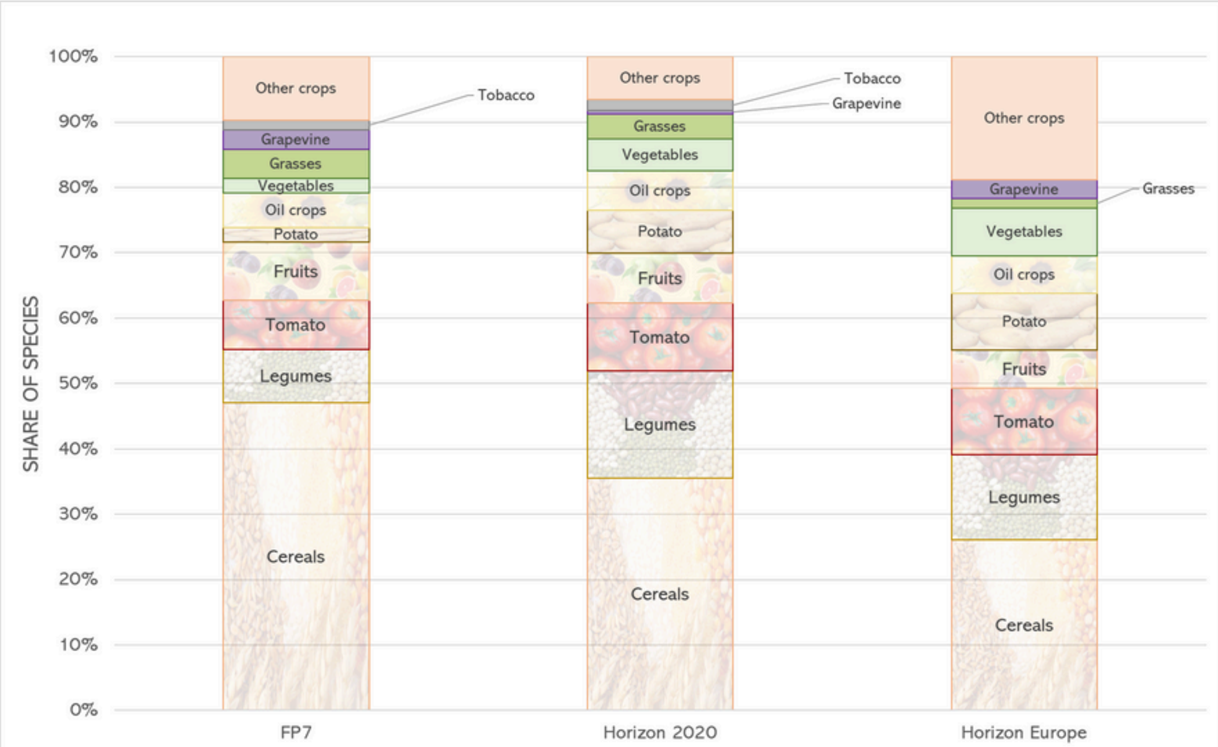


Figure 11: *Plant species investigated in plant breeding-related projects. Percentage share refers to species and not projects, since multiple species can be investigated in the same project.*

Specifically, the proportion of R&I dedicated to cereals decreased by 10% in each subsequent FP, dropping from nearly 50% of all plant species investigated in FP7. Cereals included wheat, barley, maize and rice, which accounted for 85% of cereals investigated.

The importance of breeding high-protein plant species has been emphasised in the past years as the so-called “protein gap” and the desire for a true “protein transition” persists — as a result, the focus on high-protein plant species has increased. Legumes, as an important source of proteins for food and feed, made up only around 7% of all species investigated in FP7. An increase to almost 17% of all species was marked in Horizon 2020.

Research on tomatoes, fruits and oil crops has remained relatively consistent across the FPs. The “Other crops” category includes species such as dandelion, coffee, hemp, chicory, pepper, teff, and ornamentals. The complete list of crops can be found in Annex 10.

The proportion of plant breeding-related projects focused on specific plant species did not directly translate to the proportion of funding they received. Between 2007 and 2024, cereals were the most commonly investigated species (38%) and also received the largest share of funding (29%). Smaller discrepancies of a few percentage points are evident among the other species, as illustrated in Figures 12 and 13.

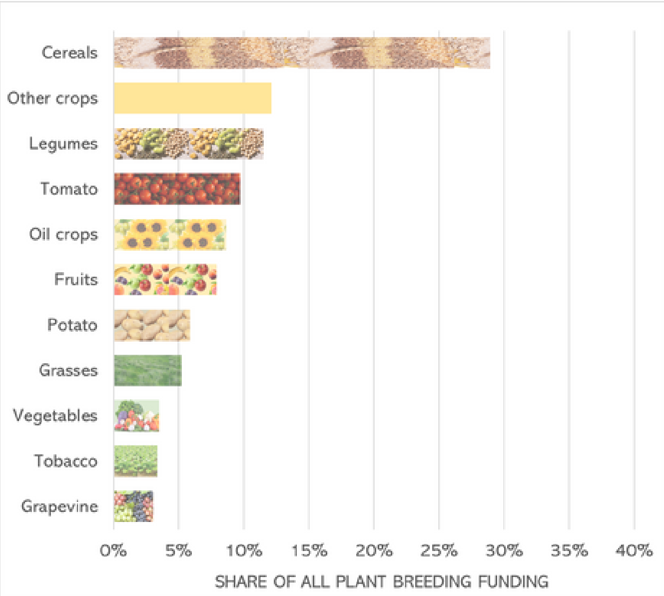


Figure 12: *Share of total funding for R&I in plant breeding dedicated to specific plant species from FP7 to the first half of Horizon Europe combined.*

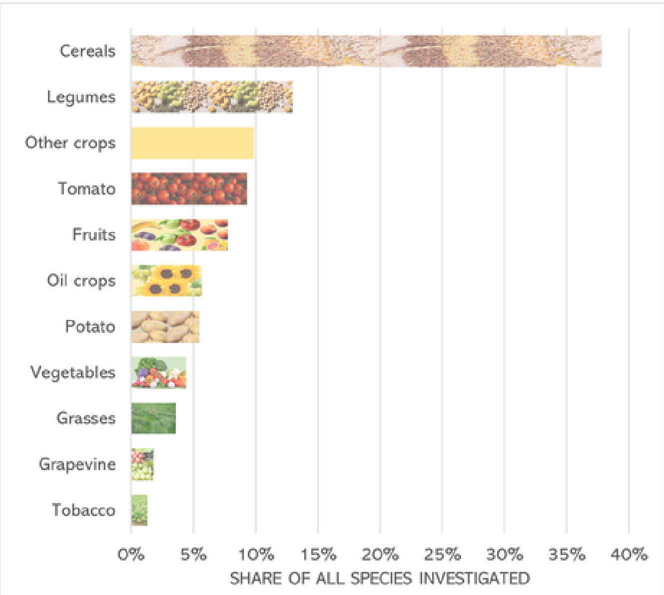


Figure 13: *Share of specific plant species investigated in plant breeding R&I from FP7 to the first half of Horizon Europe combined.*

Despite representing less than 6% of the plant species investigated, oil crops received approximately 9% of the total funding for R&I in plant breeding.

On average, oil crop breeding-related projects received a higher budget (€2.6 million) compared to cereals (€1.3 million) or legumes (€1.5 million). These projects often also involved more private partners and aimed for higher TRLs.

Among the highest-funded plant breeding-related projects, those exceeding €7 million, 33% included, at least in part, R&I on cereal breeding. Oil crops were featured in 19% of these top-funded projects, followed by legumes in 15%. The remaining high-budget plant breeding-related projects focused on species such as dandelion, hemp, tobacco, coffee, tomato, potato and fruits.

The trend towards more species for agrifood to increase biodiversity, food and nutritional security and resilience, requires a boost in funding for plant breeding R&I.

Projects most commonly fulfilled one or more different objectives. This report has categorised the plant breeding-related objectives into seven key areas:

- Technology development for plant breeding
- Basic biological processes (including investigating regulatory pathways and networks of agriculturally relevant characteristics)
- Breeding targets (including developing pre-breeding material)
- Identifying genes/markers
- New lines and potential cultivars
- New cultivars or varieties
- Product prototypes

Figure 14 represents the proportion of R&I efforts, within plant breeding-related projects, addressing any of these categories within their objectives. In FP7, R&I focusing on technology development for plant breeding were less common, comprising slightly over 20% of the total. This focus significantly increased in subsequent FPs, with almost 40% of plant breeding-related projects, in the first half of Horizon Europe, dedicating at least part of their R&I efforts to this area.

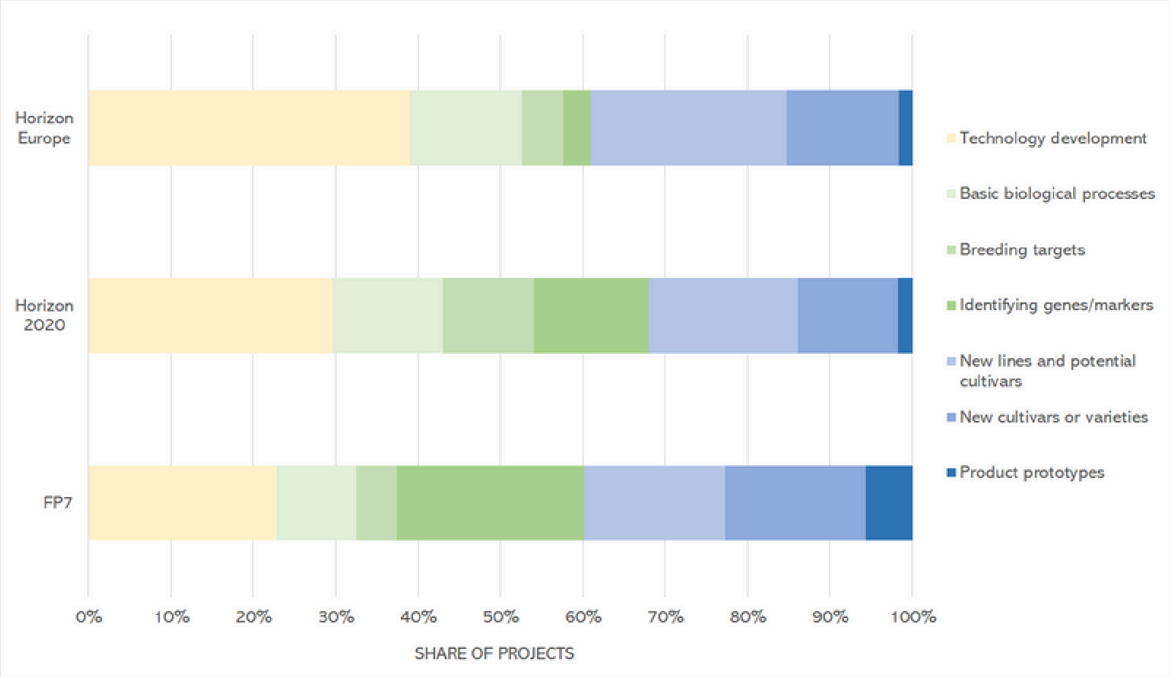


Figure 14: *Distribution of R&I objectives for plant breeding-related projects across Framework Programmes.*

This shift can be attributed in part to the growing prominence of plant breeding innovation, such as new genomic techniques (NGTs), which have been adapted for many plant species since the last decade. Examples include the Horizon Europe project GeneBEcon, which is creating a gene editing breeding toolbox using CRISPR, and the Horizon 2020 project COSMOS, which developed CRISPR methodology specific to camelina and crambe. It is important to note that advancements in technology development extend beyond NGTs; they also include improvements in conventional breeding methods, as demonstrated by the Innovine project, and organic-focused approaches, such as the LIVESEEDING project.

Plant breeding-related projects that explore molecular mechanisms, identifying genes and markers, and defining potential breeding targets, constituted a significant portion of outcomes, particularly in FP7 (37% of outcomes) and Horizon 2020 (38% of outcomes). These outcomes typically correspond to low TRLs, which is aligned with the observed TRL distribution in these FPs.

The development of new plant breeding lines, potential cultivars, and registered cultivars or varieties — highlighted by the two light blue categories in Figure 14 — was noted in 34% of plant breeding-related projects for FP7, 30% in Horizon 2020, and 37% in Horizon Europe. Projects that successfully registered new cultivars or varieties, such as SWEETFUEL, MYCORED, FLOWERPOWER, and Newcotiana, often involved private partners who played a critical role in the registration process.

It is worth highlighting that registrations of new varieties and cultivars frequently occur outside the project's lifetime and are not always a collective effort, which can lead to under-reporting in databases like CORDIS. Despite the European Commission's impact measurement indicators, comprehensive data on plant variety registrations remains elusive. Some of the contacted consortium members reported that they were able to directly apply project results in their breeding programs or further exploit the results within their organisation based on specific needs.

FP7 stands out for generating the most product prototypes as outcomes (6%), including both food products (e.g., yogurts and sauces in the EUROLEGUME project) and non-food products (e.g., feed, bioenergy products in the LIBBIO project, and car tyres and latex gloves in the EU-PEARLS and DRIVE4U projects). Plant breeding-related projects that produce, or plan to produce, such products tend to have high TRLs (7-9) and receive above-average funding, with an average budget of €6.8 million. Most of these projects (91%) focus on food and feed applications, while non-food applications include R&I in plant breeding for ornamentals, pharmaceuticals, biofuels and biomaterials.

These outcomes are achieved through a variety of approaches, including plant breeding innovation, such as NGTs. The next chapter will look into the use and promotion of plant breeding innovation in the FPs.

PLANT BREEDING INNOVATION FALLING OUT OF FAVOUR?

The use of gene transfer, TALENs, ZFNs, and CRISPR, resulting in genetically modified (GM) or new genomic technique (NGT) plants, was observed across all FPs. Plant breeding-related projects tend to fall into two categories: either focusing on fundamental research, often carried out by a single organisation or small consortia with limited budgets; or applied research with larger budgets aiming for TRLs above 3-4.

In FP7, 76% of plant breeding-related projects utilised conventional breeding methods, while the remainder utilised GM (18%) and NGTs (6%) (Figure 15). In Horizon 2020, a substantial increase in the use of plant breeding innovation, NGTs (23%) and GM (14%), was observed, with the use of conventional breeding methods reduced to 63% of plant breeding-related projects. This is mostly a result of the innovative plant breeding technique CRISPR gaining prominence in the beginning of Horizon 2020.

In the first half of Horizon Europe, 25% of plant breeding-related projects utilised NGTs. Interestingly, only one project (2%) was found to

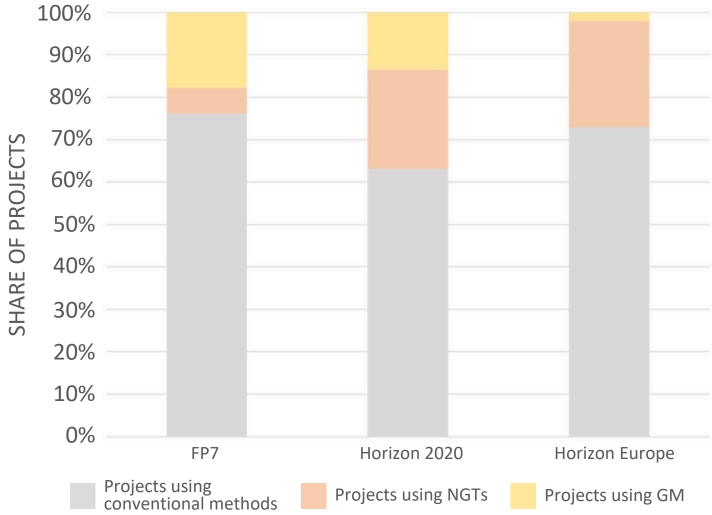


Figure 15: *Proportion of projects using conventional breeding methods, New Genomic Techniques (NGTs) or Genetic Modification (GM) across Framework Programmes.*

utilise GM, suggesting a phase out of GM, for the benefit of more versatile and cost-efficient NGTs.

However, the use of NGTs has not fully compensated for the reduction in the use of GM compared to Horizon 2020, with projects utilising conventional breeding methods at similar levels as for FP7 (73%). This suggests the momentum gained for plant breeding innovation during Horizon 2020 is being lost in Horizon Europe, mostly likely due to the uncertain regulatory environment for NGTs in the EU.

Indeed, plant breeding-related projects often encountered challenges in fully exploiting their results due to the lack of clarity regarding the legal status of certain breeding techniques, like NGTs. For instance, the MeloCRISP project, which ended in 2021, aimed to exploit its results to the seed market and breeding programs, but was unable to do so because plants developed through CRISPR are "still considered as genetically modified organisms (GMO) in Europe".

Similarly, MalusEdit indicated that "a less restrictive EU regulation on DNA-free gene-edited plants" would be necessary for the project to fully exploit its results in apple breeding programs.

The MSCA Horizon 2020 project BIO-Banana IN and OUT initially aimed to produce a genetically modified banana resistant to Fusarium wilt. Interestingly, the researchers note the following as one of the reasons for dropping their ambitious goals: "genetically engineered bananas might have faced difficulties with consumer acceptance and would have been difficult to de-regulate". As a consequence, the project shifted its focus to R&I on biologicals against the disease and did not conduct any breeding activities.

BUNGEE reported an unexpected complication with executing field trials, as their legal status was disputed in light of the ruling of the Court of Justice of the European Union (ECJ) on the Confédération Paysanne case in 2018 **[18]**. This halted all the field trials, limited the number of screened plants from the initially planned 100,000 to 1,000, and prevented the researchers from reaching the proposed TRL 5.

In the case of the FRUIT BREEDOMICS project, which developed an apple variety, the legal status of the variety within the EU was unclear due to the plant breeding approach the researchers used. However, the project involved partners from outside the EU (e.g., South Africa, New Zealand, and China), who were better positioned to capitalise on the project outcome.

While these projects secured funding, they encountered significant challenges during implementation. In Horizon 2020 and Horizon Europe, these obstacles arise before a project even starts, already in many project calls, as outlined in the last section.

STRICTER REQUIREMENTS LIMIT THE USE OF PLANT BREEDING INNOVATION

The scope and requirements of funding calls have evolved significantly over the years. These results refer to the plant breeding-relevant calls released under the Agrifood work programmes.

During FP7, calls were broadly defined with limited specificity. Notably, FP7 promoted plant breeding innovation, as seen in KBBE-2008-1-1-01: Development of new tools and processes based upon genomic resources to support R&D in crop plants for breeding using innovative gene technology breeding methods (transgenics/cisgenics/intragenics) **[19]**. At that time, there was no stipulation for the resulting products to apply to specific agricultural production systems.

With Horizon 2020, a significant shift in approach became evident. R&I calls and their topics became more focused on the applicability of project results, with clearer requirements and expectations, aiming to ensure that specific objectives were pursued. At the same time, these requirements introduced limitations on the methodologies that could be used in the plant breeding-related projects.

In non-food-related plant breeding R&I, the work programmes continued to encourage the use of "modern breeding technologies", as exemplified by the description of the topic ISIB-5-2014: Renewable oil crops as a source of bio-based products **[20]**.

However, a new trend emerged in food-focused plant breeding-relevant R&I calls, where an increasing number of calls required that outcomes "benefit both conventional and organic agriculture." Some topics offered a more flexible interpretation, allowing for the consideration of

[18] Case C-528/16: Judgment of the Court (Grand Chamber) of 25 July 2018.

[19] FP7 Cooperation Work Programme: Theme 2 – Food, Agriculture and Fisheries and Biotechnology

[20] Horizon 2020 – ISIB-5-2014 Renewable oil crops as a source of bio-based products. Presentation by the EU Commission.

"conventional and/or organic" systems. Around 20% of the plant breeding-relevant calls in Horizon 2020 included these conditions. Out of the four such calls, only one call offered the aforementioned more flexible "and/or" framing.

This trend has continued to grow in the first half of Horizon Europe, with the requirement for results to be applicable to organic and conventional farming affecting an estimated 44% of plant breeding-relevant calls in the first two Agrifood Work Programmes (WP 2021/22 and 2023/24). The calls explicitly required outcomes to serve both conventional and organic farming systems. A few exceptions remained, such as a call on legume breeding, which was "open for the breeding needs of the legume sector in conventional, agroecological, and organic farming," implying that consortia could propose projects relevant to any of these production systems. Additionally, one innovation-friendly NGT-specific call was released in Horizon Europe, which funded one project. Contrary to the agrifood sector, non-food sectors are still encouraged to leverage plant breeding innovation.

It appears that the support toward using plant breeding innovation in the agrifood sector, which was more prevalent in earlier FPs, has diminished in recent years. This shift may be partly explained by political developments surrounding NGTs since the aforementioned ECJ ruling in 2018.

Current legislation concludes that NGTs produce genetically modified organisms (GMOs), which are not permitted in organic agriculture. Consequently, plant breeding relevant calls that require outcomes to benefit both conventional and organic agriculture, effectively rule out the use of NGTs in plant breeding activities.

Furthermore, in 2023, the EU Commission proposed a new legislation for plants obtained by certain NGTs, that excludes their use in organic systems under Article 5 (2) **[21]**. This has further reinforced the exclusion of plant breeding innovation from EU plant breeding-related projects, that require the results to be applicable to both conventional and organic agriculture.

The organic Action Plan published in March 2021, aimed to dedicate at least 30% of the R&I budget to research benefitting organic agriculture. In the case of R&I in plant breeding for the first half of Horizon Europe, this goal has already been exceeded (44%), perhaps at the expense of other agrifood systems.

[21] Proposal for a Regulation of the REGULATION OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL on plants obtained by certain new genomic techniques and their food and feed, and amending Regulation (EU) 2017/625.

CONCLUSIONS

Plant breeding remains the pillar of our agrifood systems, as evidenced by the conclusions of the Strategic Dialogue on the future of EU agriculture **[22]**.

Even though some countries are more active in EU-level plant breeding-related projects than others, multi-actor breeding approaches with larger and more diverse consortia are becoming more common in collaborative projects, especially under the Agrifood subprogramme funding.

A small percentage of R&I in plant breeding is also funded under subprogrammes of other pillars/priorities, such as Industrial Leadership, EIC and Spreading Excellence. These subprogrammes should be further leveraged to promote the exploitation of plant breeding R&I in Europe.

While plant breeding-related projects are increasingly expected to deliver market-oriented outcomes while addressing social, economic, and environmental aspects, the budgets have not kept pace with the growing scope of expected impacts. The decline and inconsistencies in funding are most noticeable in fundamental research and training of the next generation of researchers and entrepreneurs, raising concerns about the continuity of the R&I cycle. This continuity is crucial, as underscored by the EU Commission's evaluation of the 7th Framework Programme; "stable funding is necessary to realise the full benefits of past investments" and to support both academic and business communities" **[23]**.

The decrease in funding might be linked to a reduction in suitable proposals, potentially due to restructuring and a lack of awareness and understanding of the funding mechanisms. As noted in the EU Commission's evaluation of Horizon 2020, the funding landscape is challenging to navigate **[24]**. Moreover, while national funding plays a significant role in certain Member States and Associated Countries, EU level funding promotes collaborative and multidisciplinary research, addressing challenges on the European level.

The involvement of private partners is crucial, as the private sector is the main driver for developing new plant varieties, given that the public sector's contribution is relatively limited **[25]**. When evaluating the entire R&I funding of Horizon 2020, the EU Commission noted that 28% of the total FP funding was allocated to the private sector **[24]**. In the field of plant breeding R&I, this relative amount was only 20% for Horizon 2020. This suggests there is still potential for increased private sector involvement in plant breeding-related projects, which could further catalyse research activities.

The exclusion of specific plant breeding innovation from EU R&I in plant breeding limits the sector's ability to innovate, adapt, and ensure EU agrifood systems remain competitive, particularly in light of the EU's Green Deal targets of reducing inputs and agricultural land, while ensuring global food and nutritional security, biodiversity, competitiveness and resilience.

As stated in the FP7 legislation, "European Technology Platforms contribute to setting common research priorities, in fields such as plant genomics and biotechnology" **[26]** - this almost 20-year-old legislation appears to be slightly neglected. European Technology Platforms continue to play a crucial role in driving public-private collaborations in R&I, focusing on the translation of research outcomes into products, services and benefits for society, thereby addressing the innovation gap. This was recently discussed in the Council meeting in May 2024, with

[22] European Commission (2024). Strategic Dialogue on the future of EU agriculture - A shared prospect for farming and food in Europe.

[23] European Commission. (2015). Directorate-General for Research and Innovation. Study on network analysis of the 7th Framework Programme participation – Methodological annex.

[24] European Commission (2024). Report from the Commission to the European Parliament and the Council: Ex post evaluation of Horizon 2020, the EU framework programme for research and innovation.

[25] Van Elsen, A., Ayerdi Gotor, A., Di Vicente, C., Traon, D., Gennatas, J., et al. (2013). Plant breeding for an EU bio-based economy: The potential of public sector and public/private partnerships. [Research Report] Auto-saisine.

[26] European Parliament (2006). Decision No 1982/2006/EC of the European Parliament and of the Council of 18 December 2006 concerning the Seventh Framework Programme of the European Community for research, technological development and demonstration activities (2007-2013).

the conclusions highlighting "the need to ensure a better connection between innovation and industrial initiatives" and "the importance of drawing on existing mechanisms and partnerships [...], including European Technology Platforms" **[27]**.

Given the importance of plant breeding in our agrifood systems, accounting for 67% of agricultural production increase in the EU in the last two decades, it seems counter-intuitive that R&I in plant breeding is subjected to a decrease in the proportion of total FP funding allocation. Considering the wide-ranging contributions plant breeding makes across the agrifood value chain, from primary production to the consumer level, and the wider bioeconomy, one would expect a more strategic, EU-wide and coordinated approach to funding R&I in plant breeding at critical mass.

Nonetheless, as previously highlighted, the strategic plan for the second half of Horizon Europe has highlighted plant breeding as a key strategic research area, suggesting that funding allocation to R&I in plant breeding could still see a much-needed shift in the remaining Horizon Europe work programmes and, hopefully, in the following Framework Programme (FP10) to leverage its full potential.

[27] Council of the EU OUTCOME OF PROCEEDINGS (2024)

ANNEXES

ANNEX 1

RELEVANT FUNDING MECHANISMS

All of the following funding mechanisms/areas/networks were investigated for plant breeding projects funded between 2007 and 2024:

- Framework Programme 7, Framework Programme 8, Framework Programme 9
- EIP AGRI
- EU CAP NETWORK
- LIFE PROGRAM
- FACCE JPI
- FACCE SURPLUS
- ERA GAS
- BIODIVERSA
- COST
- RECROP
- BIOECONOMY NETWORK
- ERC
- CBE JU
- SUSFOOD2
- ERA HDHL
- JPI HDHL
- FOSC ERA
- ICT AGRIFOOD
- ERA COBIOTECH
- PRIMA
- EJP SOIL
- SUSCROP
- CORE ORGANIC COFOUND
- GREEN ERA HUB
- EIT
- JPI CLIMATE
- LEAP AGRI
- ERA NET COFOUND
- BIOEAST
- ERA CAPS

The entire structure of the three Framework Programmes is outlined below. The main programmes/priorities/pillars are marked in blue, and their belonging topics listed below them. The areas that funded plant breeding to any extent are marked in green and bold font. Funding information and adjustments to 2020 prices is available in the accompanying documentation, available from Plant ETP.

FP7

Programme

Cooperation

Health

Food, Agriculture and Fisheries and Biotechnology

Information and Communication Technologies

Nanosciences, Nanotechnologies, Materials and New Production Technologies

Energy

Environment (including Climate Change)

Transport (including Aeronautics)

Socioeconomic Sciences and the Humanities

Space

Security

Programmes

Ideas

People

Capacities

Research Infrastructures

Research for the benefit of SMEs

Regions of knowledge

Research Potential

Science in Society

Coherent Development of Research Policies

Activities of International Cooperation

NON-NUCLEAR DIRECT ACTIONS OF THE JOINT RESEARCH CENTRE

EIT

Horizon 2020

Priority 1

Excellent Science

ERC

Future and emerging technologies

MSCA

Research infrastructures

Priority 2

Industrial Leadership

Leadership in enabling and industrial technologies

Access to risk finance

Innovation in SMEs

Priority 3

Societal Challenges

Health, demographic change and well-being

Food security, sustainable agriculture and forestry, marine, maritime and inland water research, and the bioeconomy

Secure, clean, efficient energy

Smart, green and integrated transport

Climate action, environment, resource efficiency and raw materials

Europe in a changing world - Inclusive, innovative and reflective societies

Secure societies - Protecting freedom and security of Europe and its citizens

Spreading excellence and widening participation

Science with and for society

NON-NUCLEAR DIRECT ACTIONS OF THE JOINT RESEARCH CENTRE

EIT

Horizon Europe

Pillar 1

Excellent Science

ERC

MSCA

Research infrastructures

Pillar 2

Industrial Competitiveness and Global Challenges

Health

Culture, Creativity and Inclusive Society

Civil Security for Society

Digital, Industry and Space

Climate, Energy and Mobility

Food, Bioeconomy, Natural Resources, Agriculture and Environment

NON-NUCLEAR DIRECT ACTIONS OF THE JOINT RESEARCH CENTRE

Pillar 3

Innovative Europe

EIC

European innovation ecosystems

EIT

Widening Participation and Strengthening the ERA

Widening participation and spreading excellence

Reforming and enhancing the European R&I System

ANNEX 2

KEYWORDS AND DATA BASES

All the data bases were searched with a set of keywords, applying the relevant filters if necessary. The keywords included:

- plant breeding
- plant gene editing
- genome editing plant
- genomic selection plant
- germplasm
- markers
- barley
- rye
- wheat
- perennial grass
- cereals
- maize
- tomato
- legume
- rice
- berry
- triticale
- hemp
- oilseed
- apple
- potato
- seed
- resilient crop

A range of data bases were consulted, including but not limited to CORDIS, FACCE PROJECT WHEEL, ERA LEARN and all the respective websites of the funding mechanisms listed on Annex 3.

ANNEX 3

INCOMPLETE PROJECT DATA RESULTS

Thirty-five plant breeding projects that were only partially funded by EU funds were identified. Many of them lacked information on the exact start and length of the projects, as well as on the funding details. These projects were funded through co-funding or other types of partnerships, securing both national and European funds. The majority of partners were from the public sector (80%) and based in EU countries. A total of 185 unique partners collaborated on these projects. Compared to the main results presented in the report, these projects involved more North African countries (Algeria, Tunisia, Morocco, Egypt), which made up 6% of all participants.

The coordinators of the majority of these projects and funding mechanisms have stated that they cannot disclose additional information on partner involvement or funding. Table 5 below gathers information on the funding mechanisms that supported these 35 projects. It is not possible to determine exactly how much of the EU funds were allocated to an individual project or individual partner, as the so-called top-ups for each action differ. All of these actions have multiple calls, some co-funded and others not, with various priorities and approaches. Therefore, it would be inaccurate to assume any proportions from the total EU funds dedicated to these funding mechanisms.

FP	Funding Mechanism	Start	End	Plant breeding projects	All projects in the programme	EU funds dedicated to the entire funding mechanism overall
FP7	ERACAPS	2011	2015	15	26	€ 1.989.658,00
FP7	ARIMNET	2008	2013	1	10	€ 999.999,00
FP7	EUROSTARS	2007	2013	4	781	€ 1.200.000.000,00
FP7	CORE Organic II	2010	2013	1	14	€ 999.976,00
FP7	CORE Organic Plus	2013	2018	1	11	€ 2.999.999,00
H20	FACCE ERA NET PLUS	2013	2018	1	11	€ 4.000.000,00
H20	SUSCROP	2018	2023	7	38	€ 5.000.000,00
H20	CORE Organic Cofund	2016	2022	1	29	€ 4.999.997,50
H20	FACCE SURPLUS	2015	2020	1	28	€ 5.000.000,00
H20	FOSC	2019	2025	3	28	€ 4.999.999,95

Table 5: *Actions, partnerships and other mechanisms that funded plant breeding-relevant projects and received EU funding.*

ANNEX 4

PRICE ADJUSTMENTS

All budgets in this report were adjusted to 2020 prices to ensure comparability. The annual inflation rate was referenced from the World Bank Group Data and the adjusting factors were calculated, see below in Table 6. Horizon 2020 and FP7 budgets were all adjusted with corresponding factors. The adjustment for Horizon Europe was needed only for a part of the overall budget calculations. As stated in the regulation relevant for Horizon Europe, certain areas were allocated additional funds in constant 2018 prices - therefore these top-ups were adjusted to reflect 2020 prices.

Inflation adjustment Factor 2018-2020	Inflation adjustment Factor 2006-2020	Inflation adjustment Factor 2013-2020
1,01630872	1,22672468	1,05084119

Table 6: *Inflation adjustment factors used to calculate budgets and prices in this report.*

ANNEX 5

TECHNOLOGY READINESS LEVELS

Based on the definitions provided by the Horizon 2020 General Annexes, the following differentiation of TRL was adopted:

TRL 1: Basic principles observed
Includes the observation of molecular pathways and regulatory mechanisms.

TRL 2: Technology concept formulated
Models for plant breeding programmes developed, initial plant breeding activities undertaken, including pre-breeding material development.

TRL 3: Experimental proof of concept
Successful development of mutant plants and new lines, demonstrating the concept in a controlled environment.

TRL 4: Technology validated in the laboratory setting
Includes small-scale laboratory testing or plants grown exclusively in a controlled setting, like a laboratory glasshouse.

TRL 5: Technology validated in a relevant environment
Includes field tests conducted in an uncontrolled setting.

TRL 6: Technology demonstrated in a relevant environment
Includes large-scale field tests conducted at multiple sites over an extended period.

TRL 7: System prototype demonstration
Includes connecting farmers, seed companies, and other stakeholders in a real-world environment.

TRL 8: System complete and qualified
Includes active and established use of the developed materials by the end consumer, such as farmers. Also includes first feeding trials, human consumption trials, or product prototype tests for non-feed products.

TRL 9: Operational system
The system is fully operational and used in a production environment.

Figure 16 on the next page provides the full scale of TRLs proposed in FPs projects.

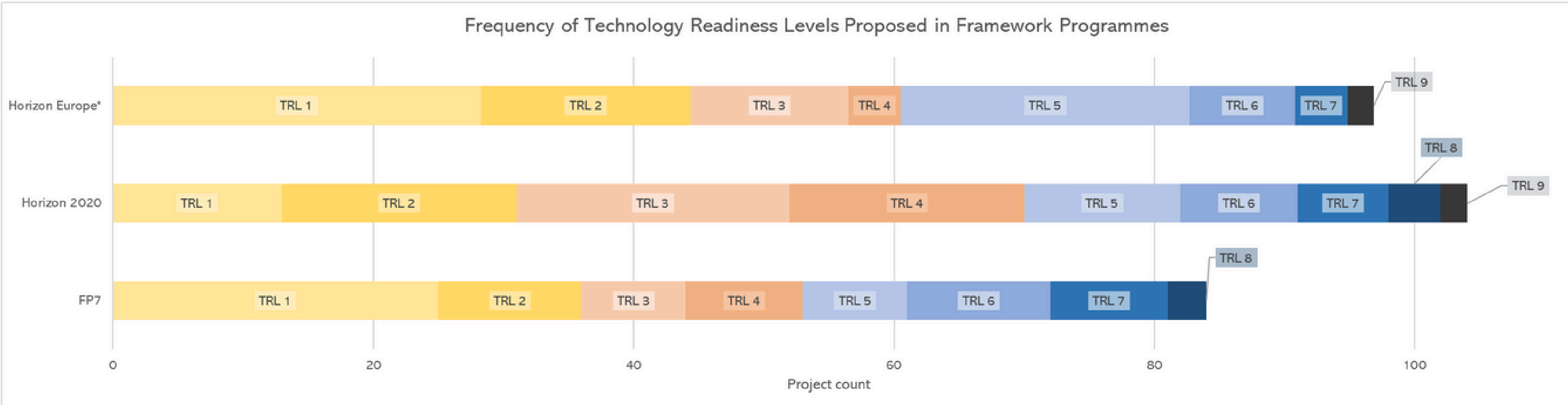


Figure 16: *Projects proposing a specific TRLs across Framework Programmes.*

Figures 17, 18 and 19 on the right showcase the correlation between TRLs and three different factors: private partner involvement, consortium size, and project budgets. The strongest correlation is seen with private partner involvement and TRLs.

In the analysis, a multiple linear regression model was built to examine the relationship between the independent variables and the dependent variable.
The proportion of private partners has a significant positive effect on TRL. For every 1% increase in private partners, TRL is expected to increase by about 1.58 units. The budget has a significant positive effect on TRL, subtle but statistically significant. Although positively associated with TRL, the effect of consortium size does not have a strong impact on TRL compared to the other variables.

Figure 17: *Correlation between share of private partners and proposed TRL.*

Figure 18: *Correlation between consortium size and proposed TRL.*

Figure 19: *Correlation between the budget size and proposed TRL.*

ANNEX 6

LIST OF ALL PLANT BREEDING-RELATED PROJECTS

Programme comparison

- ERC/IDEAS
- MSCA/People
- Agrifood
- Industrial Leadership Biotech
- Industrial Leadership SME
- EIC
- Spreading Excellence

Table 7: List of all plant breeding-related projects.

Horizon 2020		
ACHILLES-HEEL	EUCLEG	PhotoBoost
ACQUIRE	ExpoSEED	PHOTONET-C4
ADAPT	FLOWERPOWER	PlantHUB
AEGILWHEAT	FrATGaria	Pod Yield
AIR	FROOTS	PotatoMASH
BigWheat	G2P-SOL	POTENT
BIO-Banana IN and OUT	GAIN4CROPS	PRE-HLB
BIOVALUE	GainGrain	PROCROP
BLASTOFF	GENEVABREED	PROTEIN2FOOD
BREEDCAFS	GENEVOSYN	PrunMut
BreedingValue	GenSPaD	RADIANT
BREEDIT	GenSPI	ReMIX
BRESOV	GoodBerry	REPROHEAT
BUNGEE	GSAS	RiZeSisT
CallMechanics	HARNESSTOM	ROOTPHENOBIOME
CaMILLET	HEAT-WHEAT	SAAT2020
CAPITALISE	HEIREC	SaToBa
CHIC	HerbaRice	SOCLE
CHROMADAPT	HISPOB	SolACE
CONSTRAINTS	HyArchi	SunPro
COSMOS	IDRICA	SUPERTEFF
CRISP-4-CROPS	InteCue	TESS
CropStrengthen	INVITE	TOMATO EXODERMIS
Crossover control	LANDRACES	TomGEM
dcPolyWheat	LIBBIO	TomRes
DeMMYR	LIVESEED	TOPPER
DIVERSIFOOD	LUSH SPIKE	TRADITOM
DIVERSify	MAGIC	TRANSFER
DIVINFOOD	MalusEdit	TRANSFR-Q
DrugCrops	MEIOBARMIX	TriVolve
DURETO	MeloCRISP	UnleashLupin
ECBS	MetKnock	UNTWIST
ECOBREED	NEURICE	YIELDFACTOR
EPICROP	Newcotiana	
EPIMAIZE	PERLIFE	

FP7		
3TO4	FLARE	NUE-CROPS
ABSTRESS	FRUIT BREEDOMICS	OPTIMISC
ADAPTAWHEAT	FUTURE-PHARMA	PROTECT CROP
AENEAS	GESEFOL	RECBREED
ALIENC	GRAPERIPE	REDHOTGEN
AMAIZE	GRASSMARGINS	REDHOTGEN 2
AREA	GRASSWALL	REPROTAG
BARLEYNONHOST	HEALTHYMINORCEREALS	RGIFRUTO
BIOFORCE	HIPPOHEALTH	ROOTOPOWER
BREED4FUTURE	ICON	RXOMICS
CAREBREED	INNOVINE	SECA
CarotenActors	INTEREST	SEXYPARTH
CHIP-ET	INTERMEDIUM	SOLIBAM
CHROMELIM	IOF FLAVOR	SOYLIFE
CROPLIFE	JATROPT	SPICY
CROPS2INDUSTRY	LEGATO	SPIKE
DRIVE4EU	LEGUMEPLUS	SPOT-ITN
DROPS	LILY VERNALIZATION	SWCD
DURABLERESISTANCE	LOWASRICE	SWEETFUEL
DURES	MARS	TRIBE
ECOSEED	MAX-CROP	TRITICEAEGENOME
ELITE	MEIOSYS	VITACITRUS2
EPITRAITS	miPDesign	VITAFRUIT
EUBERRY	MULTIBIOPRO	WATBIO
EU-PEARLS	MULTIHEMP	WATER4CROPS
EUROLEGUME	MYCORED	WHEALBI
EUROOT	NGRB	YIELD
EVOBREED	NOVABREED	

HE		
3Dwheat	FlowCODE	PLANeT
3P-Tec	FRUITDIV	Plant-a-Jet
AsexualEmbryo	GeneBEcon	PLANTEX
BarleyMicroBreed	GrapeBreed4IPM	P-use efficient rice
BELIS	HelEx	RESIST
BEST-CROP	HybridSeed	Root2Res
Bio-LUSH	IASIS	SAMEY
BOLERO	InnOBreed	SEPTOWHEAT
BOOSTER	IPMorama	SHIELD4GRAPE
BYTE2BITE	Legume Generation	SorghEau
COLORnamental	LGSMAIZE	StickyFT
COUSIN	LIVESEEDING	StomAQP
CRISPit	Multi-Crop	SymbioticExchange
Crop4Clima	NatGenCrop	TRICOT
DARkWIN	NectarGland	TriDeTo
EpiSeedLink	PATAFEST	VISCREEN

ANNEX 7

PLANT BREEDING-RELATED PROJECTS PER COUNTRY

EU Coutries

Country	Number of projects	%
Total # of projects	2061	
Albania	1	0,05
Argentina	6	0,3
Armenia	1	0,05
Australia	8	0,4
Austria	48	2,3
Belgium	69	3,3
Bosnia and Herzegovina	1	0,05
Brazil	4	0,2
Bulgaria	15	0,7
Cameroon	1	0,05
Canada	8	0,4
Chile	3	0,1
China	27	1,3
Colombia	1	0,05
Croatia	2	0,1
Czech Republic	0	0,0
Denmark	39	1,9
Ecuador	1	0,05
Egypt	1	0,05
Estonia	6	0,3
Ethiopia	3	0,1
Finland	11	0,5
France	252	12,2
Georgia	1	0,05
Germany	265	12,9
Greece	46	2,2
Guatemala	2	0,1
Hungary	37	1,8
Iceland	2	0,1
India	3	0,1
Ireland	21	1,0
Israel	28	1,4
Italy	220	10,7
Japan	4	0,2
Kazakhstan	3	0,1
Kenya	1	0,05
Latvia	9	0,4
Lebanon	5	0,2
Lithuania	3	0,1
Luxembourg	0	0,0
Madagascar	1	0,05
Mali	1	0,05
Malta	0	0,0
Mexico	7	0,3
Netherlands	134	6,5
Nicaragua	2	0,1
Nigeria	2	0,1
North Macedonia	1	0,05
Palestine	1	0,05
Peru	2	0,1
Poland	32	1,6
Portugal	59	2,9
Republic of Cyprus	0	0,0
Romania	12	0,6
Russia	3	0,1
Serbia	17	0,8
Slovakia	3	0,1
Slovenia	17	0,8
South Africa	5	0,2
South Korea	2	0,1
Spain	196	9,5
Sweden	31	1,5
Switzerland	82	4,0
Taiwan	5	0,2
Tunisia	1	0,05
Türkiye	17	0,8
Uganda	2	0,1
Ukraine	2	0,1
United Kingdom	183	8,9
United States	21	1,0
Vietnam	3	0,1

Table 8: *List of plant breeding-related projects per country.*

ANNEX 8

ADDITIONAL TABLES

Most Involved Partners

Table 9 depicts the top ten partners involved in R&I projects in plant breeding between FP7 and the first half of Horizon Europe.

Partner (PU/PR)	Projects	EU Funding received between FP7 and first half of Horizon Europe
INSTITUT NATIONAL DE RECHERCHE POUR L'AGRICULTURE, L'ALIMENTATION ET L'ENVIRONNEMENT (PU)	72	€ 45.426.979,80
WAGENINGEN UNIVERSITY (PU)	52	€ 28.241.623,94
AGENCIA ESTATAL CONSEJO SUPERIOR DE INVESTIGACIONES CIENTIFICAS (PU)	28	€ 23.836.441,49
CONSIGLIO PER LA RICERCA IN AGRICOLTURA E L'ANALISI DELL'ECONOMIA AGRARIA (PU)	26	€ 8.163.056,81
LEIBNIZ - INSTITUT FUER PFLANZENGENETIK UND KULTURPFLANZENFORSCHUNG (PU)	22	€ 12.065.810,83
THE JAMES HUTTON INSTITUTE (PU)	20	€ 7.241.489,57
MAX-PLANCK-GESELLSCHAFT ZUR FORDERUNG DER WISSENSCHAFTEN (PU)	19	€ 20.849.163,89
ALMA MATER STUDIORUM - UNIVERSITA DI BOLOGNA (PU)	17	€ 6.570.053,66
KWS Saat (PR)	17	€ 3.594.563,32
EIDGENOESSISCHES DEPARTEMENT FUER WIRTSCHAFT, BILDUNG UND FORSCHUNG (PU)	15	€ 4.502.127,41

***Table 9:** The top ten most involved partners in plant breeding-relevant projects, public sector and private sector abbreviated in brackets (PU=public, PR=private).*

Plant Breeding Projects - Overview of Subprogrammes

Table 10 represents the development of budgets and projects funded. ERC shows a decreasing budget, however, more projects are being funded. MSCA average budgets decreased, as expected since the overall budget for the MSCA subprogramme also decreased. The Agrifood subprogramme is the least variable in terms of average budgets. Later FPs also started funding plant breeding projects under other pillars such as the EIC or Industrial Leadership, which previously did not exist under FP7.

	FP7		Horizon 2020		Horizon Europe	
Subprogramme	Count of projects	Average budget	Count of projects	Average budget	Count of projects	Average budget
ERC	13	€ 2.717.269,91	21	€ 1.753.706,78	13	€ 1.241.110,92
MSCA	35	€ 777.442,23	44	€ 334.952,63	11	€ 458.447,79
Agrifood	35	€ 5.456.644,57	30	€ 5.930.393,51	19	€ 5.589.342,52
EIC					3	€ 2.628.704,33
Industrial Leadership: Biotechnology			5	€ 7.447.155,15		
Industrial Leadership: SMEs	1	€ 2.815.308,61	3	€ 60.423,37		
Widening participation and spreading excellence					2	€ 1.301.949,68
Grand Total	84	€ 3.051.581,61	103	€ 2.591.209,80	48	€ 2.872.185,17

***Table 10:** Number of projects under their respective Framework Programmes and subprogrammes, with deliniated average budgets for each. All values are in 2020 prices.*

ANNEX 9

PRIVATE PARTNERS CATEGORIES

Private partners categories were merged based on the key common interest. Below the breakdown of what part of the sector each of the categories mentioned in the earlier Figure 9 includes.

Seed and Breeding Sector includes

- seed companies,
- breeding companies,
- biotechnology companies.

Research Sector includes

- research companies,
- bioinformatic companies,
- laboratories,
- academic and research associations.

Consultancies with the following main areas of work

- project management,
- energy,
- environment,
- intellectual property rights,
- science communication.

Agricultural Sector includes

- associations,
- farms,
- fertiliser companies,
- agricultural consultancies
- plant nurseries.

Manufacturers and processors in the field of

- machinery,
- feed,
- agricultural chemicals,
- cosmetics,
- fibre,
- textile,
- sugar,
- rubber,
- oil

Food Sector includes

- mills,
- wine companies and associations,
- retailers,
- food companies,
- bakeries,
- brewing companies,
- coffee companies.

Organic Sector includes

- organic seed companies,
- organic associations,
- organic digital platforms.

Non profit organisations include

- conservation non profits,
- multistakeholder platforms,
- charities,
- consumer organisations.

Software and Technology includes

- software companies,
- bioinformatic tools companies.

Other includes

- construction companies,
- trade unions and interprofessional organisations.

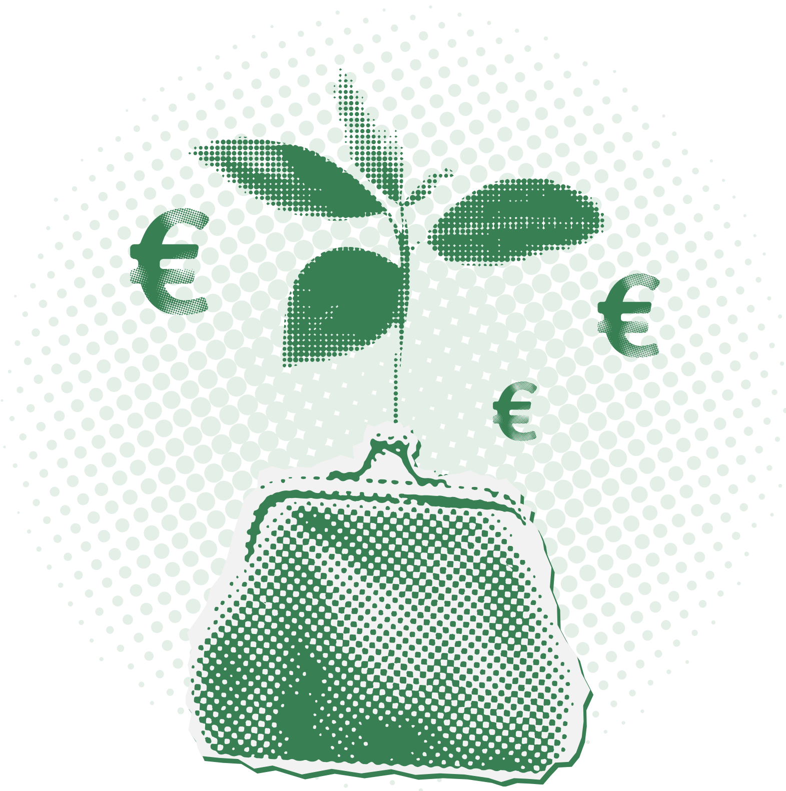
ANNEX 10

SPECIES CATEGORIES

This report merged multiple species into overarching broader categories for a more comprehensive overview.

- **Cereals** include maize, wheat, barley, rice, sorghum, oats, millet, teff and quinoa.
- **Legumes** include soybean, lentil, pea, chickpea, beans, lupin, alfalfa, lucerne and clover.
- **Fruits** include apple, citrus, apricot, berries, banana, melons, plus and peach.
- **Oil crops** include oil seed rape, sunflower, rapeseed, olive, camelina and crambe.
- **Vegetables** include broccoli, kohlrabi, cabagge, onion, carrot, lettuce, eggplant, sugar beet and squash.
- **Grasses** include forage grass, perennial grass, seagrass and ryegrass.
- **Other crops** include dandelion, pepper, coffee, cocoa, amaranth, chicory, nettle, ornamentals, guayule, hemp, spelt.

Plants for the Future
European Technology Platform



WHAT IS PLANTS FOR THE FUTURE ETP?

Plants for the Future ETP promotes the flow of innovation to the market for the benefit of society. We are a multi-stakeholder platform representing the plant sector from fundamental research to crop production and distribution. We bring stakeholders from the plant sector together to consider the challenges and opportunities of agricultural value chains holistically, while developing a vision for future systems spanning food, feed, and biobased raw materials.

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