# Data gathering and analysis to support a Commission study on the Union's options to update the existing legislation on the production and marketing of plant reproductive material

Final report

Written by ICF

February 2021

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**EUROPEAN COMMISSION**

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## List of abbreviations

| | |
|---|---|
| CSO | Civil Society Organisation |
| DUS | Distinctiveness, Uniformity and Stability |
| EC | European Commission |
| FRM | Forest Reproductive Material |
| IA | Impact Assessment |
| IP | Intellectual Property |
| NCA | National Competent Authority |
| OCR | Official Control Regulation |
| PRM | Plant Reproductive Material |
| RNQPs | Regulated non-quarantine pests |
| VCU | Value for Cultivation and Use |

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## Abstract

The Council has asked the European Commission to carry out a study to assess the options to update the existing legislation on the production and marketing of plant reproductive material (PRM). A supporting research study was contracted to ICF (henceforth "ICF study").

The PRM legislation (12 Directives covering agricultural, vegetable, forest, fruit and ornamental species and vines) establishes rules for the registration of plant varieties and the certification of seed lots and the production and marketing of seed and other plant reproductive material from these varieties.

The work carried out by ICF provides an updated review and synthesis of evidence available in literature and insights collected from stakeholders on key aspects of the PRM legislation. It:

- provides an updated PRM legislation problem analysis, identifying current issues, their drivers and implications;
- explores how recent developments, such as technical developments, new regulations (Official Controls Regulation, Plant Health Regulation) and increasing concerns around biodiversity and food security, impact on PRM issues; and
- addresses criticisms of previous proposals, by filling gaps in knowledge on the amateur gardener market and addressing Forest Reproductive Material separately.

The ICF study finds that the flexibilities afforded to Member States by the Directives have resulted in a range of differences in how variety registration and PRM certification are administered and implemented. The views of stakeholders on the current policy framework and the way forward are mixed.

## Executive summary

**Introduction:** The ICF research study (henceforth "ICF study") set out to collect and analyse data to support a European Commission study on the Union's options to update the existing legislation on the production and marketing of plant reproductive material. The research was undertaken by ICF on behalf of the European Commission's Directorate General responsible for health and food safety (DG SANTE). The legal framework currently comprises 12 Directives, referred to as the Plant Reproductive Material (PRM) legislation. The Directives (covering agricultural, vegetable, forest, fruit and ornamental species and vines) establish rules for the registration of plant varieties in national catalogues and the certification of seed lots and the production and marketing of seed and other plant reproductive material from these varieties.

**Context and background:** A proposal from the European Commission in 2013 to simplify and update the PRM legislation and harmonise its implementation across the EU was rejected by the European Parliament and subsequently withdrawn by the European Commission. More recently, the Council[1] requested that the European Commission carry out a study on the Union's options to update PRM legislation, and submit a proposal if appropriate in view of the outcomes of the study or otherwise inform the Council of alternative measures.

**ICF study objectives:** The ICF study builds on earlier works, gathering data with the aim to:

- provide an updated problem definition, identify current issues, their drivers and implications for the PRM legislation;
- deepen the European Commission's understanding of existing and new issues;
- explore how the latest developments, such as technical developments, new regulations (Official Controls Regulation (EU) 2017/625, Plant Health Regulation (EU) 2016/2031) and increasing concerns around biodiversity and food security, impact on the PRM issues; and
- address some of the criticisms raised towards earlier proposals, such as filling gaps in knowledge on marketing to amateur gardeners and address issues in relation to Forest Reproductive Material (FRM).

**Methodology:** A matrix was developed framing the ICF study's overarching approach to evidence collection and analysis and providing links to the research questions. The data collection combined desk-based research and stakeholder consultation through a programme of selected stakeholder interviews, targeted stakeholder surveys, an online workshop, and a validation survey.

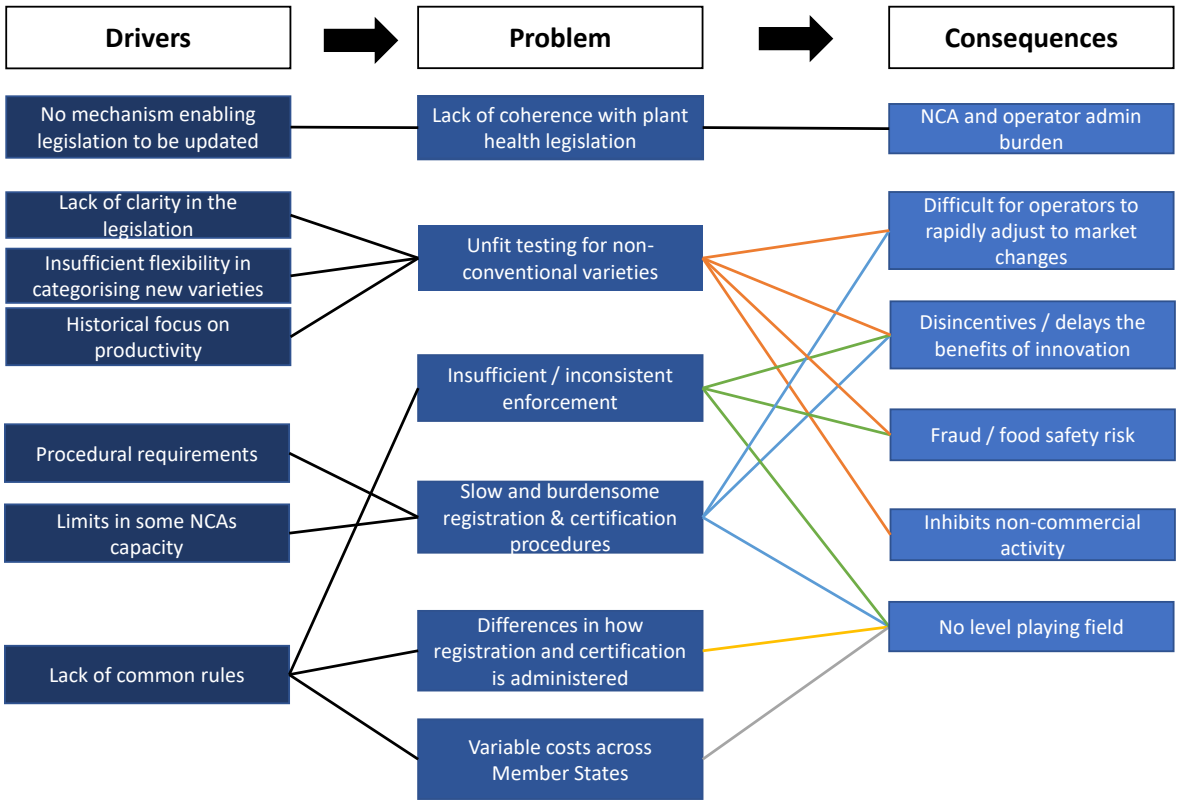
Key limitations in the design of the research and methodologies were: the availability of data with reference to the size of the PRM industry; relatively small-scale field research restricted by budget and a limited timetable (six months); and stakeholder self-selection bias.

**Key findings and conclusions**

**Problems with the existing PRM legislation:** Figure 1 provides a simplified overview of the problem analysis, indicating problems identified, their drivers and consequences.

[1] Council Decision (EU) 2019/1905

*Figure 1. Simplified problem tree analysis*




The six key problems identified were:

1. There are **differences in how registration is administered** across Member States. This is a problem, for example, when VCU tests are carried out on agricultural species, in terms of how VCU criteria are interpreted, weighted, and how test results are calculated and assessed, which undermines the EU level playing field.
2. There are **differences in how Member States calculate fees** (and share costs) for variety registration and PRM certification, which undermines the EU level playing field and can have a potential greater impact on SMEs and non-profit organisations with commercial activities. The lack of common rules in the Directives on how costs are calculated or shared between operators and NCAs results in operators facing different costs for registration and certification in different Member States. Mutual recognition of registered varieties across the EU (through the common catalogues) mitigates the impact of different registration processes to some extent.
3. **Testing for conservation and amateur varieties[2] and varieties intended for organic production does not appropriately reflect the needs of these varieties**, impacting the ability of operators to register new varieties. There is insufficient flexibility in legislative requirements (testing criteria) for these varieties, whilst there is also a lack of clarity in the language and terminology used in the legislation. The use and application of derogations is variable across Member States.
4. **The registration process requires time and can be burdensome**. However, it is a key safeguard ensuring the quality of PRM on the market. Whilst the legislation permits the transfer of aspects of the certification procedures, under

[2] Amateur varieties are varieties with no intrinsic value for commercial production but developed for growing under particular conditions)

certain conditions, to industry through a system of certification under official supervision, that option is not currently feasible for registration purposes (i.e. DUS and VCU testing). Differences in NCA capacity and performance can result in differences in the time required for registration.

5. There is **a lack of coherence between the PRM marketing legislation and the Plant Health Regulation** on the issue of regulated non-quarantine pests (RNQPs), resulting in uncertainty for NCAs in terms of which list to consult.
6. Terminology used to describe aspects of **the control requirements in the PRM legislation is ambiguous** and is interpreted differently across Member States resulting in inconsistent and potentially insufficient control and enforcement. Although for some Member States the flexibility afforded by the Directives is desirable.

**Non-harmonised implementation of the legislation:**

Key differences identified between Member States related to:

- the registration systems of Member States (including the effectiveness of the system, speed and ease of the process, appropriate testing stations etc.). These can impact the decisions made by industry on where to register a variety. The 'typical' length of the registration process varies between 1 to 5 years, depending on the species and Member State.
- discrepancies in relation to the characteristics used to assess VCU tests. A number of Member States use single key characteristics (especially in species where the yield increase is not very high) to assess VCU tests. Some use an index weighting approach across multiple criteria, while others use a mix of both approaches. In almost all Member States decisions can also be made on the basis of overriding criteria, most frequently linked to high quality varieties or varieties with special characteristics such as high resistance to pests. In most Member States there is no formal inclusion of sustainability criteria in VCU tests.
- Member States' approaches to registering organic varieties, with only a small number having a separate system.
- the extent of variety reference collections (ranging from less than 5,000 to over 50,000 varieties) and how they are maintained: most Member States use living variety collections and databases with characteristics and descriptions, although the relative popularity of the methods differs by species.
- the cost of registration and technical fees charged for testing. Although cost was not identified as a deciding factor in choosing where to register a variety, it can be a barrier to SMEs and non-profit organisations marketing PRM. Member States also take different approaches to cost recovery: less than half have some system of cost reduction in place for applicants, although in some Member States this is only for conservation and amateur varieties.
- the frequency of reporting new registered varieties to the Common Catalogues with timeframes ranging from multiple times per month to once per year.
- divergent Member States' approaches to control and enforcement.

**Synergies with the Plant Health Regulation:** There is an overlap between the PRM Directives and the Plant Health Regulation on the issue of regulated non-quarantine pests (RNQPs). Duplication in the listing of RNQPs (albeit with some differences) has resulted in confusion on which list should be consulted by Member States authorities. This has meant additional effort to check both lists and to ensure appropriate application of the legislation. Some Member States argued in favour of a single document listing RNQPs with a preference for that to be the PRM Directives which allows Member States to include the RNQP list in the national regulation. However, some of the pests currently in the PRM Directives were not recommended for listing as RNQPs in the Plant Health Regulation and hence such differences are likely to remain.

**Synergies with the Official Controls Regulation**: The PRM legislation does not fall under the Official Controls Regulation (OCR). Harmonising rules on control across Member States was considered beneficial by the majority of NCAs. Opinion on whether to include the PRM legislation in the OCR was mixed. Arguments in favour of inclusion focussed on the efficiency of implementation (with inclusion in the OCR clarifying and streamlining responsibilities within Member State authorities), and harmonisation in the costs of compliance across Member States. Arguments against valued the flexibility currently afforded by the PRM Directives and highlighted additional complexity and additional burden for NCAs from inclusion of the PRM legislation under the OCR.

**Technical developments in the breeding sector**: A growing number of New Genomic Techniques (NGT) have emerged, making use of plant genetic information in the breeding process to alter the genome of organisms. Of relevance to the PRM legislation is the extent to which the varieties and PRM resulting from NGTs are accessible to farmers and are subject to the existing registration and certification requirements. There is a need for transparency in how varieties obtained through NGTs are registered and certified, if allowed in the EU.

**Digitalisation:** In an increasingly digitalised world, there is potential for digital solutions, such as blockchain technology or the use of Digital Object Identifiers (DOI), to improve traceability, and offer greater assurance on the identity, quality and health of seeds, although stakeholders noted that transparency in the sector is improving. Digital illiteracy, poor connectivity and costs remain key barriers in the adoption of such technologies, with a small number of stakeholders also raising concerns over safety, ownership and confidentiality of the information.

**The amateur gardener market:** The ICF study engaged maintainers of varieties intended for amateur gardeners (hobby gardeners). The key findings were:

- There is mixed evidence regarding the number of varieties available to amateur gardeners, although the ICF study stakeholder survey points to an increase over the past 10 years. This is likely to vary depending on the species.
- Most amateur gardeners are primarily involved in gardening to grow edible produce for themselves and their families, for enjoyment and to enhance their aesthetic setting. A large number of gardeners also considered produce they grow important in meeting their dietary needs. As a result, their preferences when purchasing PRM differ from those of commercial producers. Amateur gardeners ranked the health and quality of varieties, and the availability of varieties with cultural or historical significance (such as heirloom or conservation varieties) as the most important factors.
- The majority of amateur gardeners suggested that the health, quality and identity of purchased seeds have met their expectations. Some differences existed between Member States. Amongst those who reported encountering problems most referred to plants that did not correspond to the characteristics described on the seed packaging and to bad quality seeds (i.e. low rates of germination). While the majority of amateur gardeners were happy with the diversity of choice available to them, many would like to see greater choice of traditional, regional/local and organic varieties.
- A lighter registration regime for varieties intended for amateur gardeners could improve both the availability and genetic diversity of the PRM available to amateur gardeners. However, adopting a lighter regulatory regime for varieties aimed exclusively at amateur gardeners may increase risks to the assurance of PRM identity, quality and health.

**Amateur and conservation varieties and preservation seed mixtures:** The PRM Directives allow derogations for amateur varieties, conservation varieties and preservation seed mixtures providing lighter market access. Despite this, there is limited use of amateur varieties, conservation varieties and preservation seed mixtures. Key reasons identified were:

- Low market demand, relatively high production costs and low profitability compared to commercial varieties mean the market is unattractive for commercial companies.
- Players involved in the production of native seeds, which are often used in preservation seed mixtures, are typically small-scale, not-for-profit producers Extent to which NCAs and public bodies in Member States encourage registration of conservation varieties and recognise their role in supporting biodiversity conservation.

There were mixed views on whether legal limits on production volumes are in fact limiting the size of the market. However, an expert advisor (member of the researched team) warned that removing the production limits could put conservation and amateur varieties in direct competition with commercial varieties, placing an advantage on the former in terms of varietal registration.

Requirements and costs for registering conservation and amateur varieties differ across Member States, although registration fees are generally lower than for conventional varieties[3] and in some cases are zero. Stakeholder views were mixed regarding the limitations imposed by the Directives on the production, maintenance and marketing of conservation varieties to their region of origin with some calling for a more flexible approach. Overall, stakeholders favoured a species-by-species approach to assess the risks related to any relaxation of region of origin rules, rather than a one-size-fits-all approach.

**Forest reproductive material:** The key problems related to the identity and traceability of FRM, and user information needs. Research institutes and academia constituted the majority of the respondents indicating a problem with the conservation of genetic diversity.

Issues around FRM **identity and traceability** were caused by the existing levels of control in the production and marketing of FRM. Contributing drivers were:

- Insufficient resources in NCAs.
- Insufficient guidance on how to identify and record the identity of FRM in relevant documentation.
- Insufficient information on FRM and its identity is collected and/or shared when a product is marketed.
- Information on basic material could be improved.
- Documentation on FRM identity (such as supplier's documents) is not uniformly completed across Member States.

Suggestions to support **increased accountability** and improve practices along the production chain and marketing of FRM included: making Master Certificate codes/reference numbers and/or Master Certificates public at a national level; the use of genetic markers; and a voluntary approach to keeping and sharing records of FRM from basic material.

Relating to the problem of the **conservation of genetic identity** in FRM, the following main drivers were identified:

- Harvesting and distribution of seed stands.
- Intensive use of single seed source.
- Limited transfer of FRM across borders.
- In addition, around half of all stakeholders identified access to state-owned FRM and access to certain types of seeds as drivers.

[3] The term 'conventional varieties' is used in this report as an encompassing term of varieties that are registered through the normal process of DUS and VCU testing. It refers to commercial production of varieties usually bred for high input agriculture, as opposed to, for instance, conservation and amateur varieties, preservation seed mixtures etc.

Relating to the user information needs, stakeholders stated that the most useful information for users of FRM would be:

- Information on FRM identity;
- Deployment zones, ideally considering both current and future bioclimatic zones and conditions for which FRM are suited or expected to be suited for;
- Information on genetic diversity of FRM; and
- Information on FRM availability.

Whilst supplier's documents contain the right level of information, they would benefit from harmonisation across the EU. Further, stakeholders indicated that in order to inform decisions on choosing appropriate planting materials the above-mentioned information would be helpful if provided in advance of purchase.

# 1 Introduction

This Final report is the final deliverable under the ICF study "Data gathering and analysis to support a Commission study on the Union's options to update the existing legislation on the production and marketing of plant reproductive material (PRM)" (henceforth "ICF study"), as contracted by the European Commission's Directorate General in charge of health and food safety - DG SANTE. This ICF study was commissioned by the European Commission (DG SANTE) in June 2020 and was undertaken by ICF, supported by a team of experts.

This report incorporates feedback received from the Commission on the Interim and Draft reports as well as additional evidence collected through the ICF study's 'validation survey'. The remainder of the report is structured as follows:

- Section 2 presents the context and background to the ICF study.
- Section 3 presents the methodology, including details on the specific data collection approaches and any methodological limitations.
- Section 4 presents a critical analysis of the ICF study research questions, drawing on the collected evidence, including:

Section 4.1 on problems relevant to the production and marketing of PRM, their drivers, how they evolved in the past years, their scale, stakeholders impacted and the potential for simplification of the existing legislation.
Section 4.2 on the latest technical developments and the potential benefits and risks of digitalisation.
Section 4.3 on the need for EU level action to address issues.
Section 4.4 on synergies between plant reproductive material legislation and other legislation, including a discussion on any likely inefficiencies.
Section 4.5 on the amateur gardener market structure and latest trends, motivation for amateur gardeners and issues experienced, including a discussion on any limitations linked to the existing variety registration system.
Section 4.6 in relation to conservation, links to the Habitats Directive and the use of conservation, amateur varieties and preservation seed mixtures.
Section 4.7 on forest reproductive material, including a discussion on current problems, user information needs, barriers and likely solutions.

- Section 5 presents the conclusions from the ICF study.

# 2 Context and background

The marketing of seeds is a critical and strategic issue. It is currently discussed in Europe as a lever not only for supporting the European agricultural sector, which historically has been a major objective of the EU, but also to address increasing public and policy concerns over sustainability, biodiversity and food security.

The marketing of seeds has been a topic for EU action and legislation for decades. The legal framework comprises 12 Directives - henceforth referred to as the PRM legislation. Key features in this framework are the mandatory variety registration[4] and, for agricultural species, certification of seed lots. There have been discussions in the past to address the shortcomings and gaps of that legal framework, as well as its simplification, which eventually led to a proposal from the Commission in 2013. That proposal was rejected by the European Parliament. In 2014, the Council then invited the Commission to put forward an updated and amended proposal. By Decision (EU) 2019/1905, the Council has requested that the Commission should submit a study on the Union's options to update the legislative framework on the production and marketing of plant reproductive material by 31 December 2020.

[4] The only exception from mandatory variety registration are ornamental plants (Council Directive 98/56/EC).

The Commission study builds on the rejection of the 2013 proposal by the European Parliament, and the request from the Council to the Commission to revisit the issue and put forward a revised proposal. Yet, in the decade that has passed since the earlier studies several developments call for a revised outlook, including:

- market developments in the PRM industry – particularly technical innovation such as the use of blockchain technologies and new genomic techniques;
- changes in legislation in the food and plant health sector;
- challenges in food security exacerbated by climate change;
- increasing concerns over sustainability and biodiversity;
- new regulations (Official Controls, Plant Health) that have recently entered into force and their relationship to PRM; and
- concerns voiced by Member State authorities with reference to the implementation of the existing legislation on PRM.

A number of the issues identified in 2013 have remained at the heart of the debates between stakeholders and Member States. As the seed industry grows in value and there is a trend towards greater market concentration (including notable recent mergers such as the Bayer-Monsanto merger completed in 2018; Bonny, 2017; Lianos, 2019; OECD, 2018), concerns remain over the extent to which the current EU framework might favour those Member States and businesses with an important stake in the production and marketing of conventional varieties (e.g. Louwaars et al., 2009). Annex 8: PRM market overview presents an overview of the PRM market structure, size, stakeholders and latest trends.

Public and stakeholder concerns over biodiversity and the state of the environment more broadly, already considered at the time of the 2013 proposal, have grown significantly to become a leading issue on the policy agenda of many Member States and the EU. This is embodied in the European Green Deal, the EU Biodiversity Strategy (which includes as an objective the full integration of biodiversity consideration into other EU policies; EC, 2020) and the Farm to Fork strategy adopted in 2020. Meanwhile, further developments in EU legislation have posed questions on potential overlaps, tensions or, rather, lack of integration between the EU legal framework for PRM and new legislation. For example, the new EU Plant Health Regulation (2016/2031) overlaps with PRM Directives on the issue of Regulated Non-Quarantine Pests (RNQPs), while the expansion of the Official Controls Regulation (2017/625) offers a potential model for more effective monitoring and enforcement practices.

Meanwhile, there has been much civil society and research activity around conservation varieties, organic production, and addressing the challenges of climate change across food production, horticulture, and forest management. That, together with EU and state sponsored experimentation, has contributed to enriching the pool of knowledge and ideas that inform the current debate on PRM and Forest Reproductive Material (FRM) in the EU.

Criticisms were raised by various stakeholders as a result of the earlier work that supported the 2013 proposal. Amongst those, a public campaign from civil society criticized the Commission for helping larger companies, putting undue burdens on a small and niche sector[5] and limiting the choice of plant varieties available on the seed market. Issues were also noted by national authorities and breeders in their everyday work with variety registration and certification. Further, some gaps and challenges were identified in the work to develop the previous proposal, including a lack of engagement and understanding of the amateur market (marketing to hobby gardeners), with the views of home gardeners being one of the gaps. Marketing to home gardeners was not addressed in the 2013 evaluation and Impact Assessment and there is a lack of

[5] By niche sector, this report refers to plant reproductive material that is *"marketed in small quantities by non-professionals or microenterprises"* (European Parliament, 2013a)

understanding and robust data on home gardeners' preferences and needs regarding PRM.

This study provides the opportunity to address criticisms raised towards earlier work and update the problem definition in order to inform and support the Commission's study on the European Union's options to update the existing legislation on the production and marketing of PRM. The ICF study provides an updated problem definition. It builds on earlier findings, strengthening and revising them where needed, identifies the current issues for stakeholders and how these have evolved since 2013, and deepens the Commission's understanding of existing and new issues. It is also a first step towards engaging stakeholders on the issue, to help address criticism to earlier work.

# 3 Methodology

This section outlines the principles and rationale underpinning the data collection (Section 3.1); provides a summary of the methods used for data collection including an overview of the quantitative and qualitative data collected (Section 3.2) and; an overview of any gaps and data limitations and an assessment of the impact of these issues in the ability of the data to provide a sound basis for responding to the ICF study research questions (Section 3.3).

## 3.1 Overarching approach

The approach to data collection was developed based on the: ICF study aims and objectives, as confirmed in the project Kick-off meeting; background to the study, including past criticisms and existing sensitivities; evidence base, as well as identified gaps in data; broad landscape of stakeholders with an interest in PRM; challenges of engaging stakeholders during the ongoing Covid-19 crisis.

The approach also benefited from ICF's experience in designing robust research tools and independent expert advice on specific aspects of the research and the most appropriate data collection methodologies.

The ICF study matrix in Annex 1: ICF study matrix identifies how each of the research tasks described below link to the research questions.

## 3.2 Data collection

The approach to data collection (summarised in Table 1) combines desk-based research and an extensive stakeholder consultation through interviews, an online workshop with FRM experts, targeted online surveys and a validation survey.

*Table 1. Data collection*

| Data collection | Description/Objective | Stakeholders engaged |
|---|---|---|
| Desk-based research | Scientific data and research, peer reviewed academic literature, grey literature (reports, working papers), industry reports and EU institutions' policy documents and studies, were reviewed ensuring that the ICF study built on existing evidence, adopted informed approaches to the stakeholder consultation and offered a representative/objective view of the key issues. | NA |
| Interviews | Interviews carried out with a selection of stakeholders explored stakeholders' views on challenges in the production and marketing of PRM including underlying drivers, recent developments in the PRM sector and their impacts (positive or | 40 interviews with academics, civil society organisations, public authorities, |

| | | |
|---|---|---|
| | negative); and advantages and disadvantages of alternative requirements. | industry representatives and farmers' organisations |
| Online workshop | A workshop with FRM experts on issues around the production and marketing of FRM, the conservation and use of forest genetic resources and the genetic diversity of FRM. | 6 FRM experts |
| Targeted surveys | • with regulators and competent authorities collected evidence on the implementation of the Directives at a national level | 27 countries, 25 Member States |
| | • with amateur gardeners collected evidence on amateur gardeners' motivation for gardening; how they source PRM and the key considerations in the purchase of PRM; and concerns or issues around the use of PRM. | 6,089 amateur gardeners from 29 countries |
| | • with maintainers and marketers of registered varieties provided an understanding of the number and types of varieties on the EU market aimed exclusively at hobby gardeners | 81 maintainers of registered varieties for the amateur market |
| | • with FRM stakeholders tested the findings and recommendations emerging from the FRM workshop. | 80 users of FRM and national competent authorities |
| Validation survey | Tested the emerging findings of the ICF study (except on FRM) with stakeholders. The results informed the conclusions. | 88 stakeholders across categories |

## 3.3 Limitations and gaps in evidence

The following limitations relate to the design of the research and methodologies employed and evidence available:

- **Data availability:** There was limited publicly available data with reference to the size of the PRM industry. Available data was difficult to aggregate or compare as it often used different metrics to describe the seed market in monetary (e.g. value of sales, market share, revenue etc.) or other terms (e.g. production volumes), rarely offering a breakdown by agricultural sector, Member State or species. Recent literature further suggests the data available are likely to underestimate the size and value of the market, while some metrics viewed in isolation may offer a distorted view of the sector (Jansen et al., 2019; Bonny, 2017).
- **Sample size:** The findings are based on a relatively small-scale field research of 40 interviews and four stakeholder surveys. The ICF study aimed to engage interviewees across categories, which imposed further restrictions in the numbers of stakeholders engaged per category. The diverse nature of stakeholders suggests that the aggregated views of participants presented in this report may not necessarily represent all stakeholders in the sector or even within each category.
- **Self-selection bias:** Stakeholders for the field research were identified with support from the European Commission and key stakeholders disseminating a call for participation in the research. Participation, particularly in the surveys, was a result of stakeholders coming forward to express their interest.
- **Political sensitivities and strong stakeholder views:** The subject of the ICF study is a highly politicised one with many stakeholders representing different

industries and interests. Responses collected indicated that there may be differences in opinions between stakeholders on what problems and drivers are most relevant and important, depending on their perspective and often knowledge. Sometimes such differences were also recorded within the same type of stakeholder. This was addressed by triangulating evidence sources, identifying differences in opinions and explaining those, to the extent possible, so that findings faithfully represent the views of stakeholders.

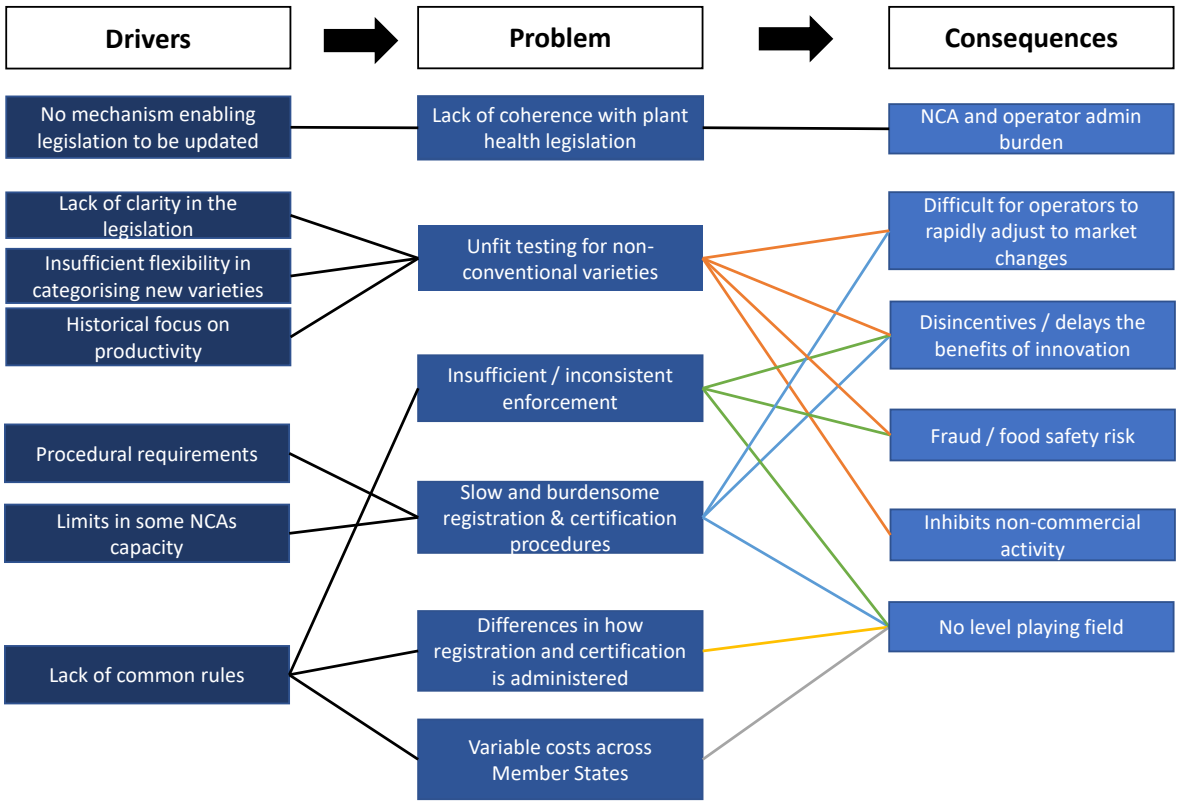
# 4 Critical analysis

This section presents analysis and findings against the ICF study research questions, drawing on the different sources of evidence.

## 4.1 Analysis of the problems that would justify updating the existing legislation

This section presents the main problems in the sector related to the legislation of PRM, as well as suggestions for how these problems could be addressed through changes to the legislation. It responds to research question 1 and research questions 1a to 1f. Figure 1 provides a simplified overview of the problem analysis.

*Figure 1. Simplified problem tree analysis of the existing legislation on the production and marketing of plant reproductive material*




This section analyses each of the problems identified in Figure 1 in turn using the following structure:

- Overview of the problem
- The drivers of the problem
- The stakeholders affected and the size of the problem
- Evolution of the problem, particularly since the 2013 Impact Assessment (IA)
- Addressing the problem and the potential for simplification of the legislation

### 4.1.1 Variable costs across Member States

#### 4.1.1.1 Overview of the problem

The registration of new varieties, the certification of PRM and the mutual recognition of registration between countries (through the European common catalogues) are key features of the current regulation on PRM. Common catalogues are compiled by the Commission on the basis of national catalogues and list the varieties of agricultural and vegetable species, fruit plants and vine propagating material that can be marketed in the EU.

Before registration, a new variety's identity is tested for: Distinctness; Uniformity; Stability (DUS testing); and Value for cultivation and use of the variety (VCU testing, for agricultural crops). Certification and inspections guarantee the identity, health and quality of seeds and propagating material before marketing. Whilst DUS tests are the same among countries for a given species, this is not the case for VCU, with some countries requiring more intense field testing and hence higher costs, or that testing is conducted on a wider number of characteristics (falling under the four VCU criteria or additional to those). Additional characteristics may also be tested on demand of the breeder. Data provided by Member States through a survey of NCAs indicates that there are differences in the fees charged by different Member States[6] and how those fees vary between species or between different types of operator. As a result, operators in different Member States face different costs for registration, which prevents the achievement of an EU-wide level playing field in the sector.

#### 4.1.1.2 Main drivers of the problem

The main driver of this problem is that there are no common rules in the Directives[7] on how fees for registration and certification should be calculated and charged or how costs should be shared between operators and NCAs. As such, Member States employ different systems, based on their understanding of how costs should be shared and what the cost structure should incentivise (e.g., whether it should incentivise biodiversity, reduce burdens on SMEs or place a higher societal value on certain species).

#### 4.1.1.3 Who the problem affects and the size/scale of the issue

The different fees may affect different stakeholders: registration costs typically affect plant breeders, whereas certification costs affect seed producers and distributors, which are likely to differ from the breeder depending on the species[8].

Both the review of past documents and the new evidence indicates that SMEs and not-for-profit organisations selling PRM at low margins are the most affected by this issue.

These types of applicants may lack the resources to anticipate and cover registration and/or certification costs. Numerous stakeholders (including NCAs involved in controls, certification and registration, farmer organisations, users and organisations representing breeders and suppliers of PRM) have highlighted how the current regulation largely underestimates the disproportionate burden that certification and variety registration imposes on SMEs and non-profit organisations with commercial activities. Some (particularly industry stakeholders) have noted how the current registration system favours larger commercial enterprises while limiting consumer choices and penalising smaller actors. As noted by one Civil Society Organisation interviewee, those who wish to register and/or certify varieties already face burden and indirect costs associated with navigating the administrative system. As such, the direct costs, on top

[6] 44% of participants to the validation survey agreed there are differences impacting the EU level playing field, compared to 22% who disagreed (see Annex 10)
[7] 65% of participants to the validation survey agreed, compared to 10% who disagreed
[8] Generally these differ for self-pollinated species.

of the indirect costs and burden of registration and/or certification, may act as a barrier or a disincentive to such applicants.

This also affects operators in niche segments with lower margins and where demand for uniformity is lower (such as those selling to amateur gardeners). As described by some respondents to the survey of operators involved in the amateur gardener market (i.e. maintainers survey), the costs of registering a variety and, where applicable, certifying seed lots cannot be justified in some cases in these niche markets. This then impacts the operator's decision to market that variety, particularly in cases where operators are dealing with a high number of varieties with relatively low turnover per variety. On the other hand, the current variety registration system provides a level playing field for operators of all sizes: varieties of large and small companies are objectively compared next to each other and are subject to the same testing regime.

For larger operators, industry interviews suggest that costs and the differences in costs between Member States do not pose a significant burden or problem. Larger operators may in fact see an opportunity in such differences and choose to register varieties in countries where the cost of registration is lower – an option that may not be available to SMEs in the sector. This would be a consideration for NCAs who may wish to apply more stringent VCU standards. Unless such standards are adopted by other Member States, they could lead to operators opting to register varieties in Member States with lower standards.

The differences in how Member States have managed to regulate the administrative burden to operators mean that this problem affects operators in some Member States more than others. For example, some Member States have a cost responsibility sharing framework in place, whereby the costs of registration and certification are split between the private and the public sector. Some Member States, such as the Netherlands, consider company size and turnover when calculating fees. Other Member States do not take these factors into consideration.

Although many stakeholders mentioned this as an issue across the consultation activities conducted, evidence on the actual scale or extent of this problem is limited.

#### 4.1.1.4 How the problem has evolved since 2013

The problem was identified in the 2013 IA. The comparison between the reviewed documents (dated 2008-2014) and the ICF study stakeholder consultations did not reveal significant change in the nature of the problem. However, changes in factors external to the legislation, such as new technical developments (e.g. new genomic techniques) and increased concentration in the market may contribute to additional burdens and pressures on operators. Considering the above, the relative significance of this issue (i.e. the differences in costs of registration and certification) may have increased, particularly for SMEs.

#### 4.1.1.5 Potential for updating and simplifying the existing legislation

Existing legislation could be amended to provide clearer guidance to Member States on costs and cost sharing, reducing the variability between Member States. The 2013 revision proposed options for the EU-wide adoption of 'full cost recovery' for registration and certification, meaning that operators would be responsible for covering the full cost of registration and certification. This addressed the problem driver by establishing rules for the calculation of costs, which would create a common approach across Member States and hence a more level playing field for the sector.

However, the proposed solution was not well received by industry stakeholders, in part because it has the potential to generate unintended consequences. Key issues were:

- It would disincentivise registration, because of the increased cost of doing so;
- It would unfairly place 100% of the burden on industry;

- It would place a disproportionate burden on SMEs, who are less able to subsume additional costs into their business, giving unfair competitive advantage to larger operators; and
- These issues could result in a reduction in the registration of new varieties, and a less competitive marketplace, ultimately leading to reduced consumer choice.

There may be other options for the Commission to issue rules or guidance for how the costs of registration and certification should be calculated, reflecting the disproportionate burden placed on SMEs and not-for-profit organisations. Such rules or guidance could also reflect the impact of higher and variable costs on niche markets and on the incentives to develop and register varieties in less profitable but ecologically important species. The previous proposal to provide a full exemption in costs for all SMEs was rejected, as explained in the report from the Presidency to the Council following the rejection to the previous proposal on the grounds that "*a block exemption would create market distortions"*. It further noted:[9]

*"If the scope of the Regulation is clear (professional and non-professional users) and there is simplified access to the market for certain types of plant reproductive material, then a reduction of costs for micro-businesses and individuals could be achieved. Moreover, consideration could be given to alternative measures to reduce costs." (p. 6)*

### 4.1.2 Differences in how registration and certification is administered

#### 4.1.2.1 Overview of the problem

Evidence collected through the survey of NCAs and interviews with stakeholders indicates that there are differences between Member States relating to the implementation and functioning of the legislation. Differences in costs (see Section 4.1.1) is one aspect. Another is the difference in how registration and certification is administered.

One element of the process, DUS testing, has been harmonised. Stakeholders indicated that harmonised DUS tests are necessary to ensure clarity and to avoid overlap with other regulations and inconsistencies between Member States. Harmonised DUS tests also help keep costs down and facilitate their administration both for Member States and operators. However, differences in DUS testing between Member States remain, notably regarding the management and composition of variety reference collections.

The conduct of VCU tests (relevant for agricultural species) differs significantly between Member States[10] and sometimes depending on the crops, in terms of which characteristics are examined, how results of VCU tests are calculated and assessed, as well as how long tests take. Most countries use some type of scoring system for calculating VCU results across the four VCU criteria. However, the specific characteristics assessed can differ (especially with reference to factors in the physical environment and pest resistance) and the application of weighting means that "*a good characteristic can outweigh a lesser result in another characteristic*"[11]. Criteria are usually further specified according to the species examined (e.g. Greece). Overriding criteria and differences in the assessment depending on the crop type can also apply. For instance, in Estonia, for varieties for which yield is more than 105% of the standard variety, quality is not important. At the same time, when assessing winter cereals the most important characteristic is winter hardiness.

[9] Council of the European Union (2014). Report 10618/14. Available online at: https://data.consilium.europa.eu/doc/document/ST-10618-2014-INIT/en/pdf

[10] 44% of participants to the validation survey agreed, compared to 20% who disagreed (see Annex 10 for detailed results)

[11] NCA survey response

There are also differences in how Member States incorporate sustainability criteria and how organic varieties are assessed (discussed in 4.3).

#### 4.1.2.2 Main drivers of the problem

The Directives allow Member States significant flexibility in how they implement and administer the certification and registration process. With regard to registration, Commission Directive 2003/90/EC sets out the four criteria Member States should use for VCU testing[12], but Member States determine how the criteria are implemented, VCU results are calculated and how these criteria are considered. They also determine how any additional criteria should be included (e.g. sustainability criteria) and how the system is applied for different production systems (e.g. organic varieties).

Differences in the administration of the registration and certification process are also influenced by institutional differences between Member States, such as how departments and agencies are organised, and competencies split within a Member State.

These differences may also be influenced by different policy environments and priorities in different Member States. This may influence, for example, the extent to which sustainability criteria are included in the calculation of VCU results.

Registration and certification within a Member State can also be managed by different competent authorities. For instance in France, the Ministry of Agriculture supported by a Technical Committee for Plant Breeding and the French Variety and Seed Study and Control Group (CTPS and GEVES)[13] are responsible for variety registration and the official service for control and certification of seeds and plants (SOC)[14] is responsible for seed certification.

#### 4.1.2.3 Who the problem affects and the size/scale of the issue

Mutual recognition of registered varieties across the EU (through the common catalogues) mitigates to some extent the impact of different registration processes by Member States, since a breeder can choose the country of registration where the process is easier and/or less costly and then sell the variety across the EU. This option may not be available for SMEs.

Interviewed stakeholders across groups expressed concerns over the lack of harmonisation and consequent lack of an appropriate level playing field in the internal EU market. It was the problem most frequently identified by industry stakeholders, with eight out of thirteen industry interviewees highlighting the issue. These stakeholders noted that the lack of harmonisation impacts the efficiency, cost, administrative burden and ease of producing and marketing varieties in the EU. How these differences manifest is discussed further in Section 4.3.

Beyond the impact on the level playing field, these differences could also affect the environmental impact of the Directives. CSO organisations interviewed expressed concerns that the Directives place too strong an emphasis on productivity, at the expense of biodiversity and the development of other traits beneficial to long-term food security. Information provided by NCAs indicate that most Member States continue to place the highest priority on yield when calculating VCU results. However, approaches do differ. Some Member States include additional sustainability criteria or place a higher value on other criteria. This means the potential contribution of the registration system to long-term sustainability goals also likely differs by Member State. PRM regulations

[12] (1) Yield, (2) Resistance to harmful organisms, (3) Behaviour with respect to factors in the physical environment, and (4) Quality

[13] https://www.geves.fr/about-us/the-ctps/

[14] https://www.gnis.fr/en/soc-official-service-for-control-and-certification-of-seeds-and-plants-in-france/#:~:text=SOC%20(official%20service%20for%20control,in%20application%20of%20French%20regulation.

offer a way to incentivise innovation on criteria of societal interest that the market insufficiently values.

#### 4.1.2.4 How the problem has evolved since 2013

This issue was identified in the 2013 IA. In the consultation following the IA, several stakeholders noted that the degree of non-harmonisation was underestimated. Differences related to sustainability criteria and the approach to registering organic varieties have likely increased since 2013, as these issues have become increasing policy priorities.

#### 4.1.2.5 Potential for updating and simplifying the existing legislation

The 2013 IA and following proposal put forward a potential solution of simplifying the legislation from 12 directives to one regulation. This would help to harmonise implementation, as a regulation allows for less Member State interpretation as compared to directives. This was criticised at the time due to a "one-size-fits-all" approach not being fit for all types of PRM nor country specifics. Some stakeholders consulted as part of the ICF study touched on this, with some expressing interest in a transition to a regulation, but with most others indicating that a degree of flexibility remains important.

Additional guidance and clarity in the directives regarding VCU testing, the incorporation of sustainability criteria and the approach to organic varieties could help to address this problem. The extent to which this is justified remains unclear: although it is apparent from stakeholder feedback that there is a problem, the evidence available does not allow for this problem to be quantified.

### 4.1.3 Practical conditions set out for testing are unfit for some varieties

#### 4.1.3.1 Overview of the problem

The marketing directives were first established in 1966 and 1971. Originally, the scope of the legislation was agricultural crops and a limited number of other species (cereal seed, beet seed, fodder plant seed, seed potatoes and forest reproductive material). Changes in today's markets and the addition of other crops to the scope of the legislation mean that aspects of the legislation (such as on testing and certification of varieties) are no longer adequate.

The application of the testing required under the legislation can result in operators having to adhere to requirements that do not accurately portray the needs of conservation and amateur varieties or the preservation seed mixtures. A majority of stakeholders responding to the 2013 IA consultation recognised that amateur and conservation varieties in particular should not be under the same regulations as other PRM categories. This includes members of Civil Society Organisations, Farmers associations, industry stakeholders and NCAs. Under the current legislations, derogations exist only for some categories of varieties.

#### 4.1.3.2 Main drivers of the problem

There are three main drivers of unfit registration, DUS and VCU testing and certification conditions:

- The historical focus of the legislation on commercial agricultural crops and varieties.
- A lack of flexibility in the specific requirements of the legislation.
- The lack of clarity of terms used in the directives.

The historical focus of the marketing directives was on improving the productivity of agricultural crops, quality for further processing (e.g. bread production) and on resistance to biotic and antibiotic stress (EC, 2013). Hence, the focus was on commercial agricultural crops and vegetatively propagated material. The criteria set for registration, DUS and VCU testing and certification are mostly modelled on the needs of these commercial crops/materials. However, stakeholder interviews reveal that the needs for

some crops and varieties – including conservation amateur and varieties destined for organic production, differ greatly from other varieties. For example, satisfaction of criteria on uniformity does not apply to organic varieties suitable for organic cultivation, which values seeds that are less homogeneous. Another example provided is that of landraces, which can be low yield and are unable to compete with high productivity varieties (particularly cereals). As such, for some of these varieties, criteria that are not relevant or are inappropriate must be applied. CSOs in particular emphasized the impact of this on producers who practice low-input agriculture with a focus on locally adapted characteristics (such as climatic resistance), maintaining diversity, reducing environmental impact etc.

This reflects the different needs of two distinct communities of users; commercial producers and a growing community of 'diversity' farmers whose interest is only semi-commercial and their primary objective is to maintain and improve genetic diversity with productivity being secondary (expert advisor input).

Interviewees (NCAs and industry stakeholders) indicated that the directives are inflexible. Where requirements laid down in the legislation are found to be inappropriate for a particular variety, NCAs or operators are not able to change those requirements to make them more appropriate. This inflexibility manifests in two ways. Firstly, the standing committee cannot edit the main body of the Directives, meaning that requirements laid down in the basic legislation cannot be changed. Secondly, a new variety cannot be allocated to the best fitting category, but must be allocated to the category identified through the existing standards for classification. For example, one industry stakeholder expressed interest in registering their special seed-propagated fruit variety within the seed-propagated vegetables, as the criteria were more fitting, but this was not permitted.

There is lack of clarity over many of the terms used in the directives. Derogations are permitted under the legislation, with lighter regimes applied for certain varieties, such conservation and amateur varieties. These are implemented by Member States. However, ambiguity in language and definitions (e.g. 'commercial use', 'region of origin') used in the legislation mean that there are differences in how the legislation is interpreted, and how lighter regimes are implemented, across Member States. This issue was raised by industry stakeholders, NCAs and CSOs. Similarly, several stakeholders highlighted how the scope for the certification process is unclear for fruit material, which has different requirements to other plant reproductive materials.

#### 4.1.3.3 Size/scale of the issue and most affected stakeholders

Inappropriate conditions can affect the time, costs, and ability of operators to get new varieties registered and certified. If varieties are not registered and plant reproductive material (seed) are not certified they cannot be marketed. The same DUS testing, as for variety registration, is necessary for obtaining plant variety protection[15].

Overall, the most directly impacted stakeholders are breeders and suppliers of varieties, especially those that do not fit in the standard categories of the 12 Directives, such as conservation, amateur, varieties intended for organic production. The direct impact is in the extra costs and administrative burden (including on NCAs) involved in following

[15] Plant variety protection refers to the granting of intellectual property (IP) rights to the breeder of a new variety. IP rights also known as the Plant Breeder Rights (PBR) are rights granted to the breeder of a new variety of plant that give the breeder exclusive control over the propagating material and harvested material of a new variety for a number of years. There are two exemptions in relation to this type of IP right. The breeder's exemption allows breeding for non-commercial purposes and for the purpose of discovering and developing other varieties. The agricultural exemption allows farmers to use the product of their harvest with regard to EU-protected varieties, as propagating material under strict and defined conditions.

requirements that would not be necessarily incumbent to certify the quality of the variety.

This reduces operators' incentives to develop new varieties and may reduce the flow of innovation in the market. Several organisations representing organic breeders and breeders of traditional, heritage, local and conservation varieties and producers of preservation seed mixtures mentioned this as a substantial limitation in their activities. The issue also affects amateur gardeners who may wish to register their own varieties but are discouraged by the administration and costs. Any reduction in market innovation has the potential to impact on both consumer choice and wider biodiversity and conservation objectives. It was suggested that the DUS criteria in particular are a hurdle to maintenance and further development of biodiversity because they are designed to benefit varieties bred for use in commercial food and feed processing.

Derogations are available for conservation varieties, amateur varieties as well as for preservation seed mixtures. However, these derogations do not cover all varieties that they may be appropriately applied to and vary in their application across Member States[16]. In addition, derogations come with their own marketing restrictions, such as quantitative limits on production (see Section 4.6).

Interviews revealed that NCAs are aware that the issues can in some cases discourage registration of varieties that do not fit well with the criteria. If varieties are not registered, they cannot be marketed. This is a particular concern for traditional varieties (popular in the amateur market) which risk being lost if they are not registered and hence available for marketing. CSOs stated that DUS criteria, developed for agricultural crops, have wrongly been applied to all types of seeds, including native seeds and amateur varieties[17]. One CSO also noted that derogations for preservation mixtures should be extended to apply beyond fodder plant seed mixtures.

Unregistered varieties are sometimes sold illegally on the black market. This can create further issues as authorities cannot control and regulate variety distribution and use. This creates further burdens on NCAs in the long run.

Ambiguity in the language and terminology used in the legislation makes it difficult to determine whether a new variety should be subject to the registration process, or should be registered using a lighter regime for conservation and amateur varieties. NCA interviewees indicated that this creates an incentive for operators to argue for varieties at the margin to be registered using the lighter regime. One NCA representative indicated that the lighter registration regime for amateur varieties can leave room for fraud, as producers may be inclined to register varieties as amateur even if they do not fall into that category to avoid do incur costs (the registration of amateur varieties are in many cases free of charge). The extent of concern regarding this issue varied across Member States. Fraudulent activity, and business conducted via the black market, have the potential to generate food safety, economic and environmental sustainability issues.

Finally, differences in the use of derogations and application of lighter registration regimes across Member States impacts on the level playing field at the EU level.

[16] Two CSOs noted that the scope of Directive 66/401/EEC could be expanded, with one specifying it could helpfully include mixtures for intermediate and subsidiary crops, flowering plants, green manure, flower strips, cereal-legumes mixtures, and variety mixtures. (Interviews with CSOs)

[17] The term 'amateur variety' is used in this report as defined in Directive 2009/145 to mean "*a variety of vegetable species with no intrinsic value for commercial crop production which is developed for growing under particular conditions and is contained within a National List"* https://www.legislation.gov.uk/nisr/2011/38/made/data.xht?view=snippet andwrap=true

#### 4.1.3.4 How has the problem evolved since 2013

The comparison between the 2013 IA and the most recent evidence indicates that the problem remains a concern for most stakeholders. Some recent developments indicate that the problem may have become more acute since 2013.

Issues have emerged with some varieties being included in groups that do not fit their species. This may be a direct consequence of the development of new varieties, which also points to the inflexibility of the current system. This causes problems in terms of the requirements they need to fulfil, and sometimes the DUS and VCU not being fit for purpose. These considerations, which were not initially included in the 2013 IA, are particularly relevant for SMEs and not-for-profit organisations.

Three industry stakeholders (n=13) indicated that the registering of varieties (including ensuring uniformity) has become stricter, which has negatively impacted organic breeders and those registering amateur varieties. One stakeholder noted that previously amateur varieties could reach the market with lower uniformity, which has now changed and can make it harder to register such varieties.

The problem has arguably become more relevant given the continuing increase in societal and political attention on climate change and environmental issues, as well as consumers preferences for conservation and organic varieties.

#### 4.1.3.5 Potential for updating and simplifying the legislation

To simplify the legislation, the rejected 2013/0137 (COD) sought to implement a horizontal framework to replace the existing 12 marketing directives. Such an approach was criticised because it was thought to not adequately address all types of PRM, nor be appropriate for all sectors. Several stakeholders expressed concerns over the proposed "one-size-fits-all" approach to testing. The evidence suggests that given the substantial differences between seed species, a single framework would not be an effective simplification, but rather would aggravate existing issues. It would not adequately address the fitting of the legislation to the specific PRM categories. This could increase the burden on Member States, on operators, and potentially further discourage innovation.

An alternative solution for simplification was suggested in Council 10618/14 SoP: "*A single regulation with different parts/chapters/sections covering the different types of plant reproductive material would be preferable. It should consolidate eleven directives (forest reproductive material excluded) and have a clear and precise scope.*" (p. 5). However, many interviewed stakeholders did not support the Directives being changed into regulations. Indeed, many stakeholders supported the flexibility in national implementation permitted by the Directives. There is a trade-off between a framework that allows for adaptation to Member State conditions, and one which ensures higher levels of harmonisation and hence a level-playing field across the EU.

Based on the problem drivers identified in Section 4.1.3.2, the following areas are identified for potential simplification:

- Ensuring registration and testing criteria are better suited to variety categories: DUS and VCU testing criteria could be updated to better match variety categories, particularly amateur, conservation and varieties intended for organic production. This may be challenging as growers active in this space value diversity over uniformity. Any amendments will also need to take into account the potential impact on PRM ensuring identity, health and quality to its user, which is ensured by the requirements and be robust enough to avoid fraudulent operators seeking to take advantage of categories with lighter regimes. Some stakeholders suggested that while the exclusion of VCU testing would be a real handicap for innovation and competitiveness for the seed industry, DUS testing should only be mandatory for field crop species, and optional for all others.

- Establish a mechanism that enables updating of variety categories: to ensure that the requirements specified in the legislation remain appropriate for new varieties (or other development) not yet known to or envisaged by the market, a mechanism is needed through which the categorisations or specific requirements can be updated. For example, moving technical requirements into implementing legislation. An alternative option is to change the existing standards for categorisation, to allow greater flexibility for new varieties to be allocated to categories that offer the best fit.
- Improve the language and terminology used in the legislation: in particular, increased clarity on which varieties/products/categories fall into the scope of commercial versus not-for-profit purposes would be beneficial. This would improve the consistency of application of the legislation across Member States and reduce opportunities for fraudulent activity.

### 4.1.4 Slow and burdensome procedures for registration and certification

#### 4.1.4.1 Overview of the problem

PRM registration and certification processes take a significant amount of time to complete. Data received from NCAs indicated that the length of the process can vary between 1 to 5 years, depending on the species and Member State, with some Member States taking 2-3 years longer than others. They generate burdens for NCAs and hinder market access for new varieties, disincentivising innovation.

#### 4.1.4.2 Drivers of the problem

NCAs are responsible for the registration and certification of varieties. Certification processes are conducted officially or under official supervision and examinations for variety registration are conducted as official examinations. Completing the registration and certification process can take a significant amount of time and places burdens on both NCAs and operators. The 2013 IA identified a number of specific aspects of the process, which contribute to this (EC, 2013):

- As part of the registration process, Member States' notifications are transferred to the EU Common Catalogue. The frequency with which Member States report national registrations for transfer to the EU Common Catalogue range from monthly to annually, depending on the country;
- At the EU level, depending on the time of the year, the administrative procedure concerning the transfer of varieties to the Common Catalogues (Official Journal) takes roughly 8 weeks;
- Member States may have limited resources for growing trials for variety testing. Therefore in some Member States the number of applications in certain species per year are limited;
- Strict deadlines for submission of application and material;
- Number of years required for the technical examination varies between Member States;
- Breeders have to accept the practical conditions for testing (e.g. locations of fields) in the examination office, which might be suboptimal for variety in question;
- For a new type of variety, the development of the necessary testing protocols can take several years.

The problem is compounded as unregistered varieties cannot be marketed and are subject to restrictions on seed multiplication.

The legislation permits the transfer of aspects of the certification procedures, under certain conditions, to industry through a system of certification under official supervision. However, the legislation does not enable certain plant species (e.g. potatoes) and categories of seed (pre-basic and basic) to fully benefit from officially supervised examination (EC, 2013).

#### 4.1.4.3 Who the problem affects and the scale of the problem

The registration process is burdensome, both in terms of costs and time. Stakeholders identified that breeders, farmers, and company operators tend to be the most affected.

New variety R&D can be expensive. The slow registration and certification process delay the point at which revenue streams can be established to recoup upfront costs and establish a profitable product. This disincentivises innovation. Numerous stakeholders (including NCAs, farmer organisations, users and organisations representing breeders and suppliers of PRM) highlighted the disproportionate burden that certification and variety registration imposes on SMEs. Some (particularly industry stakeholders) noted that the current registration system favours larger commercial enterprises, who may be better able to manage delays to revenue generation. However, varieties of small or big companies are compared and treated the same in the independent variety testing and registration process.

A wide range of stakeholders are affected by the delay that the current processes create in bringing innovations to the market and any suppressing effect that this has on innovation in general. Innovation can support improved plant performance in several ways, such as improved yield, greater resilience to drought and climatic events and climate change adaptation in general, which can benefit a range of stakeholders from farmers to consumers to society in general. Delays in bringing innovations to the market delay the point at which these benefits accrue.

Another aspect linked to this problem is the need to develop new varieties that are suitably adapted to climate change New crop development requires time and any barriers to innovation and the marketing and use of new varieties can potentially hinder crucial adaptation.

The variety registration procedures place a burden on NCAs in terms of staff time, adequately trained staff with technical knowledge to conduct the various processes, as well as supporting infrastructure. Whilst NCA burden was recognised as an issue by stakeholders, it was considered of secondary importance to the burden placed on industry (as detailed above) and the NCA burden generated by the general complexity of the legislation. Where NCA performance in administering registration and certification procedures is affected by budget constraints, this can create a feedback loop further slowing down their implementation.

Differences in NCA performance and application of derogations can result in differences in the time required for registration and certification across Member States, undermining objectives for an EU wide level playing field.

#### 4.1.4.4 How the problem has evolved since 2013

No significant changes to the problem were identified. However, stakeholders indicated that the scale of the burden placed on NCAs by the registration and certification was not as significant as concluded in the 2013 IA.

#### 4.1.4.5 Potential for updating and simplifying the legislation

To reduce the time between commencing the registration and certification process and a supply of products being available to the market, rules could be established that permit PRM multiplication and marketing prior to the completion of the variety registration process. This amendment was raised by both NCA and industry stakeholders. Permission to begin multiplication and to begin marketing could be tied to completion of certain aspects of the registration and certification process and coupled with potential restrictions on the scope or extent of such activities in order to minimise potential risks.

Involving the breeding and seed industry in the registration and certification process could reduce the burden on NCAs and unblock specific problem drivers that result from insufficient NCA capacity. A broad range of stakeholders were supportive of such a change. Stakeholder opinion on the extent to which this could increase the efficiency of

the registration and certification process were mixed. Some industry interviewees identified potential efficiency benefits of permitting a one-year examination under official supervision for registration procedures, as well as the benefits of extra flexibility that greater industry involvement would bring. Industry experts also identified potential benefits for knowledge development and exchange from their greater involvement in registration and certification processes. Some NCA and industry stakeholders raised concerns regarding a potential for deterioration in seed health if there is insufficient oversight from NCAs. This indicates a need for controls on processes, rather than solely outcomes. Concerns were also raised regarding a potential competitive disadvantage for SMEs, who may not have the resources to capitalise on the opportunity.

Linked to the argument around conservation and sustainability:

- removing obstacles for innovation can support the development of new and improved varieties, such as climate-adapted or resistant varieties;
- sustainable use of conservation and traditional varieties can support the preservation of plant genetic diversity and useful traits (e.g. growing in marginal environments); and
- allowing for more heterogeneous varieties, preservation mixtures etc. can support climate change adaptation[18].

### 4.1.5 A lack of coherence with the Plant Health Regulation

#### 4.1.5.1 Overview of the problem

Evidence indicates that there is a lack of coherence between the PRM marketing legislation and the Plant Health Regulation (see Section 4.4 for a fuller discussion of the evidence). The PRM marketing directives include, in the annexes for each directive, conditions that must be satisfied on the health of plants with regards diseases and harmful organisms. Implementing Regulation (EU) 2019/2072 for the Plant Health Regulation includes in Annex IV RNQPs and associated specific plants for planting with categories and thresholds for RNQP assessment as well as other control requirements. Many (but not all) of the diseases and harmful organisms referred to in the PRM marketing directives are RNQPs and are thus also listed in the Plant Health Regulation. However, the language and specifications used in the Plant Health Regulation implementing legislation and the PRM marketing directives are not coherent.

#### 4.1.5.2 Main drivers of the problem

The list of RNQPs relevant to the Plant Health Regulation was published in 2019. There has been no update made to the PRM legislation and hence the language and specifications have not been updated to reflect that used in the Plant Health Regulation. There is no mechanism available, beyond amendment of the marketing directives, to enable ad-hoc updates to be made to address the issue.

#### 4.1.5.3 Who the problem affects and the scale of the problem

Including RNQPs in both pieces of legislation causes confusion regarding which list should be consulted by Member State authorities. NCAs report that the lack of harmonisation makes it difficult to determine what requirements to apply. Often this means that both lists are checked, and additional effort is required to ensure appropriate application of the legislation. This increases the burden on NCAs. The issue is accentuated in Member States where the PRM marketing directives and the Plant Health

[18] It is often claimed that less uniform varieties tend to better withstand climatic challenges, such as extreme weather, heavy rainfalls and/or drought. However, preliminary results of the EU temporary experiment on populations to support this argument are limited due to the number of activities and participating Member States. Further, whilst this argument favours the production of traditional crops, commercial production models may not work as effectively with less uniform varieties (expert advisor input).

Regulation fall under the remit of different NCAs. In such cases, duplication of effort is more likely.

#### 4.1.5.4 How the problem has evolved since 2013

Implementing Regulation (EU) 2019/2072 came into force in 2019. Hence the specific issues with coherence between this aspect of the Plant Health Regulation and the PRM marketing directives was not relevant at the time of the 2013 IA. The problem will remain until the point at which a specific action is undertaken that improves the coherence.

#### 4.1.5.5 Potential for updating and simplifying the existing legislation

Given that the problem is a function of the drafting of the legislation, action by the European Commission (or potentially the Directives' standing committee) is required to address it. The solution favoured by most consulted NCAs is to establish a single definitive list. It is anticipated that this would be within the Plant Health Regulation, as there is a requirement for RNQPs to be listed in it. A single definitive source of such information, appropriately cross-referenced from the PRM marketing directives, would avoid future divergence if updates are made in the future to one or other of the legislations. If specific RNQPs are retained in both legislations, then a mechanism for enabling ad-hoc updates to one or other would be necessary to avoid potential future divergence (e.g. use of implementing legislation).

### 4.1.6 Variability in PRM control and enforcement

#### 4.1.6.1 Overview of the problem

Evidence from stakeholders[19] and the 2013 IA indicates that there is a lack of harmonisation in the control and enforcement of PRM legislation in the EU. Differences in the interpretation of the marketing Directives have led to different approaches being implemented by Member States, resulting in some Member States imposing stricter regimes than others. This variation impacts the attainment of an EU level playing field, and in cases where enforcement is potentially insufficient opens up PRM to fraudulent activity. This undermines market incentives and competition and heightens food safety and other risks.

#### 4.1.6.2 Main drivers of the problem

There is no legal framework providing Member State NCAs with a robust, comprehensive set of rules, and powers and tools for enforcing PRM legislation. No such framework is provided for in the PRM marketing legislation, and PRMs are not covered by the Official Controls Regulation (EU) 2017/625[20]. Further, there is a lack of clarity over some of the terminology used regarding controls (e.g. "random"). This has resulted in divergences in the approaches taken by Member States. EU rules on PRM do not provide for Commission audits on the functioning of national control systems, removing the opportunity for ongoing feedback to improve harmonisation and effectiveness at the national level.

#### 4.1.6.3 Who the problem affects and the size of the problem

Differences in control activities for PRM legislation across Member States have the potential to generate higher costs of compliance for organisation in those Member States with more stringent control regimes. This prevents attainment of the EU wide level playing field. Harmonising rules on control across Member States was considered

[19] responses to the NCA survey, NCA interviews and PRM industry interviews

[20] The Official Controls Regulation addresses official controls and other official activities performed to ensure the application of food and feed law, rules on animal health and welfare, plant health and plant protection products.

beneficial by 17 of 28 respondents to the NCA survey[21], while another five suggested it could be beneficial but only for certain aspects of the legislation (e.g. VCU tests).

Differences in enforcement across Member States create differences in the costs of non-compliance. Stakeholders indicated that the same offence may result in different enforcement actions in different Member States – for example, an offence may generate a relatively small fine in one but result in a prison sentence in another.

In addition, it was suggested that there are cases where companies and individuals are breeding and marketing non-listed varieties or marketing them under a false name.

Weakness in the EU wide control and enforcement of requirements for PRM undermines the functioning of a competitive marketplace. For example, one industry stakeholder stated that the advantages of registering varieties were undermined if IP and commercial activity were not adequately regulated. Reduced market incentives stifle innovation and competition limiting market development and hence the delivery of varieties that may better address the needs of consumers and society more generally (e.g. the development of sustainable varieties to better support environment and similar objectives). Fraudulent activity potentially increases the likelihood of substandard products in the market, impacting on business performance and heightening food safety and other risks.

#### 4.1.6.4 How the problem has evolved since 2013

No evidence was identified on whether Member State approaches to PRM control and enforcement have changed substantially since 2013. Similarly, no evidence was identified on the extent to which variability in Member State approaches, and insufficient control and enforcement, may have exacerbated the resulting impacts since 2013.

Since the 2013 IA a new Official Controls Regulation (EU) 2017/625 has been introduced. However, whilst it was considered, PRM was not included within the scope of the new regulation.

#### 4.1.6.5 Potential for updating and simplifying the existing legislation

There is a need to enhance the legal framework within which Member State NCAs apply control and enforcement of PRM legislation. This includes a more comprehensive package of rules and tools, as well as the opportunity for EU audit.

NCA opinion on bringing PRM under the Official Controls Regulation was mixed. Eleven respondents to the NCA survey indicated they could see a benefit (some more limited than others), while another eleven saw no additional benefits.

The main reason given in support of including the marketing directives in the Official Controls Regulation was to improve the efficiency of implementation. Member State respondents, as well as evidence in the 2013 Impact Assessment (European Commission, 2013) consider that the Official Controls Regulation could introduce a simplified and more efficient regime which lowers administrative burden, particularly for Member States that split responsibilities of control and enforcement of the Marketing Directives and Official Control Regulation across different government bodies. Five NCAs also mentioned benefits in terms of integrating controls for PRM with those of the rest of the food system (i.e. plant health, feed and food).

Reasons against the inclusion of PRM in the Official Controls Regulation included the loss of flexibility in how Member States implement PRM control and enforcement, and (in contradiction to the reason of support identified above) that the greater complexity of the Official Controls Regulation would increase the burden on NCAs and could result in confusion or a malfunctioning system (at least in the beginning).

[21] Responses were received from 28 NCAs including NCAs from 25 Member States (including two NCAs for Belgium- Flanders and Wallonia) and two non-Member States (Norway and Switzerland).

## 4.2 Technical developments and digitalisation

### 4.2.1 Technical developments

This section addresses the ICF study research question 1e, providing insights on how technical developments in the breeding sector and concerns over sustainability impact on the problems and stakeholders identified and described in section 4.1 and what are the implications for the PRM marketing legislation.

In the context of the ICF study, technical developments refer to a growing number of New Genomic Techniques (NGTs), defined as "*techniques capable to alter the genetic material of an organism that have emerged or have been mostly developed over the past two decades"* (EC, 2019). These techniques make use of the increasing amount of plant genetic information available in the breeding process to alter the genome of organisms (EC, 2019; Eckerstorfer et al., 2019).

Since 2014 and the EP resolution acknowledging the potential for innovative breeding techniques to developing improved varieties and securing the future food (EP, 2014), there has been an ongoing debate as to how these techniques should be addressed in EU legislation. In 2018, the European Court of Justice ruled that plants obtained using new mutagenesis techniques that have appeared or have been mostly developed since the adoption of Directive 2001/18/EC are considered genetically modified and fall under the scope of GMO regulation. The judgment sparked further debate[22] and in November 2019 The Council of the European Union requested the Commission (Council Decision (EU) 2019/1904) to submit a study "*regarding the status of novel genomic techniques under Union law*" (i.e. Directive 2001/18/EC, Regulation (EC) 1829/2003, Regulation (EC) 1830/2003 and Directive 2009/41/EC)." The study, expected to conclude in April 2021, will provide an overview of the latest information, the implementation of relevant legislation and implications for operators.

The ICF study approached the issue of NGTs from a different perspective, simply trying to relay the implications, concerns and considerations relevant to the PRM legislation and linked to concerns over sustainability. These implications, emerging predominantly from the analysis of interviews with stakeholders and expert advice, are listed below.

- **Progress and impact on the industry**: Experts and a number of industry stakeholders interviewed suggested that the lack of flexibility in the EU legislation to the changing needs and PRM market, can hamper progress. Some stakeholders further argued that the *"defensive"* position adopted on NGTs will in the long-term disadvantage the EU compared to other parts of the world, and argued for legislation that would "give room to operate" and create a level playing field with other countries outside the EU. That impact is more pronounced for SMEs and plant breeders in the EU who do not have an international presence. Overall, high regulatory cost can impact the overall cost of adopting new technologies, with SMEs disproportionately impacted.
- **Sustainability and food security**: In the midst of increasing concerns over sustainability and food security, there is an argument in favour of technical innovation (e.g. NGTs) that can accelerate the development of new varieties with improved characteristics such as resistance to pests or climatic conditions. This links to concerns around food security, with experts calling for the Commission to 'enable' these technologies to be part of the solution.
- **Food safety:** On the other hand, a number of stakeholders across categories called for a need to ensure the products of such processes are safe. Environmental organisations raised concerns regarding the likely unintended effects and unpredictable consequences on food and feed. The European Network of Scientists

[22] EP (2019) provides an overview of the debate and arguments brought forward by different stakeholders.

for Social and Environmental Responsibility (ENSSER) also warned about the likely presence of toxins or allergens in food and feed (EP, 2019).

- **Likely impact on (plant) biodiversity:** Concerns were found in literature noting that *"Paradoxically, intensification of plant-breeding activity may reduce biodiversity, and hence resilience. Plant genetic diversity is threatened by the loss of landraces (local varieties of plant species that have adapted over time to their ecological and cultural environments) and the domination of genetically uniform modern varieties in many agricultural production systems."* (EP, 2019)
- **Access to improved, cost-effective varieties:** If varieties produced using NGTs are dealt with as GMO, farmers in the EU may have reduced access to varieties with improved characteristics, which are also cost-effective. There is also a concern that, as with most new techniques, plant traits of varieties produced using NGTs are more likely to be patented, which could restrict the use of the breeder's exemption, according to which breeders can use varieties from other breeders for further breeding.
- **Testing for new varieties:** The intensification of plant breeding activity and new technologies used could impact the way that DUS testing is carried out. Work is underway to explore how DNA testing techniques and molecular markers can be applied to DUS testing. One industry stakeholder noted that "*at the moment, this could not replace distinctiveness but could help to identify individual traits and differentiate varieties*." This could make DUS testing easier. Such a debate can be anticipated as similar discussions have taken place with reference to the GMO legislation and whether the criterion for inclusion is process or result based (EP, 2019). Responses from the industry were mixed with some arguing that the breeding process is *"insignificant to the registration of the variety and marketing of the seed".* NCAs were overall keen to ensure there is clarity in the legislation and a common approach moving forwards to inform control and enforcement: *"as a supervising body we should know how they would use it and how to control them."*
- **Modernising administration of testing:** Administration of the variety testing system would likely need to change to reflect the new developments. Examination offices would need to change protocols and modernise examination, with one industry stakeholder suggesting that should be centralised, so that across Member States everyone uses the same techniques and methods. One industry stakeholder raised a concern over likely additional administrative requirements for registering varieties resulting from NGTs, while others noted the technology used in breeding should not impact variety registration.
- **An optional approach to any changes in testing**: Civil society organisations interviewed also emphasised the need for any revisions in current legislation to take account of industry stakeholders who do not have access to NGTs. Two concerns were raised: the first relevant to the risk of losing knowledge held by breeders using conventional breeding, for instance if public funding was diverted away from conventional breeding techniques (which tend to be more participatory and decentralised) and towards new techniques used by a minority of breeders, and; the second, ensuring that the use of molecular techniques in variety registration is optional and not mandated in any revisions of the legislation.
- **Need for a transparent, harmonised approach:** Stakeholders emphasised that transparency in how varieties obtained through NGTs are registered and certified, if allowed in the EU, will be key along with a harmonised approach across Member states.

### 4.2.2 Digitalisation and blockchain

This section responds to Q5 on the potential role of digitalisation, and blockchain in particular, to improve traceability and offer greater assurance on the identity, quality and health of seeds. The section examines the potential for blockchain technology, provides an overview of some other digital solutions, and presents stakeholder opinions

on digital solutions (including blockchain). It draws on evidence from interviews, as well as existing literature.

#### 4.2.2.1 Traceability and digital solutions

The complexity of the agri-food chain makes it vulnerable to market failures, particularly regarding imperfect or asymmetric information. The literature identifies several such problems within the sector related to traceability and transparency, which can result in issues with fraud and product quality. Traceability in the supply chain refers to the ability to track the steps in a production process – from origin to end. It provides for the collection and documentation of steps in that process, and the ability for interested parties to access that information. A transparent traceability system enables multiple stakeholders (e.g. breeders, producers and farmers) to better track and/or identify potential environmental, health and social problems in agricultural production chains. As such, a key benefit of traceability is the ability to link products to quality, and to engender trust amongst multiple stakeholder groups. Trust is a widespread issue in supply chains where stakeholders and facilities tend to be geographically dispersed, leading to disconnections between buyers and sellers and transactional complexities (Wang et al., 2019). Hence enhanced traceability and transparency are expected to greatly benefit the agri-food sector. Notably, consumers (who traditionally suffer from information asymmetry) and regulators (who would be able to more promptly detect fraud or market irregularities, where action is needed) are expected to benefit.

Digitalisation is often identified as a potential route to enhanced traceability. Digitalisation offers the possibility to keep a tidy, easily accessible record of the transactions or information about a product. In comparison to standard paper-based methods, digital records accelerate data capture and facilitate the access and retrieval of information. In addition, this can better facilitate certification audits, which further support traceability and trust.

In particular, among the new digital technology developments, blockchain often emerges as a promising solution to traceability issues. The intrinsic features of blockchain lend themselves well to the complex structure of the agri-food supply chain. The ability of blockchain to maintain seamless and *reliable* data is critical, especially in the field of food safety and sustainability. However, literature on the specific benefits and risks of the use of blockchain (beyond just the benefits of enhanced traceability) in supply chains is still relatively scarce. There are few real-world applications of blockchain in supply chains: a review conducted in 2017 found no evidence of large scale blockchain adoption in supply chains, with its application to-date focussed primarily on small scale pilot projects or trials. As such, conclusions from assessments on the adoption of blockchain are still tentative.

Other digital solutions beyond blockchain can also enhance traceability and transparency, including digital networks, DOIs (see Section 4.2.2.3), QR codes and others. These digital solutions are simpler to implement but do not offer the same benefits as blockchain. Some of these digital solutions can be complemented with blockchain for enhanced traceability (as discussed below). This section presents only a high-level overview of some of these other options.

#### 4.2.2.2 Blockchain

Blockchain is, by construction, well suited to resolve market irregularities regarding transparency and traceability in the agri-food supply chain. Originally built for digital currency markets, blockchain consists of nodes in a communication network, each of which stores a copy of the blockchain and verifies transactions through a consensus algorithm which makes transactions immutable (Wang et al., 2019, p.63). As a transaction occurs, the data is stored in a "block" which is added to the next in an irreversible chain that cannot be deleted or edited by a single party. Blockchain operates in a decentralised system, which means that no single party controls the data – the data

is visible and verifiable to all parties directly, without the need for an intermediary (disintermediation). The consensus function ensures the data cannot be manipulated.

Blockchain can be distinguished in terms of access control, which can be public (or "permissionless") or "permissioned" (where participants need to obtain an invitation to join; access is controlled by a consortium of members or a single organisation). Wang et al. (2019) find that most uses of blockchain in the supply chain in practice deployed permissioned blockchain solutions (probably given the sensitivity of supply chain information). This type is also better at "*controlling the consistency and integrity of the data appended to the blockchain (critical for decision making)*" (Wang et al., 2019, p.71).

The absence of intermediaries and direct transactions across networks makes blockchain well suited for supply chains where the multiple stakeholders involved benefit from addressing a shared problem. This means there is shared value across stakeholders for resolving the problem, which encourages participation and incentivises collaborative behaviours among participants. However, there are still unexplored risks and challenges to blockchain, aggravated by its lack of large-scale implementation (FAO, 2019 p. 10). Table 2 illustrates how some of blockchain's design features could be valuable for agri-food supply chains, comparing it with some risks associated with the technology.

*Table 2. Benefits and risks of blockchain in the agri-food supply chain*

| Benefits | Risks |
|---|---|
| ***The traceability chain cannot be tampered with. Entered data is irreversible, meaning that falsification is nearly unattainable*** – each transaction can be registered in real-time in an irreversible block, from manufacturing to distribution and sale. Moreover, timestamping ensures a temporal order to the transaction and proves the existence of data at a certain point in time. **The transparency assured by blockchain is essential in ensuring authenticity and legitimacy** – every action in the blockchain is fully auditable and the extended traceability benefits industries that are sensitive to product provenance, such as agri-food. (Wang et al., 2019) | **Mistakes cannot be reversed**. The same immutability feature of the technology that guarantees a system of trust in the network, may also create an issue when users make mistakes during data entry (Wang et al., 2018). Decentralisation and disintermediation mean increased responsibility on the user, which has its risks (FAO, 2019, p. 14). |
| ***Data integrity.*** **Disintermediation** means that the integrity of the data is guaranteed by a whole network. This attribute is particularly favourable to large networks of disparate parties. A blockchain based platform digitalises and establishes an immutable shared record of all transactions, thus solving the issue of lack of information visibility in trade and narrowing the scope for fraud or exploitation (Wang et al., 2019, p. 72). | **The technical complexity may limit confidence in, and willingness to adopt, blockchain technologies.** Blockchain is a novel technology that has not yet been widely applied to manage supply chains. It often requires specialised technical expertise to be fully understood. There could be cultural resistance to its adoption, because of a perceived loss of control (Wang et al., 2019) as well as a perception of 'excessive' transparency. As a result some companies may be unwilling to share valued information (Wang et al., 2019, p. 74). However, without widespread compliance, the benefits of blockchain may not be realised (FAO, 2019). |
| ***Strong data security.*** **Decentralisation** is a unique data security mechanism which can protect against fraud and cybercrime, as decentralised systems are more resilient to hacks. The data in a blockchain system is | **Hacking is still possible.** Hacking (the gaining of unauthorized access to data in a system) is a challenge that comes with any digitalisation practice. Although blockchain is more resilient to malicious attacks than other |

| | |
|---|---|
| immutable because the sequence of transactions is saved in chronological blocks of nodes broadcast to all other nodes (Wang et al., 2019). The **consensus mechanism** makes the system tamper-proof and complicates falsifications attempts. | systems, there is still scope for cyberattacks (Wang et al., 2019). |
| | The **costs of implementing the technology are high**. Costs includes infrastructure and technical and specialised expertise (Wang et al., 2019). This may deepen the disadvantage of SMEs in the PRM sector, which may not have the necessary resources to adopt the technology. |
| **Blockchain-supported traceability improvements could support positive environmental change in the PRM or agri-food sector**. Full traceability can promote responsible consumerism by allowing consumers to choose their products based on the method of production and consequently incentivise sustainable methods of production (FAO 2019, p.8). Moreover, blockchain can aid the monitoring of green or climate bonds – created to fund projects that have a positive environmental impact (FAO 2019, p. 9) | **The energy requirements of blockchain technologies are high**, which has a negative environmental impact (Wang et al., 2019, p.74). Although the energy consumption rate of the system also depends on the consensus algorithm adopted (PoW, PoS, Po) (FAO 2019, p.13). However, because blockchain-enabled systems in the agri-food sector also have the potential to incentivise higher investment in sustainable solutions, this may cancel out or exceed the negative environmental impacts from increased energy use. |
| **All stakeholders in the supply chain can benefit.** The improved traceability offered by blockchain has the potential to benefit stakeholders across the whole PRM supply chain: operators, breeders, regulators, and consumers. | A PwC survey[23] revealed that **the largest barrier to the technological adoption was regulatory uncertainty** (FAO, 2019). With larger scale implementation legal challenges may emerge due to the complexity of international markets (Wang et al., 2019, p. 74).<br>**Blockchain may disadvantage those with low levels of digital literacy and connectivity.** Digital literacy and connectivity remain important challenges in agriculture (FAO 2019, p.30). Rural areas tend to have poorer connection, and people in rural areas tend to be less familiar with new technologies (Sundmaeker et al., 2020). |

An important benefit of blockchain is that it has the potential to benefit all stakeholders – not only operators in the supply chain, but also regulators and consumers.

**Operators can benefit** from the integrated trust mechanism[24] offered by blockchain, access to better quality products and enhanced transparency offered by blockchain systems. A McKinsey study on *SeedAssure*, an African-led company piloting the use of blockchain in the registration of seeds in Africa, revealed that the technology led to an increase in efficiency (both in terms of time and cost gains) as well as an improvement in production (with a 250% increase in yield) (Lawrence-Brown, 2020). This was achieved because of the positive effect that the blockchain system had on data accuracy, quality assurance and the time required for seed registration. A similar system is being successfully piloted by Barilla (an Italian manufacturer) in Europe, helping to trace back

[23] PwC blockchain survey, available at pwc.com/blockchainsurvey, mentioned in FAO (2019), p.1
[24] An "integrated trust mechanism" refers to the ability of blockchain to provide intrinsically trustworthy information, which cannot be tampered with and is guaranteed by a network of users with divergent interests.

the methods of production of its "basil pesto" to guarantee its origin and product quality (FAO 2019, p. 8).

**Regulators can benefit** from having real-time access to data, which can support more effective action against fraud and more efficient correction of malfunctions in the registration process. The OECD discussion paper recognises the potential for digitalisation to accelerate the exchange of accurate information between NCAs and supply chain stakeholders (OECD TAD/CA/S/RD(2019)18/REV1). Results from the Canadian Soybean pilot study reveals that this technology has the potential to ensure regulatory compliance by ensuring that new varieties or varieties with atypical characteristics are flagged before entering markets. Moreover, it offers to flag suspicious activity such as the quantity of seeds entering the marketing exceeding the amount declared or when the yield exceeds expectations or thresholds (Miller, 2020).

**Consumers can benefit** from better quality products because of traceability and improved product information on provenance and methods of production are made more accessible (Tse et al., 2017). In the case of the Canadian Soybean pilot study, consumers could follow the path of purchasable products provided by blockchain before buying them by scanning the QR code on each package (Miller, 2020). Integrating QR codes with blockchain offers the option to provide user-friendly access to transparent information, which can be a significant enhancement of the transparency offered by blockchain. An interview with a representative for a CSO for PRM suggested that QR codes on small seed packages linking the product to the process could be useful for transparency purposes. Blockchain can be used as a complement to this easy-to-use labelling process to ensure the traceability of the product. This enables consumers to make more informed choices. Given increasing concerns over food safety and sustainability, consumers pay much more attention to authenticity and legitimacy of products. Blockchain offers a form of warranty mechanism, provided that consumers are aware and trust the type of information from this technology. This may also generate a reward mechanism for producers who employ good practices in the agri-food chain, such as sustainable farming (FAO, p. 6 and 8). Currently it is hard to provide evidence on provenance and methods of production. This was seemingly achieved by the technology *SeedAssure* in Africa, which registered higher approval rates and better performance (Lawrence-Brown, 2020).

#### 4.2.2.3 DOI

In recent years, the International Treaty on Plant Genetic Resources for Food and Agriculture (ITPGRFA) has been exploring the use of Digital Object Identifiers (DOI) to register plant genetic resources in a standard format. DOIs are permanent unique digital identifiers used to improve the identification of plant genetic resources for food and agriculture (PGRFA) by generating a standard identity code associated with the relevant PGRFA. In the context of PGRFA, DOIs facilitate the linkage between materials and relevant information associated with it, including provenance (Alercia et al., 2018). A DOI is a standardised alphanumeric code associated with a specific internet address. It is certified by a registration agency and can be placed on labels or products to link them to a website where information on that product can be provided. The DOI can be scanned with an app or inserted manually and it ensures that it redirects always to the same source. The type of information or website to which the DOI is associated depends on the manufacturer (or the stakeholder generating the DOI). The main feature is that the link is persistent, so that association is not lost.

In the context of PRM, DOIs can be used independently of or could complement other digital technologies for traceability. The DOI could be associated with a website providing information on a particular variety, including information on its origin or other relevant characteristics. It could also include information on whether and which registration process the variety had been through. By using standardised DOIs, users would be able to identify and document their PRM with a permanent and unique code. This standardised identifier will facilitate interoperability among different systems,

databases and users: the single standard identification code can be used by all users to connect disparate information about a specific product. (Alercia et al., 2018). This is because the code, when associated to a specific product, website, or other information database with relevant information will always redirect the user to the same location – thus effectively acting as a gatherer of different information.

There are two ways in which DOIs might help with the legislation on PRM. Firstly, it can be used for digital labelling either independently or paired to digital tracking activity related to the production of PRM. This information can be either be paired to the products/packaging for consumers' benefit or be linked to the various stages of production for the operators in the supply chain to access. This could facilitate the NCAs role in tracking market activities in the sector and also enhance accountability between the various stakeholders in the supply chain. The use of DOIs in the PRM sector also applies in the context of breeding methods, as genetic information on seeds and other crop materials can be readily available when associated to a DOI (Alercia et al., 2018, V). Secondly, DOIs could potentially assist NCAs in the monitoring of certification and registration processes. DOIs could act as a reference for specific varieties or categories that links crops or varieties to the relevant legislation and requirements. In that way, when registering a variety, farmers could have access to a simpler way to understand the relevant procedures, testing requirements, options, etc. Having all the information in one location may simplify access to the legislation and help minimising the burden to NCAs and operators.

#### 4.2.2.4 Digital solutions and barrier to implementation for farmers and breeders

Two important obstacles to the implementation of digital solutions in the agri-food sector are digital illiteracy and poor connectivity, especially among farmers or breeders in rural areas where connectivity is notoriously less developed (European Commission, 2015; Vironen and Kah, 2019). Improvements in digital literacy and connectivity in rural areas have the potential to benefit farmers by enabling the adoption of digital solutions that can facilitate access to information on quality of the products offered by suppliers.

Existing changes in the market, including the establishment of digital networks[25], technology supported farming[26], facilitated communications, and an increasing reliance on online reviews of products, as well as global trends in social digital interactions, digital policies[27] and telecommunications infrastructure, are expected to drive improvements in digital literacy and connectivity. As digital solutions and technologies become more pervasive in the sector, some of the perceived barriers are naturally eroding. For example, the increasing reliance of customers on online reviews of products (such as PRM) is adding a layer of transparency and traceability to the existing market, by indirectly incentivising good quality produce.

The increasing pervasiveness of technology among farmers and breeders is already helping addressing issues of transparency and traceability. Given the increasing traction of some of these digital solutions, there are promising signs that transparency and traceability in the market are improving.

This may, at least temporarily, reduce the need for adoption of blockchain. However, the digital transformation of the agri-food sector involves significant transaction and infrastructure costs[28]. For the transformation to be successful all parties involved need

[25] For example: https://digital.hbs.edu/platform-digit/submission/developing-a-digital-farmers-network-to-create-pricing-transparency/

[26] E.g. Internet of Food and Farm, at https://www.iof2020.eu/

[27] Broadband Competence Offices Network https://ec.europa.eu/digital-single-market/en/broadband-competence-offices

[28] Goedde, Lutz, Joshua Katz, Alexandre Menard and Julien Revellat (2020) Agriculture's connected future: How technology can yield new growth. McKinsey. Available at:

to benefit (Wang et al., 2019, p. 74). There are concerns that not all stakeholders or Member States will. It may be economically challenging for smaller enterprises or individuals which cannot bear the costs. Some interviewees expressed concerns over the struggle of SMEs to adapt to new technologies and the disadvantage that this could engender in comparison to larger enterprises. Moreover, existing digital solutions described above only cover one segment of the chain: the interaction between farmers and acquirers. Other more pervasive digital solutions may be needed to provide coverage for the whole supply chains.

#### 4.2.2.5 Stakeholders opinion on Digital solutions

***Positives***

Overall, most interviewed stakeholders across categories recognise that digitalisation and blockchain are potentially effective methods for improving transparency and traceability in the PRM sector.

Representatives of NCAs (n=5) indicated that the issue of digitalisation as a tool to improve traceability and prevent fraud has been discussed at the OECD level. Generally, it is viewed as a potentially helpful tool to help regulation of the sector. Among the main benefits expected are improved detection and prevention of fraud through label recognition, as well as a reduced need for physical inspections and improved trust in sellers. This could improve the current registration and inspection system for PRM and decrease the administrative burden of NCAs. NCA representatives mostly agree that digitalisation could improve interactions with other authorities. For example, representatives of one NCA said that digitalisation could help with the creation of a central platform where varieties can be listed without risk of duplication. Another NCA suggested that blockchain could improve the access to documents and the validation state of the materials, perhaps through a centralised platform. Representatives of PRM industries (n=13) indicated that the main benefits of using digitalisation included transparency, traceability, decrease in paperwork, decrease in cost, improved speed of process and improved ability to track infringements. Two stakeholders further highlighted that digitalisation can improve the speed, cost and effectiveness for plant breeders and examination officers to help a variety reach the market quicker.

Some stakeholders thought that the potential benefits may not be as great as expected. One interviewed expert noted that blockchain will not be necessary for many species, and so blockchain should not be made mandatory. Moreover, two industry stakeholders pointed out that the EU already has a transparent system in place and saw no scope for the introduction of digitalisation in the PRM sector.

***Negatives and potential risks***

Some respondents, especially CSO and industry stakeholders, called for caution in the adoption of new technologies because of concerns over security and costs. Concerns were also raised by one expert about the ownership and confidentiality of the molecular information.

One NCA representative was concerned that relying solely on digital data could create issues and blockages in case of a power outage. In addition, four industry stakeholders also recognised that digital platforms can sometimes create a false sense of security. It was noted that any digital platform should not include confidential data as this may make companies vulnerable to cyberattacks.

One NCA respondent indicated that the technology may be too expensive for the PRM sector: while some categories with more profitable markets could afford it, categories with smaller markets would not be profitable enough for such an investment. Likewise, four industry representatives noted that SMEs would be at a disadvantage because

https://www.mckinsey.com/industries/agriculture/our-insights/agricultures-connected-future-how-technology-can-yield-new-growth#

implementing digital platforms may be too costly and in-house resources may not be available. NCA representatives mostly agreed that if the cost of the technology decreased then the benefit of its implementation could outweigh the risks.

***Barriers to adoption***

NCAs recognised that there are already systems in place that could be extended and applied in the PRM sector. One NCA interviewee pointed out that in most countries data is already digitalised, so it would just be a matter of including the information on labels.

The primary barrier identified concerned stakeholders' understanding of digital solutions such as blockchain. Interviewed stakeholders, in particular industry representatives, farmers organisations and NCAs, stressed the need to understand how to best use new technological tools to enhance regulation as well as to regulate new technological developments (such as gene editing technologies in the breeding sector) when updating the PRM legislation.

## 4.3 Variation in Member State practices

Problems, practices and courses of action vary significantly across Member States. To some extent, stakeholders regard a certain degree of difference between Member States as necessary and reflective of differences in climate, markets and how Competent Authorities are organised. Key differences between Member States identified include:

- Stakeholders' experiences with the registration system;
- The volumes of applications received by different Member States;
- Different approaches to calculating VCU results;
- Different approaches to incorporating sustainability criteria;
- Different approaches to registering organic varieties;
- Different approaches to managing variety reference collections;
- Differences in costs and cost recovery;
- Different approaches to updating the Common Catalogue; and
- Different approaches to controls and enforcement.

Within interviews, stakeholders across groups were asked about their **experiences with the registration system**. Industry stakeholders interviewed considered the process to be straightforward, although a few noted that the registration system differs between Member States and that this can impact the decisions made when registering a variety. For example, one stakeholder noted that the VCU testing is more "liberal" in the Netherlands in comparison to other Member States, such as Germany, where the registration system can take up to 5 years. Data received from NCAs confirmed that the 'typical' length of the process can vary between 1 to 5 years, depending on the species and Member State, with some Member States taking 2-3 years longer than others. Industry stakeholders mentioned other factors that influence their decisions on where to register a variety, including:

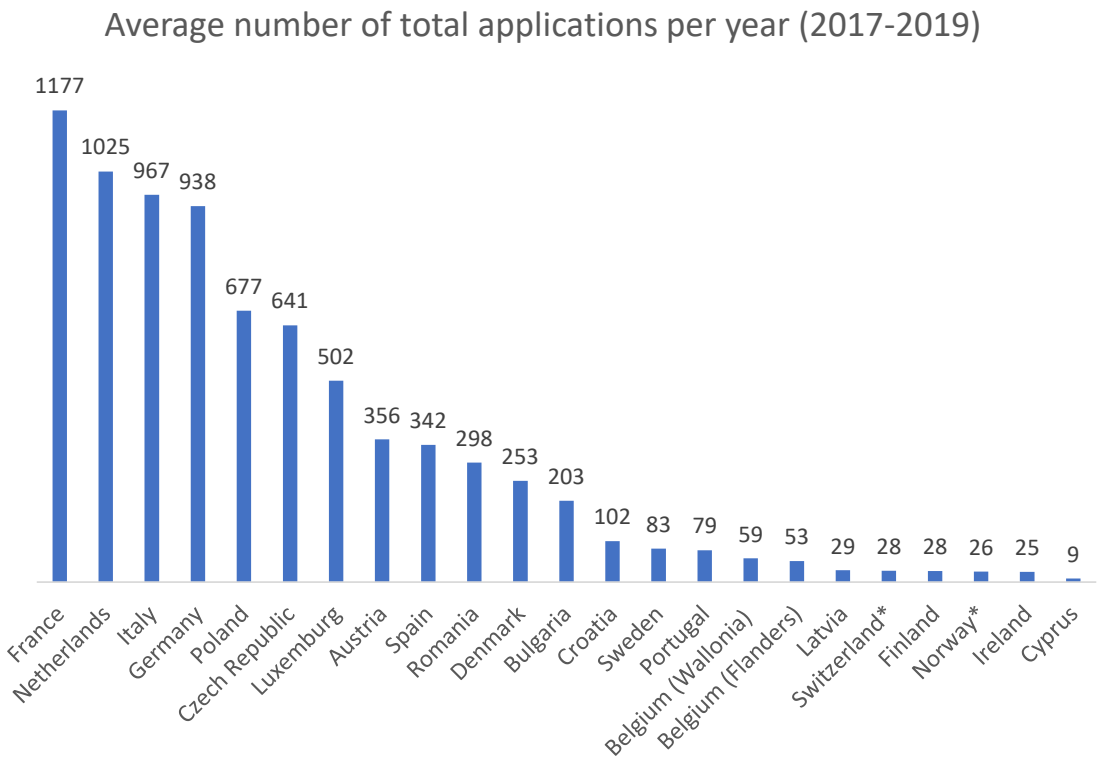
- The effectiveness of the system (including speed);
- Where the company is based;
- Where the market is;
- Environmental conditions; and
- Appropriate testing stations.

Stakeholders from civil society organisations were more critical of the variety registration process and the differences between Member States. Many represented the interests of not-for-profit producers and indicated that these types of applicants often lack the expertise and resources to complete the variety registration process. Derogations for conservation and amateur varieties do not appear to have made this any easier.

Feedback from Member States on the numbers of applications received indicate that indeed there are differences in the **volumes of applications** received in Member

States, which to some extent reflects the relative size of the markets within those Member States, but may also suggest that industry is making decisions on where to register based on the effectiveness and ease of different systems. Figure 2 indicates the average number of applications received annually across countries between 2017 and 2019.

*Figure 2. Average number of applications annually (based on NCA survey responses)*[29]




Responses to the survey of NCAs illustrate some of these differences in approach more concretely. NCAs across Member States indicated a range of more and less formalised approaches to **calculating VCU results**. Four criteria are defined in Commission Directive 2003/90/EC for the Value for Cultivation and Use (VCU) tests: (1) Yield, (2) Resistance to harmful organisms, (3) Behaviour with respect to factors in the physical environment, and (4) Quality. New varieties are compared against high performing reference varieties in terms of these criteria. The majority of Member States use single key characteristics to assess VCU tests: for these Member States, the focus appears to be on yield. Some reported using an index weighting approach across the criteria, while others reported using a mix of both approaches. This sometimes takes the form of a final score, and in other cases the focus is on the degree of improvement over reference varieties. Others reported less formal approaches. Almost all Member States indicated that decisions can also be made on the basis of one overriding criterion and that this would depend on the species. Most provided examples of high quality varieties or varieties with high resistance to pests being considered in spite of low yield (where yield often appears to be the most important criteria in Member States' assessments).

Most NCAs indicated that there is no formal inclusion of **sustainability criteria**. Some indicated that sustainability is nonetheless considered informally or through considering existing criteria, such as the resistance to harmful organisms. For those that do consider specific sustainability criteria, criteria mentioned related to stress resistance, such as

[29] Note: The total number of VCU applications per country per year is likely to include VCU tests taken over from other countries.

resistance to drought and winter hardiness and an assessment of yield as compared to the inputs required.

The NCA in France reported a more comprehensive approach to considering sustainability in VCU tests, writing:

*"Sustainable criteria is not a supplementary assessment, but is included in our decision process to check VCU of agricultural varieties. For instance, we perform VCU trials of rapeseed with suboptimal input of nitrogen fertilization, we perform VCU trials on sorghum in extensive situations with no irrigation… For a majority of species, the only used pesticide in trials is herbicide (maize, sorghum, soyabean….). We favor cereal varieties which allow a reduce use of fungicides because of good tolerance to fungi diseases. Sustainability is taken into account in both our experimental design (locations in a large diversity of environments and cultural practices including some trials carried out in organic conditions) and our decision rules (ponderation of criteria)."*

Within the interviews, one industry stakeholder mentioned that there is a need for greater harmonisation with the Organic Seed Regulations and further discussions are needed on adapting the current legal requirements to accommodate new organic material entering the market. Member States reported significant differences in their approaches to registering **organic varieties**. Five countries (Austria, the Czech Republic, Denmark, Germany and Luxembourg) reported having a separate system for registering organic varieties. These separate systems may include consideration of different criteria (e.g. as reported by Luxembourg, early growth and rapid soil covering), as well as conducting these trials in organic fields. Some Member States that indicated that they have no separate system explained that this is the case because all VCU tests for both conventional and organic varieties are carried out without phytosanitary treatment. Several others indicated that they had not considered a separate system as they had not yet received any applications for organic only varieties.

For those Member States that conduct DUS testing and therefore maintain **variety reference collections**, there are also significant differences in the extent of these collections and how they are maintained. To some extent, differences in variety reference collections are expected: depending on the size of the Member State, its climate and the most relevant species, there will be variation in these collections. However, the number reported suggest large differences, with some Member States reporting fewer than 5,000 varieties in their collections and others indicating collections of over 50,000 varieties. Member States also organise these collections in different ways: most use a variety of approaches to managing reference collections and the relative popularity of each method differs between agricultural, vegetable, fruit and ornamental species. The breakdown for each is illustrated in Table 3.

*Table 3. Variety reference collection management (based on responses to survey of NCAs, n=28)*

| | Agricultural | Vegetable | Fruit species | Ornamental |
|---|---|---|---|---|
| Living Variety collections | 22 | 14 | 8 | 16 |
| Databases with characteristics and descriptions | 20 | 16 | 8 | 15 |
| DNA-databases | 6 | 2 | 2 | 1 |
| Image collections | 4 | 7 | 8 | 9 |
| Walking reference collections | 1 | 2 | 2 | 2 |

Six Member States reported using biochemical and molecular techniques for managing reference collections for certain species. Examples provided included uses for potatoes,

stone fruits, wheat, maize, sorghum and barley, using AFLP, SNP and SSR[30] markers. Member States have used these approaches for different purposes. Some examples provided in the survey include:

- For post controls and during field inspection as additional information;
- To exclude comparisons with reference collection varieties which are significantly different from candidate varieties;
- To distinguish between varieties on specific characteristics, such as disease resistance and male sterility (in the case of cabbage); and
- To verify genetic distance, to verify the homogeneity of the material for testing and for post control.

Most Member States reported cooperating to some extent with other Member States regarding variety reference collections. There appear to be some bilateral agreements on this, but no standard approaches and many of the responses received were conflicting (e.g. Member State X reporting that they cooperate with Member State Y, Member State Y reporting that they do not cooperate with anyone).

Although industry interviewees did not highlight **costs** as a deciding factor in choosing where to register a variety, several interviewees across stakeholder groups highlighted that the cost of registration can be a barrier to SMEs and non-profit organisations marketing PRM. The data provided by Member States indicate that the fees charged differ significantly between Member States, suggesting that the ability of these types of applicants to register varieties is dependent in part on where they would like to register. Where registration and certification is handled by regional competent authorities (such as in Belgium and Spain)) this can also lead to differences in cost within a Member State.

Eleven Member States indicated that they have some system of cost reduction in place for applicants. For some, this is only for conservation and amateur varieties. Otherwise, Member States take different approaches to costs and cost recovery. For example, the Netherlands implement a system in which inspection costs are calculated based on turnover or size of the company. Another approach, as implemented by Germany, ties costs to the overall popularity of a species as a way to help incentivise biodiversity.

Member States also differ significantly in how frequently they report new registered varieties to the **Common Catalogue**. For many Member States (including Finland, Lithuania, Luxembourg, Cyprus, Portugal and Romania), this is done only once per year. Other Member States (including Italy, the Netherlands, Poland and the Czech Republic) report new registered varieties once per month. In the case of France, this is done even more frequently. The remaining Member States report somewhere between 2 and 6 times per year. This means that at any one time it is unlikely that the Common Catalogue contains up-to-date information for all Member States, and while some newly registered varieties will be included almost immediately, others may take up to a year to be visible.

Member States' approaches to **controls and enforcement** also differ. Almost all NCAs who responded to the survey (22 out of 28) indicated that at least some degree of harmonisation of controls would be beneficial (whether or not that meant the application of the Official Control Regulation, as discussed in Section 4.4). As described by one respondent, terms used such as "random", "adequate" and "representative" included in the Directives could be interpreted in very different ways and it would be beneficial to have a clear range of frequency and size of the sample, or a reference to specific methods. NCAs echoed these concerns in interview and also highlighted the need for better mechanisms for cross-border cooperation in enforcement (15 out of 28 surveyed NCAs indicated that current systems are insufficient). In addition to this, several NCAs

[30] Amplified Fragment Length Polymorphism (AFLP), Single Nucleotide Polymorphism (SNP) and Simple Sequence Repeat (SSR) respectively.

(7 out of 28) indicated that they did not feel they had sufficient resources for inspection and enforcement, likely further compounding these differences and challenges.

Differences in controls and enforcement were also picked up by industry stakeholders in interview, including:

- The lack of enforcement of plant breeders' rights and control over what seed is being used in some Member States[31]; and
- Limited control of the selling of seeds online. NCAs provided information on their activities on this through the survey, indicating that for most Member States either no controls or very few controls are conducted on online sellers. Several indicated they have found developing adequate controls for the online sale of seed challenging.

## 4.4 Synergies with other legislation

This section focuses on identifying any overlaps or synergies between the PRM marketing Directives and the (i) Plant Health Regulation (on the issue of regulated non-quarantine pests) and (ii) the Official Control Regulation. Each subsection provides an overview of the regulation, their relevance in the context of PRM, overlaps with the PRM marketing Directives and implications, and opportunities to introduce further clarity and efficiency.

### 4.4.1 Regulated non-quarantine pests and the Plant Health Regulation

This section answers ICF study research question 3 on the impact of non-quarantine pests (RNQPs) being listed in the Plant Health Regulation in relation to the PRM marketing Directives. The main sources of evidence informing this section are NCA interviews, one PRM industry interview and a review of relevant literature. Overall, there is limited evidence as the inclusion of RNQPs in the Plant Health Regulation is a recent development. This section briefly presents relevant legislation and discusses the impact of the duplication of RNQPs in the Plant Health Regulation and PRM marketing Directives.

In 2016, Regulation (EU) 2016/2031 on protective measures against pests of plants (hereinafter 'Plant Health Regulation') was published to replace Directive 2000/29/EC. The latter referred only to 'harmful organisms' which were defined as *"any species, strain or biotype of plant, animal or pathogenic agent injurious to plants or plant products",* however this definition did not distinguish between quarantine pests and RNQPs*.* Article 36 of Regulation (EU) 2016/2031 updated the definition of RNQPs to *"pests with a clear taxonomic identity, present in the EU territory, transmitted mainly through specific plants for planting, whose presence has an unacceptable economic impact as regards to the intended use, and where feasible and effective measures are available"*[32]*.* The Plant Health Regulation was to be implemented within three years of 2016. During this time, the European Commission funded a 2-year project carried out by the European and Mediterranean Plant Protection Organization (EPPO) to identify which RNQPs should be included in the Plant Health Regulation. To do so the project used a 'decision tree' whereby potential RNQPs were assessed against a list of criteria to identify whether they qualify to be included in the list of RNQPs in the Plant Health Regulation. The results of this research project fed into the Commissions Implementing Regulation (EU) 2019/2072 of 28 November 2019, which set out in detail what RNQPs are included and how they will be regulated (EPPO Regulated non-quarantine pest Project, accessed December 2020). Annex IV and V of this regulation lists the RNQPs and specific plants for planting with categories and thresholds for RNQP assessment as well as other control requirements.

[31] Note: plant variety protection is private law enforced by breeders as opposed to the national competent authorities.

[32] REGULATION (EU) 2016/2031 of the European Parliament of the Council of 26 October 2016 on protective measures against pests of plants, Official Journal of the European Union, Article 36

The PRM marketing Directives include conditions that must be satisfied on the health of plants with regards diseases and harmful organisms. This information is provided in annexes to each of the PRM marketing directives. It is provided in a number of different formats across the PRM marketing directives, and with differing degrees of specificity and detail.

The full list of RNQPs included in the Plant Health Regulation is detailed in Annex IV[33] of Implementing Regulation (EU) 2019/2072. The language and format used to identify pests and diseases in the marketing directives differs to that in the Plant Health Regulations. For example, the marketing directives mention some pests and diseases throughout the text, whereas the Plant Health Regulation provides a breakdown of RNQPs and their impact on specific genera and species. A couple of NCA interviewees noted that there is a lack of coherence in the RNQPs listed in the Plant Health Regulation and the diseases and harmful organisms included in the PRM marketing directives, including in the terminology used. In addition, Annex V[34] of Implementing Regulation (EU) 2019/2072 includes information on measures to prevent RNQPs, however does not include requirements relating to fruit plants and vine propagating material.

NCAs stated that including RNQPs in both pieces of legislation causes confusion regarding which list should be consulted by Member State authorities when controlling RNQPs, and that the lack of harmonisation between them makes it difficult to determine what requirements to apply. Often this means that both lists are checked, and additional effort is required to ensure appropriate application of the legislation. This increases the burden on NCAs.

NCA interviewees also noted that in some Member States the marketing Directives and the Plant Health Regulation fall under the remit of different competent authorities. In such cases, coordination between relevant authorities is necessary to avoid duplication of effort. This includes potential duplication of inspection effort, where separate plant health inspections are undertaken to satisfy the Plant Health Regulation and the relevant PRM marketing directive. In another Member State, where the same competent authority controls RNQPs listed in the Plant Health Regulation and Marketing Directives, the duplication of information across the Plant Health Regulation and the PRM marketing Directives was considered beneficial.

In response to a question on how the incoherence regarding RNQPS between the Plant Health Regulation and PRM marketing directives can be mitigated, some NCAs suggested that all RNQPs should be included in a single list. One NCA expressed a preference that this list is found in the marketing Directives, instead of the Plant Health Regulation, as it would become a recognised legal requirement and would not be questioned by legal entities responsible for the Marketing Directives. However, this is not considered legally viable as there is a requirement for RNQPs to be listed in the Plant Health Regulation. NCA respondents stated that if two lists are to be used, those should be identical. Both solutions would introduce clarity and provide efficiency savings for NCAs. In addition, Picard et al. (2017) concluded that some of the pests currently in the PRM marketing directives were not recommended for listing as RNQPs in the Plant Health Regulation and hence such requirements would need to be maintained.

### 4.4.2 Official Controls Regulation

This section answers ICF study research question 4 on the impacts of the Marketing Directives not being included in the scope of the Official Controls Regulation (2017/625). Evidence sources used to inform this research question include interviews with NCAs, one PRM industry stakeholder, one civil society organisation, the NCA survey and relevant literature. Since the Official Controls Regulation has only been applicable since

[33] List of Union regulated non-quarantine pests and specific plants for planting, with categories and thresholds as referred to in Article 5

[34] Measures to prevent the presence of RNQPs on specific plants for planting

2019, only a proportion of interviewees offered an opinion, some of whom noted it was too early to provide a comprehensive response. This section provides an overview of the Official Controls Regulations in relation to PRM and discusses whether there is a case for the Marketing Directives to be included in the scope of the Official Controls Regulation.

The first Official Controls Regulation was introduced in 2004[35] which applied specifically to feed, food, animal health and animal welfare. A new version of the Official Control Regulation[36] came into force in 2017, which significantly expanded the scope of the regulation to include different agri-food chains in the EU (including plant health). The Official Controls Regulation gives competent authorities power of inspection, instruments to act in response to infringement and creates networks for cooperation between Member States on enforcement activities, as well as giving the Commission audit and control powers. The PRM marketing Directives do not fall under the Official Controls Regulation. Expansion of the scope of the Official Controls Regulation to include PRM was considered and proposed as the preferred option in the 2013 Impact Assessment supporting its recent update, but the option was not taken forward. However, an expansion of the Official Control Regulation remains a potential model for addressing PRM monitoring and enforcement practices in the future.

Stakeholder feedback[37] suggests that there is a lack of harmonisation in the control and enforcement of PRM legislation in the EU. In particular, differences in the interpretation of the controls in the marketing Directives has led to different approaches being implemented by Member States, resulting in some Member States imposing stricter controls than others. In such Member States companies would be disadvantaged as they would incur higher costs to ensure compliance. Harmonising rules on control across Member States was considered beneficial by at least 17 of 28 respondents to the NCA survey. However, when asked about the possibility of the marketing Directives falling under the Official Control Regulation, responses from NCAs were mixed; eleven respondents to the NCA survey indicated they could see a benefit (some more limited than others), while another eleven saw no additional benefits.

The main reason given in support of including the marketing directives in the Official Controls Regulation was to improve the efficiency of implementation. Of the NCAs who thought including the marketing Directives within the scope of the Official Controls Regulation would be beneficial, three noted that it could help to harmonise the control of PRM with other sectors such as plant health, feed and food that already fall under the scope of the Official Controls Regulation. At present, competent authorities in some Member States split responsibilities for marketing and official controls across departments and agencies. A few responses to the NCA survey and interviews noted that including the marketing Directives in the scope of the Official Controls Regulation would streamline these responsibilities within Member States authorities. This is also supported by evidence in the 2013 Impact Assessment (EC, 2013) which notes that the Official Controls Regulation could introduce a simplified and more efficient regime, which lowers administrative burden, particularly for such Member States that split responsibilities of control and enforcement of the Marketing Directives and Official Controls Regulation across different government bodies.

Two reasons were given against including the marketing directives in the Official Control Regulation: Firstly, two NCAs noted that the marketing Directives provide authorities with the flexibility to decide on the most appropriate controls at a Member State level, which they wanted to retain. This would not be possible under the Official Controls Regulation, which would require harmonisation across Member States. Secondly, some NCAs considered the system for implementing Official Controls to be complex. The

[35] Regulation (EU) No 882/2004)
[36] Regulation (EU) 2017/625
[37] responses to the NCA survey, NCA interviews and PRM industry interviews

inclusion of the PRM marketing Directives would add to this complexity and create additional burden for competent authorities. This is despite the majority of respondents to the NCA survey (21 out of 28 NCAs) noting that there is sufficient resource in their Member State to implement controls of the marketing Directives.

## 4.5 The amateur gardener market

This section focuses on the marketing to amateur gardeners (amateur gardener[38] market). It provides an overview of the structure of the market, the number of amateur varieties available, amateur gardener motivations, preferences and any issues encountered related to the diversity, availability and quality of seeds and PRM available. Finally, it discusses the merits of a lighter registration system for varieties marketed exclusively to amateur gardeners.

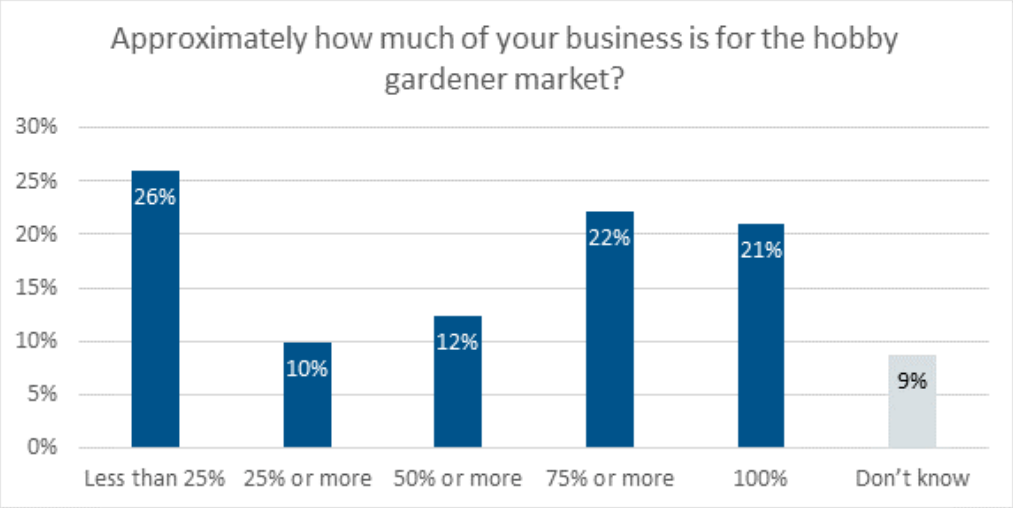
### 4.5.1 Market structure and varieties aimed exclusively at amateur gardeners

This section answers ICF study research question 6a and discusses findings on the number of varieties aimed at amateur gardeners. The key sources of evidence used to answer this question are the maintainer survey and the NCA survey. There is little relevant available literature.

#### 4.5.1.1 Extent to which maintainers target amateur gardeners

The maintainer survey provides insights into the amateur market and how it has changed over the last 10 years. Among respondents, there was a mix of those whose business consists solely of supplying the amateur gardener market and those for which only a proportion of their business is targeted at amateur gardeners. A quarter of respondents indicated that the amateur market made up less than 25% of their business. However, more than half of respondents (55%) suggested that 50-100% of their business was targeted exclusively at the amateur gardener market (Figure 3). In addition, almost half of the respondents to the maintainer survey suggested that they breed, market or sell varieties that are aimed exclusively to the amateur market (Figure 4).

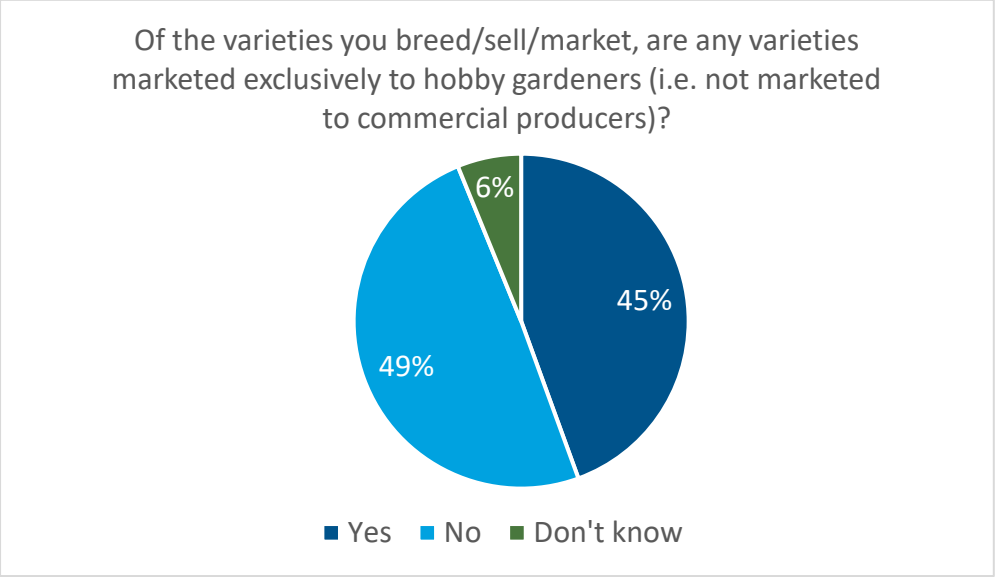
*Figure 3. Percentage of business for the amateur gardener market*




*Source: Maintainers survey, Q7 'Approximately how much of your business is for the hobby gardener market?', n=81*

[38] Throughout this section, amateur gardeners are also referred to as hobby gardeners. Early discussions with experts and stakeholders suggested the latter term is easier to understand and translates across languages and was therefore the preferred term used in surveys and interviews.

*Figure 4. Varieties marketed exclusively to amateur gardeners*

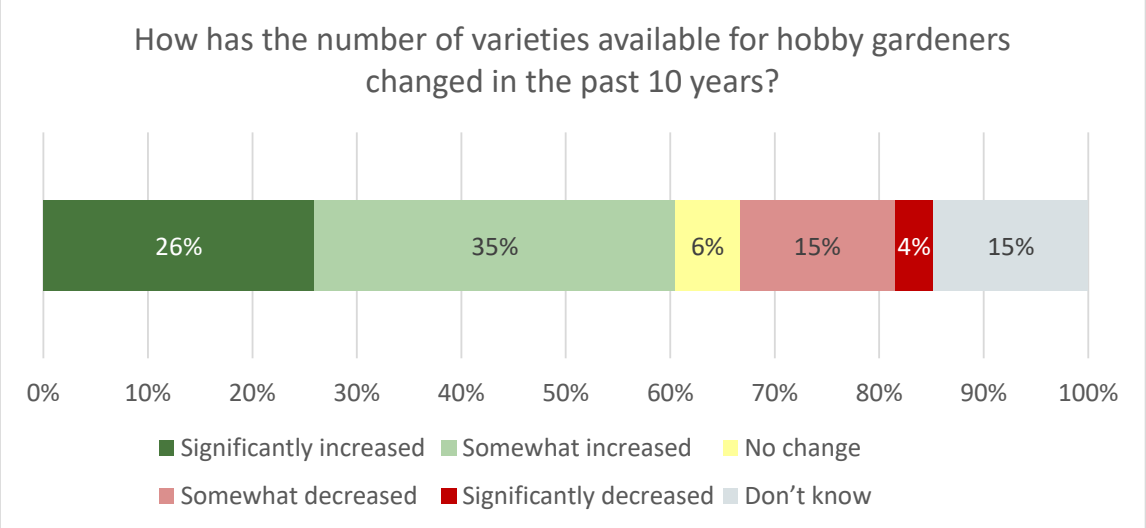



*Source: Maintainers Survey, Q9 'Of the varieties you breed/sell/market, are any varieties marketed exclusively to hobby gardeners (i.e. not marketed to commercial producers?', n=81*

#### 4.5.1.2 Number of varieties

There is no comprehensive evidence on the number of amateur varieties available in the market. Of the 28 NCAs participating in the survey[39], only four[40] provided data, with another two noting the that the area and quantity of amateur varieties produced is negligible[41].

*Figure 5. Change in varieties available to amateur gardeners in the last 10 years*




*Source: Maintainers Survey, Q8 'How has the number of varieties available for hobby gardeners changed in the past 10 years?', n=81*

The majority (61%) of respondents to the maintainer survey indicated that the number of varieties available to amateur gardeners has somewhat or significantly increased over the past 10 years. Only 19% suggested that the number has decreased (Figure 5).

[39] Responses were received from 28 NCAs including NCAs from 25 Member States (including two NCAs for Belgium- Flanders and Wallonia) and two non-Member States (Norway and Switzerland).
[40] France, Sweden, Norway and Slovenia
[41] Ireland and Spain

These results contradict suggestions in the literature that there has been an overall decrease in the availability and diversity of varieties to amateur gardeners (Mammana, 2014). These results should be caveated on the fact that an increase in the number of marketed varieties may still co-exist with a loss of diversity. For instance, an increased number of varieties may be available which are closely related and therefore offer relatively little diversity compared to a smaller number of varieties that are distantly related. With regards to developments in recent decades, new species and different varieties have emerged particularly in the vegetable sector (e.g. tomatoes and lettuces but also in fruits (trees, berries etc.).

### 4.5.2 Gardener motivations

This section addresses ICF study research questions 6c and 6f. It examines the extent to which amateur gardeners in the EU rely on produce they grow to satisfy their dietary needs. It also examines how the incentives, motivations and risks of amateur gardening differ from those of commercial producers across the EU. Evidence used to answer these research questions was drawn from a review of relevant literature, interviews with NCAs, the PRM industry, CSOs, farmer organisations and expert stakeholders, the amateur gardener survey, and the NCA survey.

#### 4.5.2.1 Motivations

Results from the amateur gardener survey (Figure 6) indicate that there are three dominant reasons that motivate people to engage in amateur gardening. The majority (79%) of respondents strongly agreed that growing edible produce was an important reason for being involved in gardening; 72% strongly agreed that they garden for enjoyment (i.e. as a hobby); and 54% strongly agreed that they garden to improve or maintain the appearance of their garden.

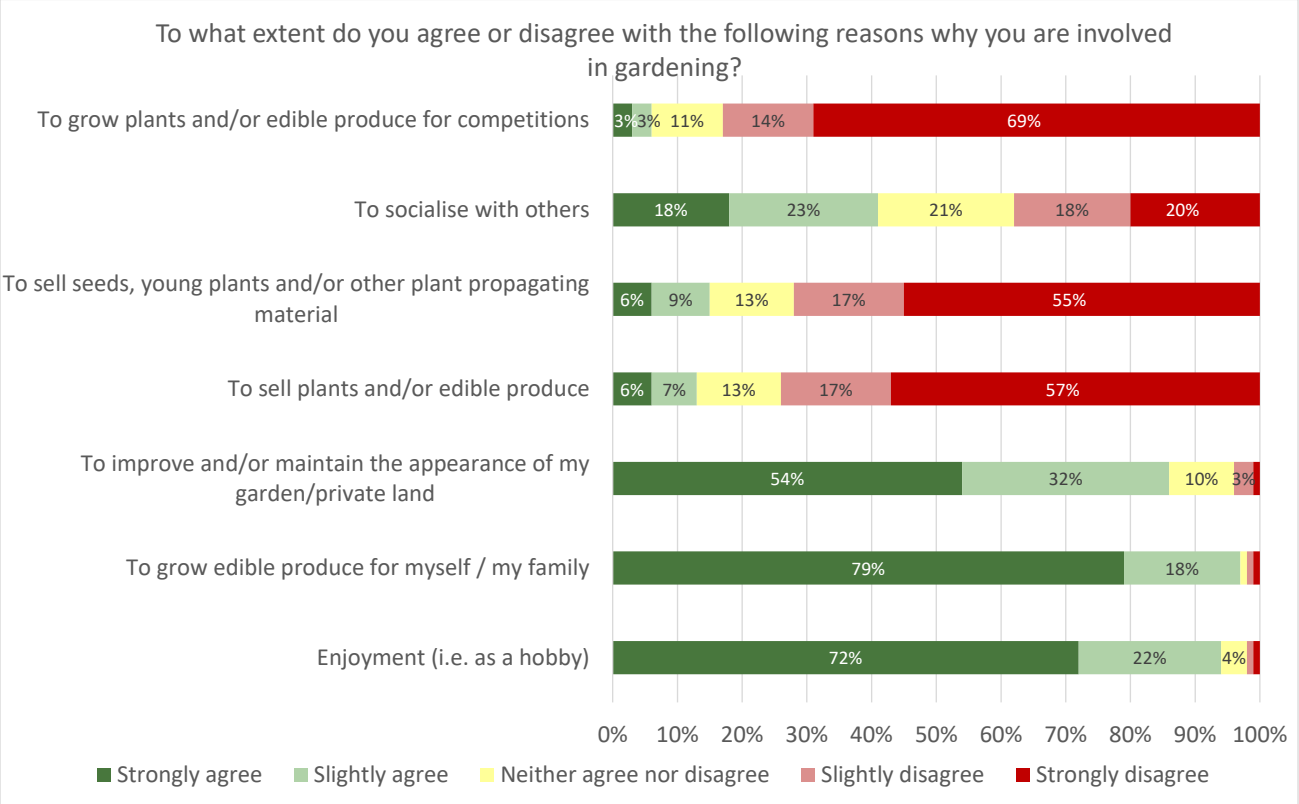
These results suggest that most EU amateur gardeners are primarily involved in gardening to cover their dietary needs, because they enjoy it and to enhance their aesthetic setting. Other motivations were generally considered less important, such as to sell plants or seeds, to socialise or to grow plants or edible produce for competitions, although these reasons were important for a minority of respondents.

These findings are broadly consistent with evidence in the literature and from interviews with NCAs, civil society organisations, farmer organisations, PRM industry and experts, which note that enjoyment and wellbeing and improving aesthetics of surroundings are key motivations (e.g. Tomkins, 2014; Lee and Matarrita-Cascante, 2019; Diversifood, 2017). However whilst gardening to cover dietary requirements was a key reason identified in the survey, it is not identified as such in the literature or by interviewees. Survey results show that EU amateur gardeners consider produce that they grow to be important in meeting their dietary needs. Of the 5,963 EU respondents, 71% considered home produce to be extremely important or quite important to meeting their dietary needs (Figure 7). This is likely linked to the increasing demand for healthier food.

These findings were fairly consistent across Member States, although comparisons by Member State need to be caveated by large differences in the number of respondents per country which reduce confidence. Exceptions, where there was a statistically significant difference in responses (i.e. responses that differed noticeably from the average), included the Netherlands and Belgium. In the Netherlands, 29% of amateur gardeners were less likely to think their garden produce is quite important or extremely important in covering their dietary needs, as did 26% of amateur gardeners in Belgium.

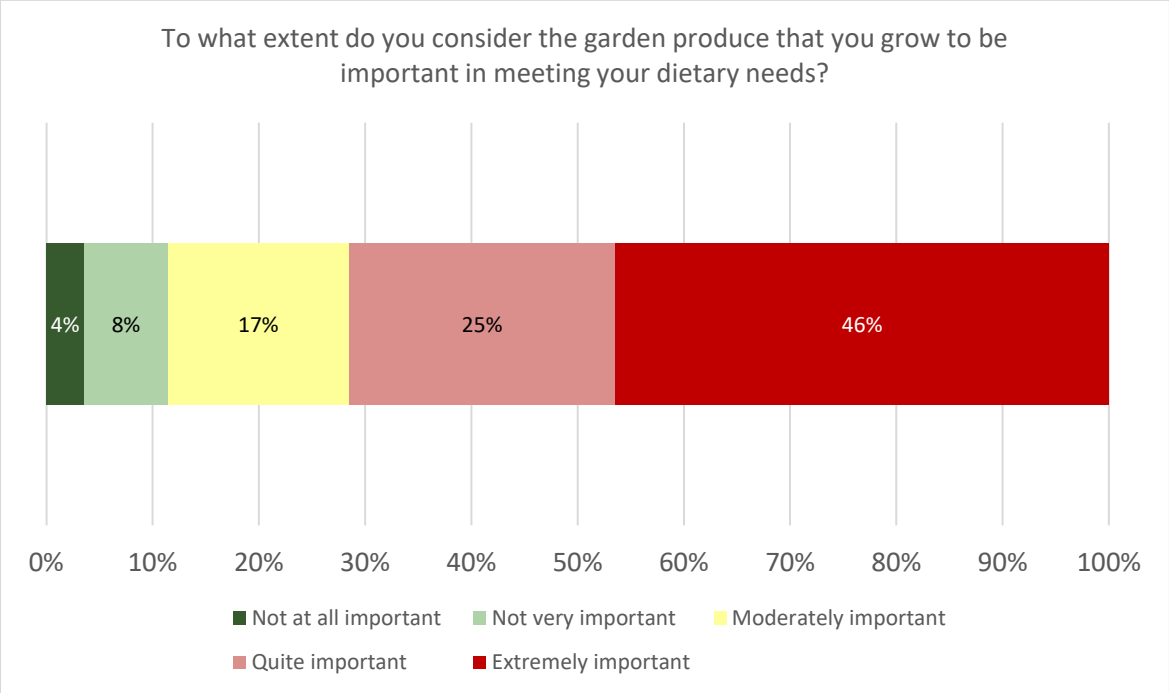
Literature also suggests that differences may also exist within a country's population, across demographic groups (Tomkins, 2014; Winkler, Maier and Lewandowski, 2019; Taylor and Lovell, 2014). For instance, Trendov (2018) reports a growing demand for allotment gardens in Zagreb (Croatia) driven mainly by elderly people producing vegetables for consumption and food security.

*Figure 6. Reasons for being involved in hobby gardening*




*Source: Hobby gardener survey, Q6 'to what extent do you agree or disagree with the following reasons why you are involved in gardening', n=5963*

*Figure 7. Importance of gardening in covering dietary needs*




*Source: Hobby gardener survey, Q9 'To what extent do you consider the garden produce that you grow to be important in meeting your dietary needs?', n=5912*

#### 4.5.2.2 Differing motivations, incentives and risks of amateur gardeners compared to commercial producers

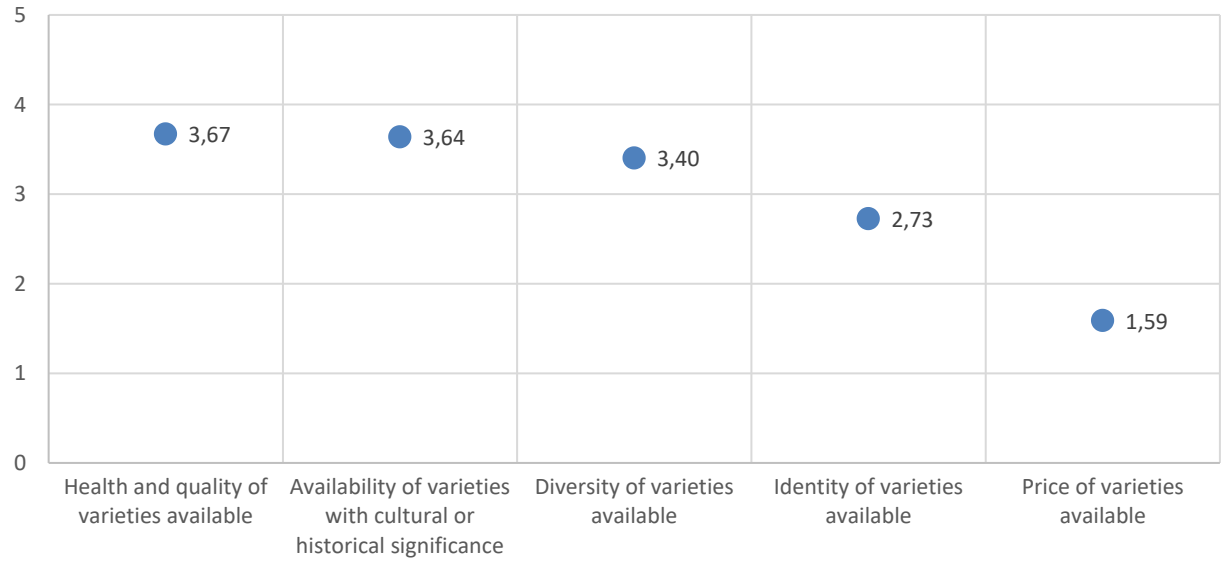
Amateur gardeners and commercial producers have different motivations and incentives. Interviewees noted that commercial producers rely on their harvest to make a living and are therefore motivated to increase yield and improve product characteristics, such as homogeneity and uniformity, that will ultimately make their business more profitable. In contrast, as established in the section above and noted by interviewees, amateur gardeners are seldom motivated by profit but instead garden for a number of reasons including to cover dietary needs, for enjoyment and wellbeing and to improve the aesthetics of their surroundings. Given these differences, the risks faced by commercial producers were considered to be of greater significance than those for amateur gardeners. For example, one PRM industry interviewee noted that commercial producers cannot risk cultivating the wrong plant as this will lead to huge economic loss.

#### 4.5.2.3 Gardener preference and trade-offs

This section answers ICF study research questions 6d and 6h. The section addresses amateur gardener preferences with regard to diversity of choice and identity of PRM, quality and health of the material and what amateur gardeners would consider an acceptable trade-off between a higher choice of available varieties and the quality of the material. The main sources of evidence used to answer these questions include the amateur gardeners survey, maintainer survey, existing literature and NCA survey.

In order to identify amateur gardeners' preferences regarding PRM, respondents to the amateur gardener survey were asked to rank the importance of different factors when buying PRM on a scale of 1 to 5 (where 5 is most important and 1 least important) (Figure 8). The health and quality of varieties, and the availability of varieties with cultural or historical significance, such as heirloom or conservation varieties, were consistently ranked as the most important factors, with average scores of 3.67 and 3.62 respectively. Demand for such varieties is growing, according to amateur gardener survey responses and two PRM industry stakeholders. The diversity of varieties available for amateur gardeners to buy was also important (averaging 3.40). The identity of varieties and price were seen as less important (average scores of 1.59 and 2.72 respectively). No evidence is available on the extent to which amateur gardeners would consider it acceptable to make trade-offs between choice, availability and quality.

*Figure 8. Importance of different factors for hobby gardeners when buying seed and PRM (average score, ranked from 5 - most important - to 1 - least important)*



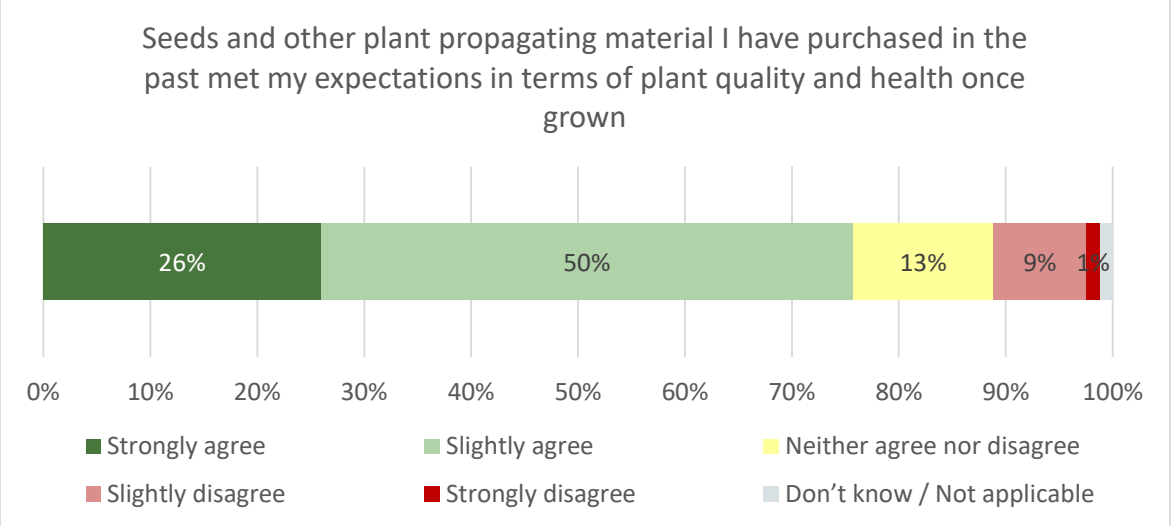
*Source: Hobby gardeners survey, Q13 'How important are each of the following factors to you when you are buying seeds, young plants and/or other plant propagating material?' n=5988-6086.*

### 4.5.3 Key problems with diversity of choice, identity, health and quality of PRM

This section addresses ICF study research question 6e and covers the extent to which amateur gardeners currently experience problems with the identity, health and quality of the seed. The key evidence used to answer this research question is the amateur gardener survey and the NCA survey.

For the most part, NCAs and amateur gardeners are positive about PRM. For example, a total of 76% amateur gardeners strongly or slightly agreed that purchased seeds have met the health and quality expected (Figure 9), and 80% of amateur gardeners also agreed that identity of the purchased seeds met their expectations (Figure 10). Likewise, 20 out of 28 NCAs did not recognise any current issues with the identity, health and quality of seeds for amateur gardeners. In addition, the majority of respondents to the amateur gardener survey (64%) strongly or slightly agreed that there is currently a good diversity of choice (Figure 11), which is normally purchased through local gardening networks (78% of respondents) and shops such as garden centres (72% of respondents).

*Figure 9. Extent to which purchased seed meets expectations in terms of quality and health*




*Source: Hobby gardeners survey, Q10b 'Seed and other plant propagating material I have purchased in the past met my expectations in terms of plant quality and health once grown', n=6089*

However, there were some significant differences in opinions on PRM identity, health and quality between Member States. Amateur gardeners in Greece and Slovakia were more likely to disagree (21%; n=62; and 16%; n=330, respectively) that their expectations for plant quality and health had been met, compared to the average results for the EU27 (10% disagreed). In Latvia, respondents were more likely to disagree that their expectations for plant identity had been met (13% disagreed; n=70) compared the overall results (7% disagreed). However, in all cases, the proportions of respondents indicating problems i.e. disagreeing with the statements in the survey, are relatively small.

Amongst amateur gardeners who indicated there were issues with the identity, quality and health of PRM, open-ended responses detailed the following issues:

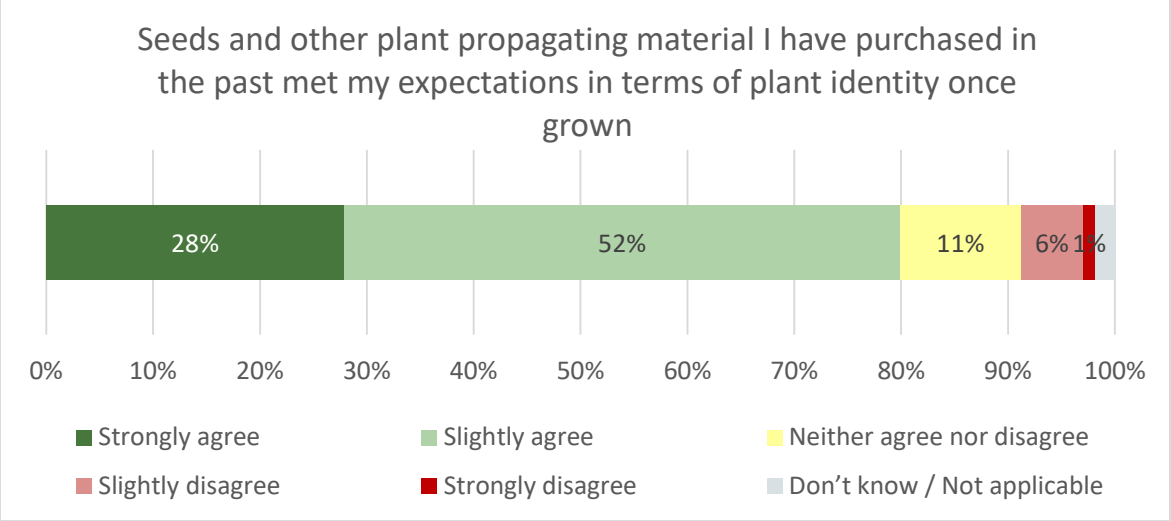
- **Identity:** Some amateur gardener respondents noted that the packaging, including the description, photos and advertisement of the seed, did not always correspond to

the contents of the seed packet. A number of amateur gardeners noted that the colour, taste, size, type of seed and resistance ability (to pests and climatic conditions) were different from that outlined on the packaging. Examples given by respondents included the purchase incorrectly identified sunflowers and red cocktail tomatoes.

- **Quality and health**: The main issue raised by amateur gardeners in the survey related to "*bad quality*" of purchased seeds. A few stakeholders made specific references to tomato and cucumber having low rates of germination. In addition, some respondents thought that the quality of purchased seed had deteriorated in recent decades. The key issues recorded under bad quality and health included poor seed germination, poor yield, size and taste of the produce, ability to resist disease.

However, some literature indicates that consolidation within the PRM market has led to lower diversity and reduced choice for amateur gardeners. For example, Volmary/Nebelung, who now own the two former independent seed selling companies Kiepenkerl and Sperli, now only sell very few open-pollinated varieties, which had been previously offered by Kiepenkerl and Sperli (Mammana, 2014).

*Figure 10. Extent to which purchased seeds meet expectations in terms of identity once grown*




*Source: Hobby gardeners survey, Q10b 'Seed and other plant propagating material I have purchased in the past met my expectations in terms of plant quality and health once grown', n=6089*

### 4.5.4 Genetic diversity and the case for a lighter regime

This section covers ICF study research questions 6b, 6g and 6i and addresses the impact of legal requirements on genetic diversity, the case for a lighter regime to improve genetic diversity, and whether such a regime would be accepted by the public across the EU. The main sources of evidence used to address these questions are the amateur gardener survey, maintainer survey, interviews with NCAs, CSOs, farmer organisations, PRM industry and experts, and available literature.

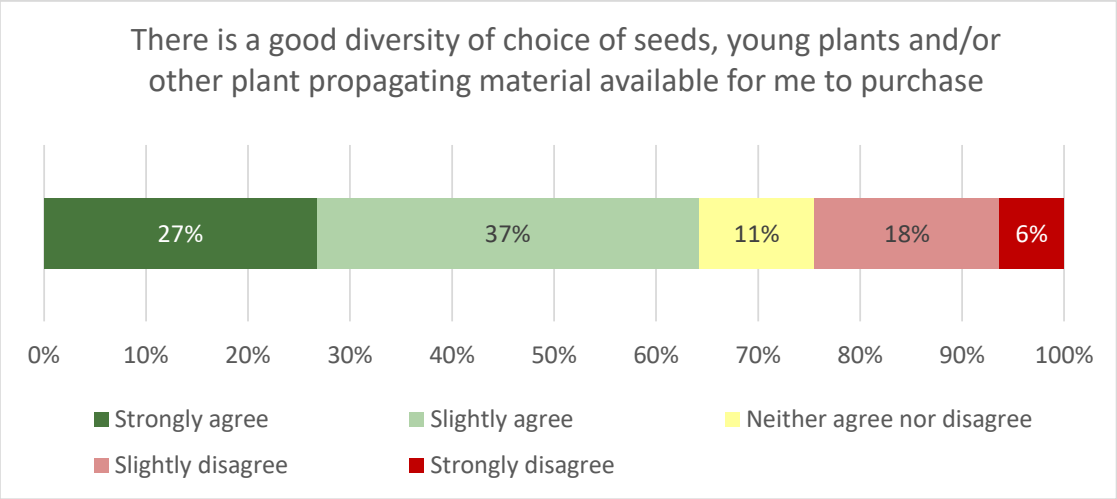
#### 4.5.4.1 Genetic diversity

Overall, stakeholders engaged as part of the ICF study suggested that there is a good level of PRM genetic diversity in the EU. For example, 64% of amateur gardeners strongly or slightly agreed that there is good availability and diversity of varieties for amateur gardeners (Figure 11). In addition, one sector expert interviewee, one NCA interviewee and two PRM industry interviewees also thought that genetic diversity available to amateur gardeners is already high in the EU. However, many stakeholders who had knowledge on the amateur market still considered that the genetic diversity of PRM available in the EU could be improved.

A minority (24%) of amateur gardeners think that the availability and diversity of varieties is not good (Figure 11). When asked what they would like to see in terms of seeds, young plants and/or other PRM, many amateur gardeners stated a greater choice of traditional, local and organic varieties. More specifically:

- **Traditional varieties**: Many amateur gardeners wanted access to *"old"*, *"traditional"* varieties, with some suggesting those were *"no longer available"*. Others noted that it is very difficult to access such varieties and they are only available through *"specialist networks"*. Amateur gardeners noted that old varieties were *"proven"* to be of better quality, health, have better taste, improved resistance to local conditions and are capable of reproduction, unlike hybrids.
- **Regional and local varieties**: many amateur gardeners noted they would like to have access to native, regional and local seed varieties. Such varieties were thought to offer characteristics that are well adapted to the local area and climatic conditions.
- **Organic varieties**: Fewer amateur gardeners stated that they would like access to more organic varieties in a broader range of crops.

*Figure 11. The extent to which there is good diversity of choice of PRM in the EU*




*Source: Hobby gardener survey, To what extent do you agree or disagree with the following statements on seeds, young plants and/or other plant propagating material: There is a good diversity of choice of seeds, young plants and/or other plant propagating material available for me to purchase?, n=1582*

### 4.5.4.2 Case for a lighter regime

Existing literature generally indicates that the current EU seed regulatory framework is very strict and thereby impacts negatively on the amateur gardening sector. Similarly, although the majority of amateur gardeners noted that current levels of genetic diversity are high, a common view across consulted stakeholders was that legal requirements are restricting the level of genetic diversity and diversity of choice available to amateur gardeners. the United States of America allows the marketing of local varieties without legal restriction (FAO, 2010). According to Galluzzi et al. (2009), EU policies have traditionally provided little incentive for, and do not recognise the role of, home gardening in the conservation of genetic diversity.

Concerns over the restrictions imposed by the legal requirements were also raised by amateur gardeners in comments received to the survey. Relevant to amateur gardeners who are interested in making PRM they grow commercially available, many hobby gardeners stated their preference for a regulatory regime that enables them to freely share, exchange and sell/buy seeds from other gardeners, thus contributing to maintaining and improving PRM diversity. Despite the anticipated acceptance of a lighter regime, concerns regarding the identity, quality and health of PRM, as raised by stakeholders interviewed, would need to be considered further.

This viewpoint was reinforced by the majority of other stakeholders who participated in interviews and surveys. These stakeholders indicated that current legal requirements restrict the amount of varieties available. For example, 50% of respondents to the maintainer survey noted that the current legal requirements limit what they can market to amateur gardeners, compared to 25% who said the current legislation did not limit what they were able to buy. Respondents noted that the cost of registering (and maintaining varieties) and attaining quality standards were the key restrictions encountered as a result of the legal requirements.

Interviewees across stakeholder groups suggested that genetic diversity could be improved if the regulatory regime for varieties aimed exclusively at amateur gardeners was lightened. More specifically, PRM industry stakeholders stated that a well organised, regulated and low-cost registration process for (amateur varieties) could improve both the availability and diversity of the PRM available to amateur gardeners.

Findings from the amateur gardener survey suggest that a lighter regime would be widely accepted by organised and non-organised amateur gardeners, with no significant differences in opinion observed across Member States. Similarly, the majority of stakeholders during interviews agreed that a lighter regime would improve availability and diversity of varieties, some concern was raised regarding the implementation of different regulations for different varieties. One PRM industry interviewee cautioned that offering two lines of production for each of commercial and amateur varieties could be problematic, as some varieties intended for the commercial market could be submitted as amateur varieties to avoid costs and extensive testing. A small number of PRM industry, CSO and NCA interviewees also noted that although a lighter regime may lead to more varieties being available on the amateur market in the short-term, the number and diversity of products could decrease in the long term due to a potential deterioration in quality and identity.

In re-designing PRM regulations relevant to the amateur gardener market, the potential trade-offs between protecting seed identity, health and quality and trying to maximise the availability of particular varieties and general diversity of choice, would need to be carefully balanced.

## 4.6 Conservation, amateur varieties and preservation seed mixtures

This section answers ICF research question 7 on the extent to which Directives 2008/62/EC, 2009/145/EC and 2010/60/EU have facilitated the acceptance of conservation varieties[42], varieties with no intrinsic value for crop commercial production but developed growing under particular conditions (amateur varieties) and preservation seed mixtures and whether the Directives have contributed to the conservation *in situ* and sustainable use of plant genetic resources and the preservation of the natural environment (e.g. certain habitat types).[43]

The section discusses the (i) use and drivers of use, (ii) costs and requirements for registration, (iii) links to the Habitats Directive, and (iv) region of origin issues, for conservation varieties, amateur varieties and preservation seed mixtures.

[42] Defined in Commission Directive 2009/145/EC, Article 1 as 'landraces and varieties which have been traditionally grown in particular localities and regions and are threatened by genetic erosion'.

[43] The Directives include: Directive 2010/60/EU: Derogations for marketing fodder plant seed mixtures for use in preservation of the environment; Directive 2009/145/EC: Derogations for accepting vegetable landraces and varieties traditionally grown in certain regions, threatened by genetic erosion and varieties with no intrinsic value for commercial production but developed growing under particular conditions; marketing of their seed; Directive 2008/62/EC: Derogations for agricultural landraces and varieties naturally adapted to local conditions, threatened by genetic erosion; marketing their seed and seed potatoes

This section is based on evidence from the available literature, the NCA survey, interviews with stakeholders at EU and national level, including civil society organisations, farmer's associations, NCAs and experts, as well as written input provided by researchers and experts.

### 4.6.1 Use and drivers of use

#### 4.6.1.1 Historical and current context

All food production depends, directly or indirectly, on plant genetic resources, and plant genetic diversity is essential to meeting current and future food needs. Ex situ conservation needs to be complemented by in situ conservation and active use of crop genetic diversity. Through the International Treaty on Plant Genetic Resources for Food and Agriculture (the Plant Treaty), and more specifically Article 6.1, EU countries have agreed to "*develop and maintain appropriate policy and legal measures that promote the sustainable use of plant genetic resources for food and agriculture*" (FAO, 2009).

Changing climatic conditions, the increasing loss of biodiversity and the decline of genetic diversity have underlined the importance of maintaining genetic resources and scaling up ecological restoration activities. The use of conservation varieties, amateur varieties and preservation seed mixture including native seeds[44] can play an important role as genetic resources in tackling these challenges as well as mitigating climate-related risks. They provide raw material inputs needed for the preservation of the natural environment and activities to support habitat restoration and as such can contribute to the EU's biodiversity and agricultural/food security objectives (Abbandonato et al., 2018; Mainz and Wieden, 2019). However, the amounts produced in the EU (see paragraph 5.6.1.4) show that these are niche markets and their importance thus lies more in conservation as genetic resources.

**Amateur and conservation varieties** contribute to genetic crop diversity and can support the agriculture sector's ability to adapt to higher temperatures and new pests and diseases and thus contribute to safeguard food production (Jarvis et al., 2011; Prip and Fauchald, 2016; Maxted et al., 2020). In 1998, the fodder plant seed regulation opened the marketing of seed mixtures of plants intended for use in the preservation of the natural environment (Barrel et al., 2015). Conservation varieties, including agricultural landraces[45] and other traditional varieties that do not meet conventional agricultural principles, are included in the Common Catalogues. Directive 2008/62/EC was adopted regulating the agricultural species involved to support the conservation initiatives in agricultural biodiversity. Directive 2009/145/EC was adopted to allow for derogations for accepting vegetable landraces and vegetable varieties with no intrinsic value for commercial production but developed growing under particular conditions (amateur varieties). These directives have provided greater legal space for the maintenance of crop genetic diversity in the EU (Winge, 2014). Nevertheless, interviewed CSOs argued that the marketing Directives are responsible for the decrease of plant genetic diversity and environmental degradation, due to their focus on increasing short-term productivity rather than sustainability.

**Preservation seed mixtures** are primarily used for the restoration and conservation of natural habitats and wild fauna and flora. From a conservation perspective, there is a need to promote the production, trade and use of local seeds mixtures to support internationally agreed ecological restoration targets (Abbandonato et al., 2018). However, this would need to be based on locally derived material, as the use of non-native seed mixtures could cause genetic pollution and genetic erosion (expert advisor input). Native mixtures can be used for ecological restoration projects. However, Schröder and Prasse (2013) caution that hybridization between cultivated varieties and

[44] Native seeds are seed species from a naturally growing population from a specific region. Native seeds can be used in preservation seed mixtures.

[45] 'Landrace' means a set of populations or clones of a plant species which are naturally adapted to the environmental conditions of their region (Commission Directive 2009/145/EC, Article 2).

local populations can change the genetic diversity of local populations, which in the long-term can lose traits which would otherwise be determined by natural selection to be optimally adapted to the environmental conditions. Feedback received from conservation experts echoed this concern. Nevertheless due to the limited availability of native seeds a few core species or non-native seed mixtures are often used (Tischew et al., 2011; Broadhurst et al., 2016). Directive 2010/60/EU was adopted to facilitate the preservation of the environment allowing derogations and thus lighter market access for the marketing fodder plant seed mixtures.

#### 4.6.1.2 Conservation and amateur varieties in the common catalogues

The common catalogues of varieties of agricultural and vegetable plant species list the varieties which can be marketed throughout the EU. Catalogues consist of the plant varieties that have been registered in EU Member States. Listed varieties passed examination tests for distinctness, stability and uniformity as well as proved to be of value for cropping and use.[46] Previously, EU seed legislation made it difficult to commercialise conservation varieties because registration to the common catalogues required distinctness and stability and uniformity[47]; traits that these varieties typically do not have (Spataro and Negri, 2013). The legislation did not adequately recognise the natural heterogeneity of conservation varieties and other variable populations (Broadhurst et al.,2016). Interviewed CSOs emphasized that the principles applied to seeds used in commercial agriculture should not be applied to conservation and amateur varieties. Directives 2008/62/EC and 2009/145/EC provide for certain derogations, which allow conservation varieties to be included in the common catalogues, and hence accepted for commercial marketing in the EU. However, these derogations do not cover all conservation and amateur varieties and stipulate restrictions on the marketing of these varieties.

The common catalogues do not contain preservation seed mixtures, because mixtures do not require registration but are authorised by the Member States. Preservation seed mixtures are therefore excluded from further discussion in this section.

The common catalogue database includes 375 varieties of agricultural species and 161 varieties vegetable species of active recorded conservation varieties and 613 vegetable amateur varieties across 30 European countries (including Switzerland, Iceland, and Norway)[48].

The NCA survey[49] collected data on the total number of variety applications and registrations, including conservation and amateur varieties, for each species per year for the period 2017-2019. It was not possible to determine which varieties were conservation and which amateur varieties. In addition, the number of applications does not say anything about the varieties that actually were notified and included in the common catalogue.

#### 4.6.1.3 The market for conservation and amateur varieties and preservation seed mixtures

No quantitative data on the production and use of conservation and amateur varieties are available. Results of the NCA survey confirmed this, as did the interviews with NCAs

[46] The European seed legislation on conservation varieties: focus, implementation, present and future impact on landrace on farm conservation. Genetic Resources and Crop Evolution, 60(8), 2421–2430. doi:10.1007/s10722-013-0009-x.

[47] To ensure seed-quality, high output varieties are required to be genetically distinct, uniform and stable in production (the 'DUS criteria')

[48] Based on the 'active' records for conservation varieties in the Commons catalogue as accessed in February 2021.

[49] Responses were received from 28 NCAs including NCAs from 25 Member States (including two NCAs for Belgium- Flanders and Wallonia) and two non-Member States (Norway and Switzerland).

(5), experts (2), civil society organisations (5) and academics (3). Written input received form conservation experts has also been taken into consideration.

#### 4.6.1.4 Conservation and amateur varieties market size and growth

Regarding **conservation varieties**, the majority of the 26 NCAs[50] that responded to the survey indicated that there is either no data available or that there is no, or a negligible level of, conservation variety production. Of the 21 NCAs that provided data (in terms of area or amount in kg) ten indicated that production of conservation varieties over the last three years was zero, and eleven indicated production in kg or per ha for agricultural and vegetable species using generic terms (e.g. Croatia: Peppers) or specific variety names (e.g. Sweden: Phaseolus vulgaris "Signe"). Overall, the differing levels of production across the Member States have remained broadly stable over the last five years. The exception was Latvia, which reported an increase. Wallonia (Belgium) is expecting first production requests in 2021. In general, the number of these varieties have increased in the Common Catalogues over the years.

Regarding **amateur varieties**, only six NCAs reported some level of amateur variety production[51] . 22 NCAs indicated that there was either no data available or that there is no or a negligible level of production. As with conservation varieties, production levels are reported to have been broadly stable over the last five years. Only Sweden indicated an increase in the production and marketing of amateur varieties by seed companies, although no data is available on the volume of production in Sweden.

NCA interviewees[52] indicated that the use of both conservation and amateur varieties vary greatly across countries. Whilst the NCA survey generally indicated that volumes of production have been stable over the last five years, interviewees considered there to have been a general increase in the number of amateur varieties listed. A few NCAs from Member States mentioned during interview an increase in the use of conservation and amateur varieties, including Austria, Germany and Italy. However, survey responses indicated that there is no data available on the quantity of amateur varieties produced in Austria, Italy and Germany.

#### 4.6.1.5 Preservation seed mixtures market size and growth

Of the 26 NCA survey responses, only Sweden, Czech Republic, Germany and Austria reported meaningful volumes of activity for preservation seed mixtures. Other Member States flagged that there is no information available or that preservation seed mixtures are either not produced or that quantities produced are negligible. One of the supporting factors identified by stakeholders interviewed is the strong presence of environmental non-profit organisations lobbying for progressive measures in Germany and Austria. Numerous preservation mixtures are also reported to be permitted for use in Switzerland, where derogations are in place for the production of autochthone seed for regional restoration of pastures on around 600 ha of natural grassland. No data was provided regarding the actual production.

There is mixed evidence on whether the market for seed preservation mixtures is growing or not. Mainz and Wieden (2019) indicate that it is. According to interviewed CSOs there has been a growing interest from non-commercial players operating at a local or community level, as well as from farmers shifting towards sustainable agriculture. However, interviewed conservation experts[53] indicated that in most

[50] 26 NCAs from 25 Member States, including Belgium (Flanders and Wallonia), Estonia, Finland, Croatia, Italy, Lithuania, Luxembourg, Latvia, Netherlands, Poland, Sweden, Bulgaria, Cyprus, Czech Republic, Denmark, Hungary, Ireland, Slovenia, Poland, Austria, France, Portugal, Romania, Spain, Germany and Greece. Two responses received from NCAs from non-EU MS, including Switzerland and Norway.

[51] Sweden, France, Norway, Slovenia, Ireland and Spain

[52] Five NCAs were interviewed

[53] Interviews with academics and conservation experts

European countries preservation seed mixtures are little used. The exceptions were Germany, Austria and Switzerland (although no data is available to verify their views). The sale of preservation mixtures in Germany is thought to have grown steadily over the last decade, according to one conservation expert. Mixes are used for restoration purposes but also in other public projects and by private users. The Austrian and Swiss markets are also thought to have developed to a certain extent. In contrast, the French market is thought to remain highly restricted, which has curbed domestic production of preservation seed mixtures.

#### 4.6.1.6 Factors affecting market size and growth

All evidence sources indicate that there is limited use of conservation varieties and preservation seed mixtures. Possible reasons for this, raised by interviews across stakeholder groups,[54] and found through desk research included:

- Differences between Members States in terms of control and enforcement of the legislation.
- Differences between Members States in terms of the implementation of the Directives (e.g. strict measures going beyond the Directives' requirements).
- Restrictive legal requirements on seed marketing and limits on annual production which limit the potential market size (see Section s).
- Low market demand, relatively high production costs and low profitability, compared to commercial varieties, mean the market is unattractive for commercial seed companies.
- A relatively low level of interest from stakeholders in conservation varieties and genetic diversity (e.g. limited number of active non-profit organisations and local producers involved in preservation of genetic diversity and conservation).
- Difference in the extent to which organisations in Member States encourage registration of conservation varieties (e.g. public bodies raising awareness about the importance of these varieties in addressing biodiversity loss and genetic erosion).

Factors specifically raised for preservation seed mixtures included:

- Players involved in the production of native seed mixtures are typically small-scale producers engaged in the preservation of genetic diversity and conservation.
- Native seeds, which are often used in preservation seed mixtures, are not widely commercially available placing a constraint on production. For example, local officials need to approve access to collection areas (Abbandonato et al., 2018).

**Promotional activities:** Public and scientific bodies and CSOs can play an important role in promoting the production and use of preservation seed mixtures (Abbandonato et al., 2018; Barrel et al., 2015; Spataro and Negri, 2013; interviews with CSOs and farmer associations). For example, in Italy and Greece community seed banks and CSOs are reported to have been key drivers of the development of a seed market that is driven by factors others than profit (such as conservation).

Increased awareness about the importance of these varieties could explain the differences in terms of use across Member States. This is for example the case with Sweden, where a Swedish public institution dealing with biodiversity and genetic resources promoted the registration of conservation varieties in Sweden (Spataro and Negri, 2013). This is broadly in line with the results of the NCA survey. One of the interviewed CSOs involved in maintaining genetic diversity highlighted their strong relations with the NCA which they argue supports the production of conservation and amateur varieties.[55]

[54] Similar arguments were voiced by civil society organisations, NCAs, farmers organisations and industry representatives.
[55] Interview with a CSO

**Problems with fraud:** According to Spataro and Negri (2013) registering varieties as amateur may be preferred to registering them as conservation varieties, due to lighter restrictions of the former. One NCA respondent suggested that the slight increase in registered amateur varieties might be the result of fraudulent registrations. The NCA respondent and a CSO respondent[56] both suggested that because of the 'light registration regime' the system is more open to fraud than it might otherwise be. They indicated that producers may try to register varieties as amateur even if they do not fall into that category to avoid costs. Registration of amateur variety registration is often free of charge. Another NCA respondent indicated a comparable issue with conservation varieties, noting that there might be many conservation varieties that are produced and marketed without registration.

Multiple sources indicate that the marketing of conservation varieties and native seeds[57] has remained largely unregulated with often poor seed quality as a result (Laverack et al., 2007; Ryan et al., 2008; Haslgrübler et al., 2013; Marin et al., 2017). Native seeds are produced and marketed without international guidance documents (Pedrini and Dixon, 2020) and conservation varieties are often produced at local level and exchanged within a community (Bocci, 2009). Feedback from interviewed NCA representatives indicated that there are several issues related to the control and enforcement of the marketing Directives regarding conservation varieties, especially pertaining to the lack of clarity and fuzziness of some aspects of the directives. For example, the specifics of official controls are not clarified in the Directives, which means that they are subject to interpretation.[58] One of the interviewees remarked improved Member State collaboration could help to detect non-compliance.[59] Survey results showed that the lack of sufficient resources exacerbates control and enforcement issues for some EU Member States.[60] The majority of NCA respondents indicated to be in favour of harmonising controls across Member States.

#### 4.6.1.7 Annual production limits

Interviews with CSOs and experts suggest that legal limits on production volumes may be a key factor limiting the size of the market. Quantitative restrictions included in the Directives place limits on the volume of conservation varieties and preservation seed mixtures that can be marketed and sold in a Member State in a given year or season. There are three such restrictions, stipulating that each Member State ensures that:

- "*the total quantity of seed of preservation mixtures marketed each year does not exceed 5% of the total weight of all fodder plant seed mixtures"* (**Directive 2010/60/EU, Article 14)**
- "*the quantity of seed marketed per year does not exceed the quantity necessary for producing vegetables on the number of hectares specified"* (**Directive 2009/145/EC**)
- "*for each conservation variety, the quantity of seed marketed does not exceed 0,3-5% (depending on the species) of the seed of the same species used in that Member State in one growing season, or a quantity necessary to sow 100ha, whichever is the greater quantity*". Also that "*the total quantity of seed of conservation varieties*

[56] Interview with a CSO

[57] Relates to herbaceous species which are commonly used in Europe to restore European grasslands

[58] Directive 2008/62/EC and 2009/145/EC stipulate that PRM should comply with the specific conditions with respect to certification and verification. Official post control should be carried out and official monitoring of the supply chain should be performed. Member States can adopt their own provisions regarding distinctness, stability and uniformity, hence how to control the requirements in the Directives remains rather vague.

[59] Interview with an NCA

[60] Belgium (Flanders and Wallonia), Hungary, Portugal, Spain, Poland and Sweden

*marketed in each Member State shall not exceed 10% of the seed of the species concerned used yearly in the Member State*". (**Directive 2008/62/EC Article 14)**

Overall, the data indicate that the production limits are not reached in the majority of Member States. Quantitative evidence reveals a difference between the actual production and the quantitative limits laid down in Directives, showing that there is available capacity for the market to grow.

Out of the eleven NCA respondents that collected and assessed the difference between the total amount of conservation varieties produced compared to the limits, only Latvia reached the maximum production limits with others noting that the production of conservation varieties is well below the permissible limit. However, the extent to which the limits – acting as a cap on the potential market size - regardless of current levels of production, effect the attractiveness of the market for commercial enterprises is not clear.

Poland, Czech Republic and Luxembourg provided general comments on the volume of production stating that the volume equals the maximum permitted by the limits. Latvia flagged that the permitted amount for hemp has been reached, which is 10,000 kg, and therefore they propose "*to revise the volume criteria set out in Directive 2008/62/ EC in order to allow a larger amount of seed of conservation varieties to be placed on the market."*

For amateur varieties only three NCAs provided meaningful comments: Estonia and Slovenia stated that production of amateur varieties does not exceed the limit; Czech Republic commented that there is no quantitative limit for these varieties.

For preservation seed mixtures only Estonia commented on the difference, stating that the difference varies per species but overall remains small. One of the NCA interviewees stated that even though there has been an increase in the use of preservation seed mixtures under the new environmental regulations, the use is still far below the limit for marketable mixtures. For Switzerland, the NCA survey response indicated that despite not imposing any limits to production, preservation seed mixture production in Switzerland is similar to the level that would be permitted under the EU quantitative restrictions. In Switzerland the limits are not considered necessary as high production prices and high-performing standard mixtures already limit demand for preservation seed mixtures.

### 4.6.2 Costs and requirements

Interviews with NCAs indicated that requirements and costs for registering conservation and amateur varieties differ across member states. NCA survey results show that specific derogations for conservation varieties exist at national level, such as lower registration and certification costs and lighter requirements. A majority of NCA survey respondents (17 out of 28 NCAs) indicated that the registration fees for both conservation and amateur varieties are lower than for conventional varieties (e.g. Estonia, Lithuania, Norway, Czech Republic, Ireland), or even free of costs (e.g. Italy, Estonia, Cyprus, Bulgaria, Hungary, Denmark, Finland. Although in some Member States the registration fees for conventional, conservation and amateur varieties are the same (e.g. Slovenia). Some member states have less strict requirements for certain conservation varieties regarding technical examination (e.g. Croatia, Sweden, Slovenia). The majority of NCA respondents indicated that public financial support is provided, in the form of subsidies (e.g. Poland) or through reduced cost recovery[61] for

[61] For instance, in Germany cost recovery is set at slightly lower level for species with a lower number of applications, whilst for amateur and conservation varieties the fees are very low and far from cost recovery. (NCA survey)

technical examinations, for conservation varieties and amateur varieties (Germany, France, Netherlands, Finland, Slovenia, Sweden).

Stakeholder views diverged regarding the impact of the costs and requirements for registration and certification of conservation and amateur varieties. Some industry representatives stated that the requirements in the marketing Directives have not impacted the use of conservation and amateur varieties.[62] However, interviews with CSOs, farmers associations and NCAs indicated that costs and requirements related to the production and marketing of conservation and amateur varieties does negatively impact the market. For preservation seed mixtures one expert flagged the costs of permits, documentation and certification as problematic for producers. A general lack of clarity and methodological issues in terms of the registration procedures were also mentioned as a challenge faced by producers.

One interviewee suggested that the relatively light registration procedures for conservation varieties in Germany – where only a brief description of the variety is required, rather than having to undergo technical examination - might have had a positive influence on the number of registered varieties in Germany. In contrast, even though registration of conservation varieties has been made free of charge in Italy, one of the interviewed CSOs still characterised the process as costly and bureaucratic, obstructing local producers' access to the market, which is currently dominated by international companies with limited interest in local PRM. One NCA noted that production of conservation and amateur varieties in Slovenia remains low despite such varieties attracting financial subsidies through agri-environment/climate payments.

In addition to registration costs, the production and marketing costs of conservation and amateur varieties and preservation seed mixtures are generally higher than for conventional varieties. They highlight the labour intensity and particularly expertise required to cultivate and produce native seeds used in preservation mixtures.

Mainz and Wieden (2019), and a conservation interviewee, identify such reasons as a key contributing factor limiting the supply of conservation varieties and preservation seed mixtures. However, an expert advisor (member of the research team) warned that removing the production limits could put conservation and amateur varieties in direct competition with commercial varieties, giving an advantage to the former in terms of varietal registration.

### 4.6.3 Links with the Habitats Directive 92/43/ECC

#### 4.6.3.1 Current context and problems

Conservation varieties and preservation seed mixtures can play an important role in the preservation and restoration of the natural environment and the conservation of genetic resources, and hence support the objectives of the Habitats Directive 92/43/EEC. Literature (e.g. Bonomi, 2015; Mainz and Wieden, 2018) and feedback from stakeholders familiar with the Habitats Directive reveal that many regulatory and material challenges inhibit their use (as already stated in Section 4.6.1.6) and hence the scaling up of natural habitat restoration and Natura 2000 conservation activity. As such there is a mismatch between the limited availability of native seeds and the amount needed for restoration activities. However, it was also questioned the extent to which conservation varieties are actually relevant for the restoration of habitats included in the Habitats Directive.

The Habitats Directive includes lists of plant species with conservation status that are prioritized for action under Natura 2000 (Abbandonato et al., 2018). The Directive also includes rules on so called "collection points" – the locations where native seeds can be

[62] Only 2 out of 13 interviewed industry representatives answered the question on the impact of the marketing Directives on the use of conservation and amateur varieties and preservation seed mixtures.

gathered in the wild – which limit the collection of native seeds from, and their use in, Natura 2000 sites. According to Bonomi (2015) these requirements have curbed the local production of native seeds.

The PRM legislation, regulating the production, use and marketing of native seeds and seed mixtures, was initially developed for fodder plant seeds (De Vitis et al., 2017; Mainz and Wieden, 2018) and does not adequately encompass all native seeds and support conservation activities (Spataro and Negri, 2013), despite the available derogations (as discussed in Section 4.6.1). This has resulted in limited commercial availability and unregulated trade. While all interviewed conservation experts acknowledged that that the derogations created some opportunities for the native seed market to develop, the majority of interviewed conservation expert and CSOs argued that the constraints imposed by the marketing Directives limited their availability and use and thereby are, in effect, responsible for ecological degradation and genetic erosion.[63]

### 4.6.4 Region of origin

The PRM Directives limit the production, maintenance and marketing of conservation varieties to their region of origin. To qualify as a conservation variety, multiple criteria must be met: the variety needs to be linked to a specific geographical region and must contribute to the conservation of plant genetic resources (Commission Directive 2009/145/EC: Article 4). Varieties need to be produced, maintained and marketed in their region(s) of origin. The Directive also provides derogations for "*varieties with no intrinsic value for commercial crop production but developed for growing under particular conditions"*, such as agro-technical, climatic or soil conditions (Directive 2009/1457EC: Article 1). This embodied a consensus in the scientific literature at the time on the importance of limiting the use of conservation varieties for restoration purposes to their region of origin (Sackville Hamilton, 2001; Bischoff et al., 2010; Vander Mijnsbrugge et al., 2010). One of the main reasons conservation varieties were recognised as a unique seed category was to protect the ecological and genetic distinctiveness of seeds from different places. It also helps avoid risks from the introduction of non-native species.

Scientific and operational challenges remain regarding the concepts of "local seeds" and "region of origin". The terms are considered ambiguous and open to interpretation (Goldringer et al., 2010; Winge, 2012; Winge, 2014; Prip and Fauchald 2016; la Tour, Labatut and Spiegelberger, 2020; NCA interview). The region of origin is defined by the Member States which can result in differing regions of origin for the same varieties across Europe.[64] According to Boci (2009) confusion may arise regarding the definition of the concept, "*as can be seen in the translations of the English text of the directive into other EU languages*" (p. 37).

A potential drawback of region of origin rules is that it reduces the genetic variability in restored plant populations, which can limit population resilience to climatic and other shocks (Bocci, 2009; Winge, 2012; Hölzel et al., 2012; Bucharova et al., 2019). CSOs arguing against the region of origin rules emphasized that changing weather conditions caused by climate change require the use of alternative varieties to ensure long-term resilience, recognising that many varieties perform well outside of their region of origin.

Half of the interviewed CSOs and NCAs were in favour retaining the region of origin concept with a minimum of historical, genetic and ecological links. They argued that there a premium price can be achieved when varieties are marketed using a region of origin. Experts indicated employing the region of origin help with issues of transparency and traceability. Stakeholders arguing to relax the region of origin rules argued that

[63] 3 out of 4 knowledgeable CSOs

[64] The same conservation variety can have a bigger region of origin in one Member State compared to another.

they reduce population resilience (as discussed above) and are disproportionate to the risks. Some NCAs, CSOs and experts called for a more flexible approach regarding the region of origin avoiding that these areas become so small rendering economic production impossible. Overall, stakeholders favoured a species-by-species approach to assess the risks related to any relaxation of region of origin rules, rather than a one-size-fits-all approach.

### 4.6.5 Potential solutions

In order to better support the market for conservation varieties and hence generate the supply needed to support the scaling up of activities delivering on the Habitats Directive objective, a number of legislative changes could be made. Abbandonato et al. (2018) propose a lighter and more pragmatic policy framework that takes into account the genetic diversity of native seeds and species, acknowledging the role of native seeds in both local and large-scale ecosystem restoration, but still ensuring product quality.

Conservation experts argued that a more relaxed form of regulation would enable Member States to decide species-specific quality criteria, including allowing flexibility I how DUS are applied for in situ conservation. In some European countries with more mature native seeds markets, such as Austria and Germany, independent certification schemes and controls to ensure quality standards have been developed in an attempt to make up for the lack of nationwide legal nature conservation requirements (Abbandonato et al., 2017; Barre et al., 2015; Mainz and Wieden, 2019).

Some industry interviewees[65] highlighted the importance of safeguards to ensure product quality. They cautioned that the safety and quality of conservation varieties should not be compromised in order to satisfy growing conservation and sustainability concerns. Interviewees emphasized the importance of ensuring seed quality and supporting genetic diversity.

The EU Directive on the marketing of forest reproductive material (1999/105/EC) and the OECD scheme for the certification of forest reproductive material in international trade have been proposed as inspiration for a new EU standard (Mainz and Wieden, 2019). Abbandonato et al. (2018) highlight the specialized procedures of the legislative framework for FRM.

## 4.7 Forest Reproductive Material

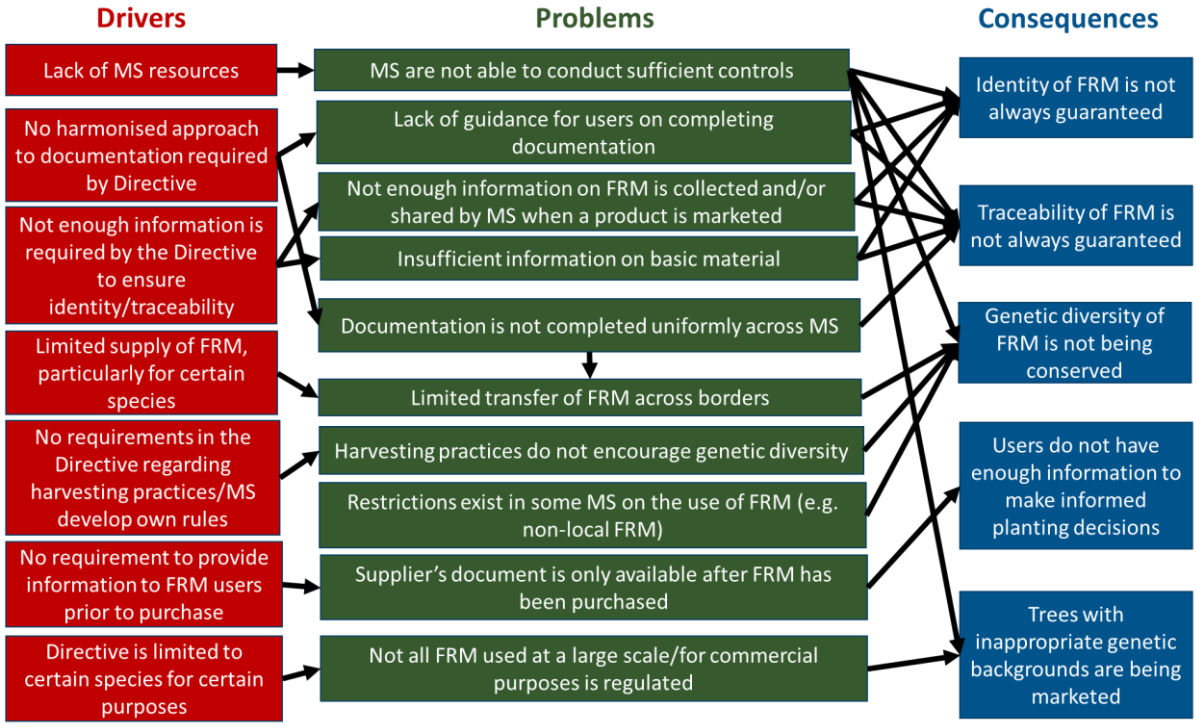
This section addresses research questions 8 and 9. Questions 8 and 8a focus on the current problems and needs related to the marketing, conservation and use of forest genetic resources and the genetic diversity of forest reproductive material (FRM), including constraints on the marketing of FRM. Questions 8b-c and 9 focus on user information needs - ensuring that users of FRM can make informed choices and approaches to enable this.

### 4.7.1 Current problems and needs

The current problems and needs are summarised in the problem tree shown in Figure 12. Stakeholders' perceptions of these problems and needs as well as potential identified solutions and their feasibility are discussed further in the sections below. These problems and their consequences imply constraints on the marketing of FRM.

[65] Interviews with two industry experts

*Figure 12. FRM Problem Tree*




#### 4.7.1.1 Identity and traceability

Within the ICF study workshop on FRM, the key issues raised related to the production and marketing of FRM were **identity** and **traceability**. The two issues were closely linked and gave rise to a discussion on existing levels of control (mandatory or voluntary) that may support increased accountability and improved practices along the production chain and marketing of FRM. Both identity and traceability are also important to the implementation of the Nagoya Protocol.

Many respondents to the survey of FRM stakeholders also indicated that there are problems with the identity and traceability of FRM (see Figure 13 and Figure 14), particularly those from competent authorities and research institutes or academia. Industry stakeholders were more likely to disagree that there are problems with identity and traceability, indicating that this is likely a challenge from the perspective of governments and researchers, but not from the perspective of businesses.

Stakeholders in the workshop on FRM put forward several drivers related to identity and traceability. These were tested with respondents to the survey who indicated some degree of agreement (either 'strongly agree', 'agree' or 'neither agree nor disagree') that there is currently a problem with controlling for the identity of FRM. These respondents largely confirmed the proposed drivers (see Figure 15).

Respondents to the survey indicated that the following contribute to the challenge of controlling for the identity of FRM, at least to some extent:

- Member State authorities' **lack of sufficient resources** (with 86% indicating that this contributes to the challenges either to some extent or to a great extent). Within the workshop, experts indicated that both a lack of personnel and financial constraints limit the ability of NCAs to control and enforce measures. Specific examples in Member States were provided where systems appear comprehensive on paper, but there are no checks for compliance with these systems from the NCAs.
- A **need for guidance** for users on how to identify and record the identity of FRM in relevant documentation (with 75% indicating that this contributes to the challenges either to some extent or to a great extent). Participants in the workshop on FRM

noted that in order to provide such guidance and identify potential tools to help with this, there is a need for improved communication between ministers, policy officers, academics and research institutes.

- **Not enough information on FRM and its identity is collected** and/or shared by Member States when a product is marketed (with 75% indicating that this contributes to the challenges either to some extent or to a great extent). Workshop participants also suggested that mandatory information on the exact FRM origin when FRM enters the market could help to reduce mislabelling. Another option to improve this would be through the use of genetic markers. However, as discussed below (see Figure 16), there are challenges with the feasibility of this approach.
- There is **insufficient information on basic material** (with 68% indicating that this contributes to the challenges either to some extent or to a great extent). A sizeable minority of survey respondents (30%) indicated that this was not a contributing factor, and the majority (59%) indicated that this was only a contributing factor 'to some extent', suggesting that information on basic material could be improved but is likely largely sufficient.
- **Documentation on FRM identity (such as supplier's documents) is not uniformly completed across Member States** (with 68% indicating that this contributes to the challenges either to some extent or to a great extent). In the workshop, experts highlighted that this also relates to the inability of Member States to adequately control documentation, due to the lack of resources. Participants in the workshop also indicated that greater harmonisation of documentation would allow for easier comparison between seed sources. Around half of respondents to the survey (n=80) also indicated that the current approach to documentation either does not or only somewhat allows for easy comparison between seed sources.

Stakeholders from NCAs and Research Institutes/Academia (n=56) were also asked whether they were aware of any challenges specific to supply chains that are transnational. This was an issue picked up in the workshop and confirmed by 52% of respondents. In open answers, several survey respondents explained that complicated supply chains make it difficult to know the full story of FRM and therefore any associated risk for disease.

To address these problems, experts in the FRM workshop had several suggestions for how to improve the identity and traceability of FRM. These included:

- The use of genetic markers;
- Keeping records of FRM from basic material to final use and sharing this with NCAs;
- Options to make Master Certificates public; and
- Improvements and increased harmonisation to FOREMATIS.

These suggestions were explored with stakeholders in the context of the survey.

Most respondents (68%) considered that the use of **genetic markers** to help ensure identity would be feasible (see Figure 16). However, several respondents (representing NCAs and academia/research institutes) raised concerns about the feasibility of this approach. Of those who indicated that it would not be feasible (16%), the most commonly cited reason was that it would be too expensive. Some also noted that it may not be a suitable approach for all species, such as for forest tree species of small economic or ecological value. Responses claiming that it would not be feasible came from Member States of different sizes and across regions.

Respondents were more sceptical about the feasibility of **keeping records of FRM from basic material to final use** and sharing this with NCAs. While 45% of stakeholders indicated it would be feasible to share data with NCAs, another 40% of stakeholders indicated that it would not be feasible or would only be feasible under certain conditions (see Figure 17). In open responses, these stakeholders suggested that any such measure would need to be on a voluntary basis, as it would represent too

high a burden for many private forests and for smaller forest owners/planters. Stakeholders also indicated that any such requirement would mean there would be a need for a simple, centralised system to record this information and that this would need to be in accordance with GDPR requirements issues.

Respondents were largely positive on the feasibility of options to make **Master Certificate codes/reference numbers and/or Master Certificates public** at a national level. Making codes/reference numbers public was considered the more feasible option; 84% of stakeholders suggested it is feasible compared to 73% for making Master Certificates public (see Figure 18). However, those that did raise concerns around feasibility raised several important points. Some mentioned that the devolved nature of their competent authorities would make it difficult to bring something like this together. Another noted that the Certificate Code contains a reference to the harvester, meaning that these codes would not be anonymous. More concerns were raised in relation to making the Master Certificate public: some noted that certain information on the Master Certificate would need to remain hidden. This would include information on the amount of FRM produced, which could be considered a commercial secret. One respondent also indicated that it may be important to remove information on the applicant's name and address.

Within the workshop, experts indicated that FOREMATIS has the potential to provide valuable information to help improve the control of identity and traceability, as well as to provide valuable research data and provide users with information that would help them choose FRM. However, in its current state, it was considered largely incomplete and insufficient for these purposes. Potential changes to FOREMATIS elicited mixed responses from stakeholders, with many indicating that proposed changes were not feasible, even if the data would be beneficial. Only those stakeholders familiar with the database (n=50) were asked about feasibility. Respondents considered including the Master Certificate code to be the most feasible option, and over half (52%) also indicated that including import information would be feasible. The suggestions to include coordinates of planting sites (final use of FRM) and monitoring information (e.g. information on how trees are performing) were met with greater scepticism, with many stakeholders indicating that these would not be feasible. Reasons given included:

- Entering coordinates of planting sites and monitoring information would require too much effort: there are a significant number of planting sites in many Member States and in some countries, competencies are devolved, adding to the challenge of implementing this. One respondent suggested that it may be more feasible to link information on origin and tree performance using a sampling approach.
- Information on coordinates and monitoring information could be considered commercial secrets: businesses would not want this information shared.
- Some indicated that this would only be feasible if mandated by legislation. Similarly, others indicated that it would not be feasible at present because the information (including import information) is not available.
- When asked if there were any other types of information that it would be feasible to include in FOREMATIS, a few respondents indicated that the current process was already too burdensome and making it easier to feed data into FOREMATIS would be a first helpful step. Suggestions on other types of information included:

Information on recommended deployment areas[66];
Information on climate (temperature and precipitation);

[66] In order to provide information on deployment areas, monitoring of FRM performance is required. Data currently available do not support this. If Member States were to monitor and record FRM, the data could be used to improve the management of European forest genetic resources, while the same records could be valuable for Member States in their CBD reporting.

Genetic information[67];
Information on the availability of material; and
Information on the silvicultural measures undertaken within the seed stand.

Respondents to the survey had other recommendations for improving the traceability of FRM. These included:

- Including information on the Supplier's Document on all of the places where the material has been planted (e.g. where material was raised before delivered to the end-user);
- Better mechanisms/platforms for sharing information and best practices between Member States. This was highlighted in particular in response to questions about regulating FRM transnationally. Respondents suggested that current systems are inefficient and insufficient;
- More attention paid to the systems and self-monitoring used by professional operators;
- The use of a unique barcode for basic material, used across all documentation;
- The use of blockchain across the supply chain; and
- More resources and improvements to control processes.

#### 4.7.1.2 Conservation of genetic diversity

Within the workshop, experts agreed that there are problems with the conservation of genetic diversity. The main issues raised related to seed production and collection, the use and transfer of FRM. The discussion highlighted the need to balance conservation of genetic diversity and tree improvement, ensuring a mix of FRM is both harvested and used, and the importance of using native, non-local and improved (through breeding programmes, where these exist) FRM to adapt to the impacts of climate change.

A minority of respondents to the survey disagreed that there is currently a problem with conserving the genetic diversity of FRM (see Figure 19). Those stakeholders involved with research institutes and academia were most likely to agree on this point.

Experts put forward several contributing factors to the problem of conserving genetic diversity. These were tested with respondents to the survey who indicated some degree of agreement (either 'strongly agree', 'agree' or 'neither agree nor disagree') that there is currently a problem with conserving the genetic diversity of FRM. These respondents confirmed some of the proposed drivers and were more sceptical of others (see Figure 20).

For survey respondents, the most significant contributing factors to the problem of conserving genetic diversity relate to the **harvesting and distribution of seed stands**. As described by experts in the workshop, there is a need to avoid collecting seeds from related materials by ensuring appropriate distances between trees during harvest. For species where seed mostly comes from a seed orchard, not collecting from the entire seed orchard (e.g. collecting most seeds from those that offer the best fruitification) would reduce the genetic diversity. When it comes to different numbers of seed stands, there is also a need to ensure that seed material harvested and sold on the market are representative. Seeds should be evenly distributed across seed stands to improve genetic diversity. In many Member States, there is a high number of seeds collected that will never be used and there are many seed stands registered throughout the EU that are not harvested.

[67] I.e. genetic markers, information of data from field trials, and/or estimated number of mature trees of the seed stand or seed orchards.

Similarly, respondents also largely agreed that the **intensive use of a single seed source**, as is often done to support tree improvement, contributes to the problem of conserving genetic diversity.

To address these issues, some Member States have requirements regarding the number of trees that must be selected as a seed source or stand. A summary of these requirements as reported by survey respondents is included in Table 10 (Annex 9). Other Member States indicated that they had recommendations for this, but no rules. A respondent from one Member State that has rules in place also indicated that these rules are very difficult to enforce. Another respondent indicated that although they have these rules, other Member States do not, and considering that FRM can be traded freely across Member States, this has implications for the level playing field.

Respondents also largely agreed that **restrictions and/or recommendations on the use of FRM in certain regions** and the **limited transfer of FRM across borders** contributes to the problem of conserving genetic diversity. At present, many Member States favour the use of "autochthonous" trees. Experts in the workshop noted that the words "autochthonous" and "non-local" should be used carefully and should not be put in opposition to one another. This is in part because "non-local" can be defined as either FRM moved from a different region of provenance, or FRM which is the result of a breeding program where the origins of parent trees are disperse. Both "non-local" and "autochthonous" trees are important considering the current uncertainty of climate change effects and the capacity of trees to react to it. Non-local trees may be capable of outperforming native (autochthonous) trees, and vice versa, however, monitoring information on both is needed to ensure they are used appropriately.

There was notably less agreement for some of the other drivers identified by experts in the workshop.

**Limited access to state-owned FRM** was identified as a contributing factor by 51% of respondents. However, this is a problem that is likely to differ between Member States, and the responses indicate that those who see this as a problem come largely from different Member States than those who indicate this is not a problem.

Other drivers identified in the workshop (the intensive use of clones, the higher price of small seed stands and the restricted ability for forest enterprises to use their own genetic resources) were confirmed by less than half of survey respondents.

Another problem mentioned by workshop participants was that some nurseries, particularly smaller nurseries, struggle to access high quality seed, in part because of increasing consolidation of the seed market. When asked whether nurseries struggle to access certain types of seed, over half (54%) of all stakeholders and 80% of nurseries indicated that they did (see Figure 21). Respondents indicated many other reasons for this, including:

- There is a limited availability of certain species and provenances, in some cases on a regular basis and in other cases in certain years. Specific species mentioned by respondents include Norway spruce, Douglas fir, larch and sessile oak. These shortages are sometimes caused by disease.
- There is difficulty in sourcing some seeds from abroad. This poses a challenge particularly for Member States that cannot rely on domestic seed sources. One respondent also noted that this can be due to phytosanitary reasons preventing imports (which is a necessary reason for preventing imports).
- Some seed sources (both state-owned and privately-owned) are not accessible for seed companies to collect seeds. This appears related to the problem of limited access to state-owned FRM.

#### 4.7.1.3 Use of FRM

Workshop participants noted that **the Directive only regulates material from certain tree species intended for forestry purposes**. If the purpose is not forestry,

the material is not covered. Therefore, seedlings can be sold for other purposes (e.g. wind protection, trees along roads, parks etc) without regulation. As a result, trees of potentially inappropriate genetic background may spread themselves and their pollen to nearby forests in the future, and this might have negative impacts (including on climate resilience). This can also create challenges for competent authorities' administrative work and inspections.

Several respondents to the survey confirmed this as an issue and elaborated on it. It was noted that because Member States are able to apply the Directive to additional species (and several have chosen to do so), the list of species was not a problem. Despite this, several respondents did also indicate specific species they would like to see added (including *Ulmus laevis, Ulmus glabra, Abies nobilis, Abies nordmanniana* and *Tsuga heterophylla*). Rather, the problem is that when regulated species are marketed for non-forestry purposes, it is difficult to enforce where these trees end up. Respondents had some suggestions for other purposes it would be beneficial for the Directive to cover, including: other forestry purposes, such as the production of forest fruits, cork and truffles; for biodiversity purposes; for agroforestry purposes (including banks of water bodies, windbreaks, green belts); and for intensive plantations such as for biomass and energy generation.

### 4.7.2 User information needs

Within the workshop, participants identified various types of information that could be considered important for informing decisions on choosing appropriate planting materials. These types of information were put to survey participants to assess how helpful each would be. The top 10 most helpful types of information are listed below and illustrated in Figure 22:

- Related to FRM: identity
- Related to FRM: information on the current bioclimatic zones for which FRM are suited and the future bioclimatic zones they are expected to be suited for
- Related to FRM: availability
- Related to seed stands: coordinates and altitude
- Related to seed stands: site conditions (climatic details including frost, risk, water storage capacity, site index
- Related to FRM: categories
- Related to seed stands: genetic origin if basic material was translocated
- Related to FRM: genetic diversity
- Related to FRM: expected genetic gain (if qualified/tested FRM)

The types of information participants judged to be less helpful were:

- Related to seed stands: size
- Related to seed stands: growth
- Related to seed stands: age
- Related to FRM: number of clones/families (if qualified/tested FRM)
- Related to FRM: collection year
- Related to FRM: contact details of seed harvesting company
- Related to seed stands: owner's contact details
- Related to seed stands: photos of typical seed trees

Participants were also asked to choose their top three choices of the options presented. Across stakeholder groups, the most frequently chosen option was information on the identity of FRM. Preferences differed by stakeholder group, with respondents from industry expressing a greater interest in information on availability and collection year as compared to other groups. Table 4 sets out the top 5 choices by stakeholder group.

These results imply that the most useful information for users of FRM would be:

- Information on FRM identity;

- Deployment zones, ideally considering both current and future bioclimatic zones and conditions for which FRM are suited;
- Information on genetic diversity of FRM; and
- Information on FRM availability.

Deployment zones were deemed likely to be useful by survey respondents. But within the workshop, FRM experts expressed concerns that existing approaches to deployment zones were insufficient, as they often do not take provenance into account and there is currently not enough data available to facilitate the development of more useful and accurate deployment zones. Existing models also often do not take future climatic conditions into account. To provide this data, experts indicated that it would be helpful to gather better data on where FRM is planted and data on the performance of that FRM. However, as described in the section on changes to FOREMATIS above, survey respondents were sceptical about the feasibility of gathering these types of information at any significant scale.

*Table 4. Top choices of information by stakeholder group*

| | Competent Authorities (n=40) | Research institute or academia (n=18) | Industry (Associations, Nurseries, FRM companies) (n=16) |
|---|---|---|---|
| 1 | Related to FRM: identity | Related to FRM: identity | Related to FRM: identity |
| 2 | Related to FRM: information on the current bioclimatic zones for which FRM are expected to be suited | Related to FRM: information on the current and future bioclimatic zones and conditions for which FRM are suited | Related to FRM: availability |
| 3 | Related to FRM: information on the current and future bioclimatic zones and conditions for which FRM are suited | Related to FRM: expected genetic gain (if qualified/tested FRM) | Related to FRM: genetic diversity |
| 4 | Related to seed stands: site conditions (climatic details including frost, risk, water storage capacity, site index) | Related to FRM: genetic diversity | Related to FRM: information on the current and future bioclimatic zones and conditions for which FRM are suited |
| 5 | Related to FRM: genetic diversity | Related to seed stands: coordinates and altitude | Related to FRM: collection year |

#### 4.7.2.1 Barriers and potential solutions

One key issue noted by workshop participants was that information that could be helpful to making informed planting decisions (e.g. information on the Supplier's Document) is provided *after* the point of purchase and therefore is too late. Ideally, therefore, participants felt that it would be most helpful to receive these types of information in advance of purchase. Survey respondents were also asked whether this would be helpful and the majority (80%) agreed (see Figure 23).

Survey respondents were then asked to rank their preferences for the format of such information. Overall, respondents considered receiving this information online (e.g. via a link or QR code) to be the most helpful, followed by the inclusion of information in price lists or catalogues. Receiving information as a printed information sheet was the least preferred option. However, preferences differed across stakeholder groups. For respondents from industry, the preferred choice was still to receive this information through a link or QR code, but this was preferred only marginally as compared to

receiving information from price lists and catalogues, suggesting that for users of FRM, it may be helpful to include both approaches.

A majority of stakeholders from competent authorities and academia/research institutions (53%, n=55) indicated that there is a need for a harmonised EU approach to suppliers' documents. In open responses, stakeholders indicated that a harmonised approach would help to speed up communication and the control of the movement of FRM, as well as facilitate cross-border trade. To make this happen, stakeholders indicated that the use of a harmonised structure, consistent terminology and definitions would be beneficial, as well as an equal level and quality of information provided. Some respondents referred to the Commission Recommendation of 14 February 2012 issuing guidelines for the presentation of information on supplier's documents, indicating that a greater take-up of these guidelines would be beneficial.

Most survey respondents (67%, n=75) indicated that supplier's documents currently contain the right level of information. Some requested additional information, such as information on where material has been in transit, information on deployment areas, genetic diversity, information on the site of the seed stand and the time of seed collection.

# 5 Conclusions

This section presents the key findings and conclusions from this ICF study. In addition to summarising findings discussed in Section 5, it incorporates the findings of the Validation survey (see Annex 10: Validation survey results) showing the extent to which stakeholders agreed to the findings of the ICF study.

## 5.1 Problems with PRM legislation

Key issues identified relevant to the PRM legislation and their drivers are presented below:

1. **There are differences in how registration is administered across Member States**. This is a problem for VCU tests (relevant for agricultural species) which differ significantly between Member States, in terms of how VCU criteria are interpreted, results are calculated and assessed, as well as how long tests take, which undermines the EU level playing field. This is driven by the flexibility the Directives afford Member States; Commission Directive 2003/90/EC sets out the criteria Member States should use for VCU testing, but Member States determine how VCU results are calculated and how these (and any additional) criteria are considered.
2. **There are differences in how Member States calculate fees** (and share costs) for variety registration and PRM certification, which undermines the EU level playing field and can have a disproportionate effect on SMEs and not-for-profit organisations. Variable costs are driven by a lack of common rules in the Directives on how fees should be calculated or costs shared between operators and NCAs, resulting in Member States employing different systems.
3. **Testing for conservation and amateur varieties and varieties intended for organic production does not accurately portray the needs of these varieties.** The process implies time and financial costs, which can impact the ability of operators (particularly of small not-for-profit organisations which tend to be most active in this space) to get new varieties registered and certified. There is insufficient flexibility in how new varieties are categorised and the requirements that are applied to them, while the use and application of derogations for conservation varieties is variable across Member States, and come with unique restrictions.
4. **PRM registration for new varieties can take a significant amount of time to complete.** However, it is understood as necessary by stakeholders with the majority suggesting it does not hinder market access for new varieties. Some administrative,

technical and practical constraints exist for NCAs, the impact of which differs depending on the NCA's capacity. There are opportunities for both certification and registration processes to be streamlined, for instance by allowing breeders to carry out VCU testing under official supervision (in the case of registration) or by allowing national authorities to carry out certification examinations under a registration process to speed up access to the market for operators (in the case of certification).

5. **There is a lack of coherence between the PRM marketing legislation and the Plant Health Regulation on the issue of regulated non-quarantine pests (RNQPs),** resulting in uncertainty for NCAs in terms of which list to consult.
6. **There are differences in the implementation of the PRM legislation by Member States** (see Table 2). Whilst such differences can impact on the EU level playing field, some degree of flexibility is desirable. Terminology used to describe aspects of the control requirements of the legislation is ambiguous and is interpreted differently across Member States. The interpretation of the control requirements and extent of enforcement of the marketing directives results in inconsistent and potentially insufficient control and enforcement.

*Table 1 Stakeholder responses on the differences in the implementation of PRM legislation between Member States*

| To what extent do you agree that the following are ***problematic*** differences between Member States implementation of the PRM marketing directives. | Agree and strongly agree | Neither agree nor disagree | Disagree and strongly disagree |
|---|---|---|---|
| Different approaches to control and enforcement of the legislation | 66% | 33% | 13% |
| Differences in registration/certification costs and cost recovery | 57% | 25% | 23% |
| Different approaches to incorporating sustainability criteria | 53% | 32% | 15% |
| Different approaches to updating the Common Catalogue | 52% | 32% | 15% |
| Different approaches to managing variety reference collections | 50% | 36% | 14% |
| Different approaches to calculating VCU results | 45% | 20% | 30% |
| Different approaches to registering organic varieties | 42% | 32% | 26% |

*Source: Validation survey (see Annex 10)*

## 5.2 Synergies with the Plant Health Regulation

There is a lack of coherence between the PRM marketing legislation and the Plant Health Regulation, particularly the language and requirements regarding RNQPs. This causes confusion regarding which list should be consulted and what requirements applied and increases administrative burdens. The issue is accentuated in Member States where the PRM marketing directives and the Plant Health Regulation fall under the remit of different NCAs. There is currently no straightforward mechanism available to enable and maintain harmonisation between the PRM Directives and the plant health regulation with regards to RNQP requirements.

## 5.3 Synergies with the Official Controls Regulation

The legal framework for the PRM marketing directives remains flexible, enabling Member States to take different approaches towards control and enforcement. Aspects of the legal framework which are open to interpretation result in differences in the extent and nature of control and enforcement across Member States. There remains no power of EU audit of Member State approaches, limiting the extent to which EU intervention can

support improvements and more coherent control and enforcement across Member States. There remain inefficiencies in control and enforcement as approaches are not harmonised between PRM marketing and related areas e.g. plant health, food. Whilst harmonising rules on control across Member States was considered beneficial by the majority of NCAs, there were mixed opinions on whether to include the PRM legislation in the OCR. Validation survey results suggest that the control and enforcement requirements remain simpler and therefore less burdensome than they would if PRM was included in the Official Controls Regulation.

## 5.4 Technical developments in the breeding sector

A growing number of New Genomic Techniques have emerged, making use of plant genetic information in the breeding process to alter the genome of organisms. There is a need for transparency in how varieties obtained through NGTs are registered and certified according to the PRM legislation, if allowed in the EU.

## 5.5 Digitalisation

There is potential for digital solutions, such as blockchain technology, to improve traceability, and offer greater assurance on the identity, quality and health of seeds. Digital illiteracy, poor connectivity and costs remain key barriers in the adoption of such technologies, with a small number of stakeholders also raising concerns over safety, ownership and confidentiality of the information. Digital solutions beyond blockchain, such as the use of Digital Object Identifiers (DOIs) or QR codes, are simpler to implement, but do not offer the same security benefits as blockchain.

## 5.6 The amateur gardener market

There is mixed evidence on the availability and diversity of varieties marketed specifically to amateur gardeners in the EU. While the majority of amateur gardeners were happy with the diversity of choice available to them, many would like to see greater choice of traditional, regional/local and organic varieties. There is also some evidence to suggest that the current EU seed regulatory framework somewhat restricts the potential number and diversity of varieties available for the amateur gardening sector. A lighter regulatory regime that reduces the costs of registering amateur varieties and addresses limits on amateur variety marketing, could improve both the availability and genetic diversity of the PRM available to amateur gardeners. Nonetheless, adopting a lighter regulatory regime for varieties aimed exclusively at amateur gardeners may increase risks to the assurance of PRM identity, quality and health.

## 5.7 Amateur, conservation varieties and preservation seed mixtures

There is limited use of amateur, conservation varieties and preservation seed mixtures due to:

- Low market demand, relatively high production costs and low profitability, compared to commercial varieties, mean the market is unattractive for commercial seed companies.
- Players involved in the production of native seeds, which are often used in preservation seed mixtures, are typically small-scale, not-for-profit producers.
- Differences in the extent to which organisations in Member States encourage registration of conservation varieties and recognise their role in supporting biodiversity conservation.

Legal limits on production volumes do not seem to limit the size of the market (see validation survey results) although mixed opinions were received from stakeholders.

The concept of 'region of origin' is ambiguous and is interpreted differently across Member States, with some calling for clarity and a more flexible approach. Overall, stakeholders favoured a species-by-species approach to assess the risks related to any relaxation of region of origin rules, rather than a one-size-fits-all approach.

## 5.8 Forest Reproductive Material

The key problems related to the identity and traceability of FRM, conservation of genetic identity in FRM, the use of FRM and user information needs.

FRM **identity and traceability** issues were caused by the existing levels of control in the production and marketing of FRM. Contributing drivers were:

- Insufficient resources in NCAs.
- Insufficient guidance on how to identify and record the identity of FRM in relevant documentation.
- Insufficient information on FRM and its identity is collected and/or shared when a product is marketed.
- Information on basic material could be improved.
- Documentation on FRM identity (such as supplier's documents) is not uniformly completed across Member States.

Suggestions to support increased accountability and improve practices along the production chain and marketing of FRM included: making Master Certificate codes/reference numbers and/or Master Certificates public at a national level; the use of genetic markers; and a voluntary approach to keeping and sharing records of FRM from basic material.

Relating to the problem of the **conservation of genetic identity in FRM**, the following main drivers were identified:

- Harvesting and distribution of seed stands.
- Intensive use of single seed source.
- Limited transfer of FRM across borders.
- In addition, around half of all stakeholders identified access to state-owned FRM and access to certain types of seeds as drivers.

Relating to the **use of FRM**, the Directive only regulates material from certain tree species intended for forestry purposes, which creates challenges for the enforcement and control of regulated species when these are marketed for non-forestry purposes. Stakeholders suggested that it would be beneficial for the Directive to cover additional purposes such as, the production of forest fruits, cork and truffles; for biodiversity purposes; for agroforestry purposes; and for intensive plantations such as for biomass and energy generation.

Relating to the **user information needs**, stakeholders stated that the most useful information for users of FRM would be:

- Information on FRM identity;
- Deployment zones, ideally considering both current and future bioclimatic zones and conditions for which FRM are suited or expected to be suited for;
- Information on genetic diversity of FRM; and
- Information on FRM availability.

Whilst supplier's documents contain the right level of information they would benefit from harmonisation across the EU. Stakeholders highlighted that in order to inform decisions on choosing appropriate planting materials the above-mentioned information would be helpful if provided in advance of purchase.

# Annexes

## Annex 1: ICF study matrix

| # | Question | How to answer this question | Data collection methods | Risks and limitations |
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| ***General questions related to the problem definition, including "Union relevance" of the problems*** | | | | |
| 1 | What are the current problems, which would justify updating the existing legislation on the production and marketing of plant reproductive material? | The answer to this question will be an assessment of the problems and drivers identified in the sub-questions and the extent to which those problems would justify an update to the legislation.<br><br>The data collected in response to this question will be largely qualitative, and many of the responses will come from stakeholders with special interests. We will consider these interests and potential biases when analysing responses and use this information to weight different data sources.<br><br>The response will be drafted based on a triangulation of evidence from the Impact Assessment and Evaluation, further desk research and interviews with stakeholders. A proposed set of problems will then be included in the validation survey. The results of this survey will help us revise and nuance the proposed problems. | • Review of the 2013 Impact Assessment and 2008 Evaluation<br>• Desk research<br>• Primary research with stakeholders (e.g. interview programme across main stakeholders and targeted surveys)<br>• Validation survey | Stakeholders will likely have different views on what problems and drivers are most relevant and important, depending on their perspective. We will rely on the wide documentation available to ensure the findings faithfully represent the views of stakeholders in spite of the relatively small scale of the field research. |
| 1a | How have the problems, drivers and state of play | The answer to this question will provide an update of the understanding around | • Review of the 2013 Impact Assessment | Stakeholders will likely have different views on |

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| | identified in the Impact Assessment to the 2013 proposal evolved? Which new ones have emerged since? | problems and drivers identified in the 2013 Impact Assessment. It will also identify any new problems and drivers emerging through desk research and primary research across stakeholder groups.<br><br>The response to this question will be largely qualitative.<br><br>The response to this question will be underpinned by the development of a problem tree, which will be used to make sense of the data collected.<br><br>We also propose to validate our assessment of the current problems and drivers through a survey at the end of the process. | • Desk research<br>• Primary research with stakeholders (e.g. interview programme across main stakeholders and targeted surveys)<br>• Validation survey | what problems and drivers are most relevant and important, depending on their perspective. We will rely on the wide documentation available to ensure the findings faithfully represent the views of stakeholders in spite of the relatively small scale of the field research. |
| 1b | What is the size/scale of the problem? Is there a cross-border dimension? | The same approach to addressing 1a will apply here. The response to this question will also address cross-border elements to the problems and drivers identified. This includes the extent to which non-harmonised implementation contributes to problems and drivers and the extent to which EU legislation impacts the situation in third countries<br><br>Although this is asking for size/scale, the response to this question will be qualitative. Weighting responses, understanding biases and triangulation will be important to answering this question. | • Review of the 2013 Impact Assessment<br>• Desk research<br>• Primary research with stakeholders (e.g. interview programme across main stakeholders and targeted surveys)<br>• Validation survey | Basing the size/scale of problems on primary research risks leading to a biased assessment: some problems will be more significant to some stakeholders than others. We will rely on the wide documentation available to ensure the findings faithfully represent the views of stakeholders in spite of the relatively small |

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| | | Our understanding of the cross-border dimension will be based on any discussion of these issues identified through desk research or interviews. We will be able to validate this information against the information collected from NCAs on the differences between Member State approaches. | | scale of the field research. |
| 1c | What are the main drivers? What are the market failures, regulatory failures or behavioural biases, which are responsible for the observed problem? What evidence is there? | The same approach to addressing 1a will apply here. The response to this question will consider the factors that have contributed to the problems identified in 1a and the size and scale of those problems as identified in 1b. | • Review of the 2013 Impact Assessment<br>• Desk research<br>• Primary research with stakeholders (e.g. interview programme across main stakeholders and targeted surveys)<br>• Validation survey | Previous research leading up to the ICF study has focused on those drivers that are associated with legislation. The ICF study should ensure that we also consider those drivers at play that are not associated with the legislation, to help ascertain the extent to which problems can be attributed to the legislation. |
| 1d | Who is affected by the problems? In what ways, and to what extent? Whose behaviour would have to change to improve the situation? | The response to this question will include a high-level mapping of the types of stakeholders affected by the legislation, as well as the relationships and interactions between those stakeholders.<br>Links between this mapping and the problem tree developed through Q1a-Q1b will be made explicit. This will help | • Review of the 2013 Impact Assessment<br>• Desk research<br>• Primary research with stakeholders (e.g. interview programme across main stakeholders)<br>• Expert interviews | It will be important to ensure a relatively complete stakeholder mapping early on in the process so that primary research undertaken to respond to other questions covers all relevant stakeholders. |

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| | | to answer whose behaviour would have to change to improve the situation.<br>The findings for this question will be validated through expert interviews. | | There may be some impacted groups, such as non-organised gardeners, whose behaviour and relationship to the issues will be harder to capture.<br>We recommend not validating the results of these findings through the survey, as the outcomes may be too political. |
| 1e | How have, and will, the problems evolve in light of developments such as new technical developments in the breeding sector and concerns over sustainability in agriculture and the conservation of agro-biodiversity? | The response to this question will need to describe what relevant new technical developments have occurred in the breeding sector and how concerns over sustainability and conservation have evolved. The response will then need to assess how those technical developments and concerns would impact the problems and stakeholders identified and described in Q1-Q1d. This assessment will require some expert input. | • Desk research (guided by expert suggestion)<br>• Primary research with stakeholders (e.g. interview programme across main stakeholders)<br>• | Views on technical developments and concerns related to sustainability and conservation will differ depending on stakeholders: to answer this question robustly, it will be important to consider views within the overall context. |
| 1f | How has the potential for simplification and improving the efficiency of existing legislation evolved since the Impact Assessment to the 2013 proposal? | The response to this question will describe how the updated problems/drivers/state of play will alter the potential benefits to be gained by simplifying legislation. It will require a reflection on the Impact Assessment, 2013 proposal and the feedback | • Review of the 2013 proposal and feedback on the proposal<br>• Validation survey<br>• | As the response to this question will be based on data collected under other questions, those same limitations will be relevant here. |

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| | | received, in light of the primary data collected for Q1a-Q1e. This response will require an expert assessment and these findings would need to be validated with stakeholders. | | |
| 2 | How has the EU level dimension of the problems evolved? How has the rationale for acting at EU level evolved? | The response to this question will be based on the discussion of the EU level dimension of problems from the 2013 Impact Assessment compared against the updated information on the state of play, problems and drivers as identified under Q1. As such, this response will cover the right to act, value added, citizens and human rights, the necessity for the EU to act and proportionality. This will also take the response to 2a into account. | • Review of the 2013 Impact Assessment<br>• Desk research<br>• Primary research with stakeholders (e.g. interview programme across main stakeholders)<br>• Validation survey<br>• | As the response to this question will be based on data collected under other questions, those same limitations will be relevant here. |
| 2a | How do problems, or practices / courses of action (e.g. differences in variety reference collections; in how extensively VCU tests are carried out (criteria, testing, and calculation of results)) vary across the national, regional and local levels of the EU? | This response will bring together information on how VCU tests are carried out in different jurisdictions and information on variety reference collections in different jurisdictions. It will compare across, highlight key differences and consider these in relation to the problems and drivers identified under Q1.<br><br>Most information to address this question will come from the survey of NCAs. This will provide basic descriptive information on practices and courses of action. Information on how problems vary will be gathered through primary research (e.g. interview programme). Information | • Desk research<br>• Include review of information already collected on this in the 2013 Impact Assessment<br>• Survey of NCAs to address gaps<br>• Primary research with stakeholders (e.g. interview programme across main stakeholders)<br>• | For some Member States, information on this may not be accessible. We will therefore seek to supplement desk research on this question with a survey of regulators. |

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| | | on reported problems will be compared against the information collected on practices. This will help to develop an understanding of what the most impactful differences are between Member States. It will also support the response to Q2. | | |
| ***Specific ICF research questions, related to the problem definition, including "Union relevance" of the problems. In relation to new issues:*** | | | | |
| 3 | What is the impact of non-quarantine pests (RNQP) being listed in the Plant Health Regulation 2016/2031, in relation to control measures (certification) laid down in the Marketing Directives? | The response to this question will need to compare the current situation to a counterfactual. It will look at the inefficiencies caused by needing to maintain the list in both the Regulation and the Marketing Directives and an assessment of burdens caused to stakeholders if certification were to be split between two different regulations.<br>The response will be based on desk research, which will form the basis of the development of a topic guide to discuss this with impacted stakeholders. A hypothesis will be formed based on these discussions and this will be tested through the validation survey. | • Desk research reviewing the results from the RNQP project (https://rnqp.eppo.int/)<br>• Interviews with impacted stakeholders<br>• Validation survey | The burdens assessed under this question will be hypothetical. This will likely be difficult for some stakeholders to respond to, adding to the importance of validating findings for this question. |
| 4 | What is the impact of the Directives not being included in the scope of the Official Control Regulation (2017/625)? (considering the control framework for the sector, e.g. principles of | This response will need to look into the differences between the existing control framework for PRM legislation and the control framework that exists under the Official Control Regulation. | • Desk research<br>• Interviews with NCAs<br>• Survey of NCAs | Because the Official Control Regulation has not been evaluated and we will not be able to fully evaluate the impact of these regulations, the |

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| | controls, audits in Member States, training programmes, official seed fraud network, secure information system)? | It will also consider the impact that the Official Control Regulation has had where it has been applied. This will be based on desk research and primary research with regulators. | | response will be indicative. |
| 5 | To what extent can digitalisation (including, for example, blockchain technologies) improve traceability and offer greater assurances to farmers and other actors in the agri-food chain about the identity, quality and health of the seed? | This response will elaborate on how digitalisation is used in the supply chain to improve traceability, as well as where stakeholders feel there might be future potential for digitalisation to improve traceability.<br><br>This response will also address the potential use of blockchain technologies, focusing on how these could be applied to the PRM supply chain based on existing uses of blockchain for supply chains, the likely benefits this would bring and challenges of implementation.<br><br>The response will be based largely on interviews with stakeholders from across the supply chain. This will be supplemented by some desk research on the use of blockchain for this purpose in other sectors, and the extent to which there are any relevant lessons or insights on this for the PRM sector.<br><br>The hypothesis developed through primary research will then be tested across stakeholders through the validation survey. As many stakeholders may not understand the purpose or benefit of blockchain, these questions will be worded in a non-technical way. | • Desk research<br>• Interviews with stakeholders involved in the PRM supply chain<br>• Validation survey | Many applications of blockchain in supply chains and for regulation are still in early phases of development. Therefore, there may not be enough experience of this among stakeholders to make informed judgments on its potential. Exploration of these issues with stakeholders will therefore need to be accompanied by a clear brief and questions will need to address specific issues identified through desk research. |

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| ***In relation to the use of varieties exclusively aimed for the use of home gardeners:*** | | | | |
| 6 | To what extent is there a case for a lighter or no variety registration system for varieties, which are exclusively marketed to home gardeners? | The response to this question will be based on a comparative assessment between Member States with less burdensome variety registration systems and those with more burdensome variety registration systems. It will consider the differences between these different groupings in terms of outcomes for home gardeners. This grouping will be based on both the results of the NCA survey and on qualitative feedback received from stakeholders. Outcomes for home gardeners will be based on the home gardener survey.<br><br>Further, outcomes could also be compared between species subject to the legislation and species not subject to the legislation (such as buckwheat, basil and rocket).<br><br>Hypotheses will be developed based on this comparison. The experience of countries with lighter regimes (e.g. the US) will also be considered.<br><br>These hypotheses will then be tested through interviews with stakeholders involved in the PRM supply chain. The results of this will then be tested in a validation survey. | • Interviews with stakeholders involved in the PRM supply chain<br>• Desk research (experience of lighter regimes e.g. in the US)<br>• Validation survey | There are many factors beyond regulation that are likely to impact home gardeners. Therefore, wherever differences are identified, we will consider the extent to which those could be linked to the regulation and test these with stakeholders. |
| 6a | How many varieties on the EU market are aimed | The response to this question will assess how many varieties on the EU market are aimed exclusively at home gardeners. It | • Request sent out to maintainers of varieties | The response to this question will focus on those varieties that |

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| | exclusively at home gardeners?<br><br>How many of these varieties are conservation or so-called amateur varieties? | will compare this against lists of conservation or amateur varieties.<br><br>The response will be based on a request sent out to maintainers/marketers of varieties registered with a Member State. This question will also be asked directly to NCAs. Where NCAs can provide an answer, this will be compared against the estimates provided by maintainers/marketers. Together, this will be used to develop an estimate for the number of varieties aimed exclusively at home gardeners.<br><br>To provide a more complete understanding of the landscape, the survey to maintainers/marketers will also ask how many varieties are marketed exclusively to commercial producers.<br><br>As much as possible, this response will be broken down by Member State.<br><br>These estimates will then be tested with a wider group of stakeholders through the validation survey. | registered on the EC database of varieties<br>• NCA survey<br>• Validation survey | have been registered. Some marketing may be happening of unregistered varieties, which may be challenging to document. |
| 6b | To what extent do existing legal requirements limit the diversity of plant reproductive material available for home gardeners? | The response to this question will assess the diversity of PRM available to home gardeners, based on the data collected in Q6a. Diversity will be assessed using a framework developed based on desk research and input from team experts.<br><br>It will then compare the diversity available in each MS against the legal | • Desk research, looking at:<br><br>How to assess diversity<br>European Commission database of varieties<br>Experience in third countries with lighter regimes | The response to this question will need to ensure the criteria used to assess diversity are appropriate.<br><br>The diversity of plant reproductive material available is also likely to |

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| | | requirements. The experience of countries with lighter regimes (e.g. the US) will also be considered.<br><br>Hypotheses will be developed based on this and these will be discussed and validated through interviews with impacted stakeholders. This will include discussions with small producers and seed savers associations. | • Interviews with impacted stakeholders | be impacted by factors beyond the existing legal requirements. The response to this question will therefore need to carefully consider the extent to which differences can be ascribed to regulation. |
| 6c | To what extent do home gardeners' in Europe rely on covering their dietary needs by own home garden produce and thus good quality plant reproductive material plays an essential role? | The response to this question will be based on primary research with home gardeners looking into the proportion of home gardeners that cultivate foodstuffs, and the extent to which those foodstuffs contribute to their dietary needs. The findings will also be compared with the information available from the literature, although it is unlikely that literature will provide much information on this.<br><br>The estimates based on primary research with home gardeners will then be included as part of the validation survey. We do not expect stakeholders to have a strong understanding of home gardener behaviour, but this validation may help us to assess whether estimates are too high. | • Survey of home gardeners<br>• Desk research<br>• Validation survey | Findings on this question based on survey results through gardening associations may be more biased toward gardeners that would grow their own food. This will need to be taken into account during analysis. |
| 6d | Which are EU home gardeners' current preferences with regard to diversity of choice and | The response to this question will be based on primary research with home gardeners looking into their preferences for diversity of choice, identity, quality | • Desk research<br>• Survey of home gardeners | Findings on this question based on survey results through gardening associations |

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| | identity, quality and health of the seed and propagating material which is marketed? | and health of seed. It will measure preferences in a way that breaks down these concepts clearly and allows for comparison between them. To ensure that these concepts are broken down and measured appropriately, questions on this will be formulated based on desk research and discussions with team experts.<br><br>No other sources will be available to inform this and the survey is unlikely to be representative. Therefore, the response to this question will need to be considered as a tentative response in need of further validation. | | may be more biased toward gardeners who value diversity of choice. This will need to be taken into account during analysis.<br><br>Survey questions will also need to be framed carefully to ensure that gardeners' stated preferences in the context of a survey are reflective of actual preferences when purchasing PRM. |
| 6e | To what extent do home gardeners currently experience problems with the identity (e.g. the plant does not conform to what is expected from the information provided on the package), health and quality (e.g. germination) of seed? Do the competent authorities have information on the prevalence of such problems? | The response to this question will describe the extent to which home gardeners currently experience issues with identity, health and quality of seed based on primary research with home gardeners. It will also describe the extent to which NCAs collect information on these issues.<br><br>Information gathered through the home gardener survey will be compared against any reports of issues provided by NCAs. | • Desk research<br>• Survey of home gardeners<br>• Survey of NCAs | Assessing the health and quality of seed may be an issue that many home gardeners feel unable to comment on. To answer this question, we will therefore need to ensure that we sample enough expert home gardeners and that we take this into account in any analysis. |
| 6f | How do the incentives, motivations for and risks of private gardening differ from those of commercial producers across the EU? | The response to this question will be developed by identifying likely differences in incentives, motivations and risks between home gardeners and commercial producers through desk | • Desk research<br>• Survey of home gardeners<br>• Interviews with commercial producers | The sample of respondents is likely to include few low-income gardeners, who will likely have different |

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| | | research and then testing those findings and hypotheses through primary research.<br><br>Incentives, motivations and risks for home gardeners will also be identified through the survey. Survey results will be compared against any available desk research and this will be used to develop hypotheses.<br><br>These hypotheses will be discussed in interviews with commercial producers. However, it is likely that this will be a small sample size. These interviews will help to further refine the hypotheses, which will then be tested through the validation survey. | • Validation survey | motivations than those better-off. This will be reflected in the discussion of the findings. |
| 6g | To what extent would a system with light or no requirements for variety registration for varieties exclusively aimed for the use by home gardeners lead to a broader diversity of varieties marketed to the non-professional sector? Under which conditions? | The response to this question will build on the response to Q6b. It will consider the relative impact of different factors beyond legislation. It will expand to consider the situation in third countries where a lighter or no registration system is already in place (and notably the US).<br><br>This question will also be put directly to seed producers of different types during interviews. The responses from seed producers will then be compared against the comparative assessment to develop a response.<br><br>Findings will be tested through the validation survey. | • Interviews with seed producers of different types<br>• Desk research<br>• Validation survey | The diversity of plant reproductive material available is likely to be impacted by factors beyond the existing legal requirements. When comparing against third countries, it will be important to incorporate these factors in the analysis. Discussing these hypotheses with seed producers who have a presence in multiple jurisdictions may help |

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| | | | | to separate out these factors. |
| 6h | What would home gardeners consider as an acceptable trade-off between a higher choice of available varieties and the quality (e.g. identity, health, purity, germination) of the propagating material of those varieties? | The response to this question will be based on the results of primary research with home gardeners. It will build on the response to Q6d.<br>As with question 6d, no other sources will be available to inform this and the survey is unlikely to be representative. Therefore, the response to this question will need to be considered as a tentative response in need of further validation. | • Survey of home gardeners | For this type of question, survey design will need to take into account likely framing effects and how this might bias responses. |
| 6i | To what extent would the general public (in particular organised and non-organised home gardeners), across the EU, accept such lighter requirements for varieties exclusively aimed for the use of home gardeners? Are there any differences across the EU? | The response to this question will be based on the results of Q6d and Q6h on home gardener preferences, as well as the conclusions of Q6g on the extent to which a lighter or no variety registration system would increase diversity.<br>It will also consider differences in preferences between Member States. | • Survey of home gardeners | We will not be able to survey the general public in response to this question. We can, however, attempt to reach both organised and non-organised home gardeners through snowballing. |
| ***In relation to conservation varieties and the functioning of Directives 2008/62/EC, 2009/145/EC and 2010/60/EU*** | | | | |
| 7 | To what extent have Directives 2008/62/EC, 2009/145/EC and 2010/60/EU facilitated the acceptance of conservation, so called amateur varieties and preservation seed mixtures and contributed to | The response to this question will be based on an assessment of the responses to the sub-questions and the extent to which they indicate that the Directives have facilitated the acceptance of conservation varieties and the preservation of the natural environment. It will also consider any | • Desk research<br>• Interviews with experts | This will likely be impacted by factors beyond the legislation itself and specific outcomes and needs will likely differ between Member States. The response to |

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| | the conservation *in situ* and sustainable use of plant genetic resources or preservation of natural environment (certain habitat types)? | differences in this between Member States and compare this against the outcomes reported by Member States.<br><br>We will also discuss this question explicitly with relevant experts and consider their insights alongside the assessment based on the sub-questions. | | this question will need to take these nuances into account. |
| 7a | How have numbers of conservation and amateur varieties in the Common Catalogues evolved over time? (Overall numbers, numbers in Member States, species concerned) | The response to this question will be based on a quantitative analysis of the conservation and amateur varieties listed in the Common Catalogues over time, broken down by species and Member State. | • The Common Catalogues | Assuming up-to-date and relevant data is available for all Member States through the Common Catalogues, we should be able to provide a robust response to this question. |
| 7b | Analyse the quantities (in terms of area or amounts in kg) of plant reproductive material of conservation and amateur varieties and preservation seed mixtures. | The response to this question will provide an analysis of the amounts of plant reproductive material of conservation and amateur varieties on the market. The response will be linked to the response to Q7d.<br><br>The analysis will focus on differences between Member States. | • Survey with regulators (quantities reported by suppliers to the Member States) | The response will take into account data provided by Member States. |
| 7c | How well is the link to the Habitats Directive 92/43/EEC working and e.g. which types of habitat have been preserved in case of the preservation seed mixtures. | The response to this question will be based on the extent to which stakeholders familiar with the Habitats Directive feel that conservation varieties are supporting their work.<br><br>Hypotheses will be formed based on the input from these conservation | • Desk research<br>• Interviews with experts<br>• Validation survey | Stakeholders familiar with the Habitats Directive may not be familiar with legislation on seeds and conservation varieties, so it will be important to |

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| | | stakeholders. These hypotheses will then be tested through the validation survey. | | phrase these questions in a way that is clear and relevant to these stakeholders. |
| 7d | What have been the differences between actual production and the quantitative limits laid down in Directives 2008/62/EC, 2009/145/EC and 2010/60/EU? | The response to this question will compare the information gathered in Q7b to the quantitative limits laid down in the Directives. | • Quantities reported by Member States to the European Commission<br>• Review of quantitative limits indicated in the Directives | The response will be based on data provided by Member States. |
| 7e | Are there historical, genetic or ecological reasons to limit the maintenance, production and marketing of conservation varieties to the region of origin? What are the advantages and disadvantages of limiting the maintenance, production and marketing of conservation varieties to the region of origin? | The response to this question will be based on desk research synthesising existing research and debate on the reasons to limit the maintenance, production and marketing of conservation varieties to the region of origin. This will be guided by our team expert Dr Nigel Maxted. The results of this will then be discussed and validated with experts in the area of conservation varieties through the validation survey. | • Desk research<br>• Interviews with experts<br>• Validation survey | Because this research relies heavily on expertise and will likely draw on different disciplines and the response will likely differ between regions, it will be important to ensure that we reach a range of experts from across Europe when seeking to answer/validate this question. |
| 7f | How do the criteria and the costs for the acceptance of conservation and amateur varieties and authorisation of preservation seed mixtures vary across the EU? | The response to this question will be based on a review of Member State costs and requirements for the registration of conservation and amateur varieties.<br>This will be supplemented with qualitative feedback from stakeholders with experience of registering | • Desk research<br>• Survey with NCAs<br>• Interviews with expert stakeholders | Our response will be reliant in part on the cooperation of Member State authorities to provide the relevant information. |

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| | | conservation and amateur varieties in different Member States. | | |
| ***In relation to Forest Reproductive Material:*** | | | | |
| 8 | What are the current problems and needs related to the production and marketing of forest reproductive material, the conservation and use of forest genetic resources and the genetic diversity of forest reproductive material? | The answer to this question will provide an update of the understanding around problems and drivers identified in the 2013 Impact Assessment. It will also identify any new problems and drivers emerging through desk research. We will explore these problems and needs in the workshop with relevant experts and test these findings through a survey with FRM producers, end users and NCAs.<br>The response to this question will be underpinned by the development of a problem tree, which will be used to make sense of the data collected. | • Desk research<br>• Workshop with relevant experts<br>• Survey with FRM producers and end users | Stakeholders will likely have different views on what problems and drivers are most relevant and important, depending on their perspective. We will rely on the wide documentation available to ensure the findings faithfully represent the views of stakeholders in spite of the relatively small scale of the field research. |
| 8a | Are there constraints on the free marketing of forest reproductive material? | The response to this question will be based on initial desk research and discussions with our team expert to identify whether any constraints or relevant potential issues have been identified in the literature, both for producers and end users. We will explore these constraints in the workshop with relevant experts and test these findings through a survey with FRM producers, end users and NCAs. | • Desk research<br>• Workshop with relevant experts<br>• Survey with FRM producers, end users and NCAs | Constraints may vary depending on Member State, region and species, our selection of relevant experts will aim to reflect this diversity. |

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| 8b | How could it be ensured that users of forest reproductive material can make informed choices of appropriate planting material with regard to current and projected future environmental and climatic conditions? | The response to this question will be based on initial discussions with our team expert and through the workshop with relevant experts to define how we interpret "appropriate planting material", considering likely differences between species and regions. We will also seek to identify possible ways of ensuring that users are able to make informed choices. These options will then be tested with FRM producers, end users and NCAs through a targeted survey. | • Desk research<br>• Workshop with relevant experts<br>• Survey with FRM producers, end users and NCAs | Experts will need to be selected carefully to ensure that we have an understanding of "appropriate planting material" that is suitable across species and Member States. |
| 8c | Would the use of deployment zones be a reasonable approach to achieve this aim? Is there robust scientific evidence for the concept of deployment zones and are there current national or international research projects addressing this issue? | The response to this question will be developed based on a review of available literature on deployment zones, guided by our team expert. We will then explore these findings within the expert workshop.<br>The feasibility and perceived usefulness of deployment zones will then also be tested with FRM producers, end users and NCAs through a targeted survey. | • Desk research<br>• Workshop with relevant experts<br>• Survey with FRM producers, end users and NCAs | We will be reliant on our expert workshop to provide further insight and help us interpret the evidence. It is therefore essential that these experts are selected carefully and represent a range of backgrounds and experiences. |
| 9 | What type of information should be added to the suppliers' document to allow end users to take informed decisions on the most suitable location for planting, taking into account current and future environmental and climatic conditions? | The response to this question will build on the information collected under 8b to define how we think about "informed decisions". We will then assess this information in relation to the supplier's document. This will also be explored within the expert workshop. | • Desk research<br>• Workshop with relevant experts<br>• Survey with FRM producers, end users and NCAs | It will be important that our survey reaches a range of different types of end users. We hope to achieve this by reaching out to different types of associations and relying on snowballing, but there is a risk that the |

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| | | Potential additions will then be tested with FRM producers, end users and NCAs through a targeted survey. | | sample will be biased toward more experienced and knowledgeable end users. The analysis and reporting will take this bias into account. |
| 9a | To what extent could the supplier's document be harmonised to improve the traceability of forest reproductive material, and to allow end users to make informed choices to plant appropriate genetic material best suited for a particular site and current/future climatic conditions? | The response to this question will be based on initial desk research and the expert workshop to assess the extent to which supplier's documents are currently not harmonised and where the most relevant gaps are in this regard.<br>Options for harmonisation and their perceived usefulness will then be tested with FRM producers, end users and NCAs through a targeted survey. | • Desk research<br>• Workshop with relevant experts<br>• Survey with FRM producers, end users and NCAs | This approach relies in part on our experts being aware of the supplier's documents and having a detailed understanding of relevant issues.<br>This will be considered when selecting experts. Ahead of the workshop, they will be provided with a full briefing, allowing them time to prepare. |
| 9b | How would this best be done? | This response will be based on an assessment of stakeholder feedback to Q9 and Q9a. With guidance from our team expert, we will then set out recommendations for how this could be done. | • Survey with FRM producers, end users and NCAs | It will be important that our survey reaches a range of different types of end users. We hope to achieve this by reaching out to different types of associations and relying on snowballing. The sample may be biased toward more experienced and |

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| | | | | knowledgeable end users. Analysis and reporting will account for this. |
| 9c | Is there a need to trace where the forest reproductive material is planted? | The response to this question will be based on initial desk research and discussions with our team expert to identify whether any constraints or relevant potential issues have been identified in the literature. We will explore these constraints in the workshop with relevant experts and test these findings through a survey with FRM producers, end users and NCAs. | • Desk research<br>• Workshop with relevant experts<br>• Survey with FRM producers, end users and NCAs | This approach relies in part on our experts' knowledge on the end use of forest reproductive material and having a detailed understanding of relevant issues. |

# Annex 2: Detailed methodology

### Desk research

The desk research extracted qualitative and quantitative information that was reviewed and analysed (in conjunction with findings from the research with stakeholders), to provide responses to the ICF study research questions. For some research questions there was little published evidence and responses relied more heavily on evidence collected through the stakeholder consultation tasks. The ICF study matrix in Annex 1 provides an indication of the research questions that desk research helped address.

The research included a review of a wide range of documentation published by the European Commission, the European Parliament, Member State public authorities, academic institutions, research organisations, relevant PRM and FRM stakeholders and international organisations on the issues relevant to the research questions.

The types of evidence and evidence sources included: scientific data and research; peer reviewed academic literature; publications from key stakeholders; grey literature (reports, working papers, blogs); industry datasets; and EU institutions' policy documents, research, studies, statistics and guidelines. A list of sources referenced in this report is included in Annex 3: List of documents reviewed. Preliminary desk research informed the design of the research tools (namely interview and workshop topic guides and survey questionnaires) presented in the Annexes of this report.

The desk research ensured that this ICF study (i) builds on existing evidence, (ii) adopted informed approaches to the stakeholder consultation and (iii) offers more representative /objective evidence compared to what may be achieved through the field research with stakeholders alone.

### Exploratory interviews

A small selection of stakeholders were interviewed to help the research team:

- Better understand stakeholder perspectives concerning the existing legislation on PRM, including current concerns and past criticism, and explore stakeholder expectations of the ICF study;
- Explore data availability (including the identification of additional sources) and better understand gaps and challenges; and
- Inform the stakeholder consultation approach and design of the research tools (namely survey questionnaires and interview topic guides).

The approach to the exploratory interviews was discussed with DG SANTE in the Kick-off meeting and a list of stakeholders agreed. Five interviews took place with experts from the Commission, an international organisation and PRM industry representatives.

### Survey with regulators and competent authorities in Member States

This targeted survey aimed to:

- Collect evidence on national practices in order to compare differences and identify gaps across the EU (for which National Competent Authority (NCAs) responses were critical due to the limited existing evidence available); and
- Ascertain the extent to which competent authorities are aware of or collect information on problems relating to identity, quality and health of PRM marketed towards and/or used by home gardeners.

The survey questionnaire is provided in Annex 4: Targeted survey questionnaires. The survey was completed by 27 countries including all but two Member States (see Annex 5: Participants to the surveys by Member State).

**Survey with home gardeners**

The survey provided evidence to respond to several research questions (see Annex 1: ICF study matrix) where little formal literature was available. It aimed to collect evidence on:

- Home gardeners' motivation for gardening;
- How home gardeners source PRM and the key considerations in the purchases of PRM, such as the diversity or purity of seeds; and
- How home gardeners use PRM and any concerns around the use of PRM, including issues on the identity, quality and health of seeds available to them.

The survey was translated to more than 20 EU languages to encourage participation. The survey was short (10 minutes to complete) to encourage participation and used language appropriate for the target audience (e.g. avoiding use of jargon). The questions were predominantly closed questions, making use of single/multiple choice, Likert scale questions and ranking questions. Participants were able to add alternative and/or additional responses and elaborate further through optional comment boxes. The final survey questionnaire, as revised after being piloted, is provided in Annex 4: Targeted survey questionnaires.

A long list of hobby gardener associations, groups and organisations across MS were identified through desk-based research and contacted to participate and/or further disseminate the survey amongst their members and networks using available channels. For instance, this included sharing links to the survey via email, e-newsletters, social media groups and more.

A total of 6,089 home gardeners participated in the survey. A breakdown of participants by country is provided in Annex 5: Participants to the surveys by Member State.

**Survey with maintainers of registered varieties**

A survey with maintainers and marketers of registered varieties for the amateur market was carried out to provide an understanding of the number and types of varieties on the EU market aimed exclusively at home gardeners.

The questionnaire for this survey is provided in Annex 4: Targeted survey questionnaires. The survey was shared with relevant stakeholders through a small number of key organisations (via email) and was further advertised during a Euroseeds Conference Session on 13 October 2020, attended by more than 200 participants. A total of 81 maintainers participated in the survey.

**Stakeholder interviews**

The purpose of the interviews was to allow the research team to collect qualitative insights from different stakeholders exploring:

- Stakeholders' familiarity with the current regulation on PRM;
- Views on challenges in the production and marketing of PRM including underlying drivers (linked to legislation, stakeholder attitudes, industry practices etc.);
- Stakeholder views on recent developments in the PRM sector and their impacts (positive or negative); and
- Advantages and disadvantages of alternative requirements.

The interviews were semi-structured and lasted45-60minutes. A master topic guide is provided in Annex 4: Targeted survey questionnaires, although questions were further tailored for each stakeholder.

A total of 40 interviews took place[68]. A breakdown of interviewees per stakeholder category is provided in Table 5. Interviewees represent a mix of stakeholder types with interests in the marketing and production of PRM (academia, public sector, industry, civil society organisations and farmer's organisations), and representation across traditional and conservation varieties, the organic sector and preservation mixes.

*Table 5. Breakdown of interviewees*

| Stakeholder type | Number and breakdown of stakeholders |
|---|---|
| PRM experts | 8 experts, covering different areas of expertise (commercial seed industry, amateur market, PRM legislation, conservation) |
| Public authorities | 7 NCAs covering different geographical regions. |
| Seed and plant propagating material industry/sector organisations | 13 in total, including:<br>• EU level associations<br>• international commercial stakeholders<br>• small commercial operators at different stages of the supply chain, covering different MSs and types of PRM |
| Farmers' organisations (conventional and organic) | 5 at EU and national level stakeholders |
| Civil Society Organisations (CSOs) | 7 covering different MSs and PRM types |

**Workshop with FRM experts**

A virtual workshop was held on September 23rd with seven FRM experts. The workshop was supported using Mural, a collaboration tool that acts as a virtual whiteboard, so that participants can contribute to the formulation of ideas and solutions. The workshop was led by ICF with support from the ICF study team's FRM expert, Dr Thomas Geburek. A topic guide, list of participants and note summarising the findings of the workshop is included in Annex 7: FRM workshop note.

Experts invited to take part in the workshop were selected, in cooperation with the team expert and European Commission, firstly to represent geographic diversity: the EU Directives on Forest Reproductive Material (FRM) were implemented across the EU, however the ecological and economic importance of the forest sector varies significantly among Member States. Small MS as well as larger-area MS were considered, as were MS with differing levels of activity in breeding programmes and with differing forest ownership structures. In addition, the list of participants reflects different areas of expertise, including both scientists and public policy professionals.

**Survey with FRM stakeholders**

The survey with FRM stakeholders was launched following the expert workshop. The findings from the expert workshop and reviewed literature and associated recommendations were tested with stakeholders through the survey.

The survey was shared with a range of stakeholders relevant to FRM, including users of FRM and NCAs. The survey questionnaire is provided in Annex 4: Targeted survey

[68] Includes six stakeholders who provided written feedback instead of an interview.

questionnaires. A total of 80 responses were received from stakeholders invited to participate.

**Validation survey**

A validation survey was conducted to test the main emerging findings and conclusions of the ICF study relevant to PRM[69]. The survey set out hypotheses and evidence statements and asked stakeholders to assess the extent to which they agreed or disagreed with them.

The survey was shared with stakeholders across all groups identified in the mapping (with the exception of hobby gardeners and FRM stakeholders). To avoid survey fatigue and counteract the short window available for participation (one week), the questionnaire employed predominantly closed, Likert-style questions providing respondents the option to skip questions that do not apply to them.

The survey was completed by 88 participants. The results of the survey are integrated in the ICF study conclusions (Section 5) and summarised in Annex 10: Validation survey results. The survey included two open-ended questions the responses to which were collated and provided to the Commission as a separate deliverable. These responses have not been incorporated in the analysis that informed this report.

[69] The validation survey did not cover FRM. FRM emerging findings were tested with stakeholders as part of the FRM survey.

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# Annex 4: Targeted survey questionnaires

### NCA Survey

**PART 1**

This survey aims to better understand the certification and registration system in each Member State.

**Introduction**

1. Which country are you responding on behalf of?

   Austria
   Belgium
   Bulgaria
   Croatia
   Cyprus
   Czech Republic
   Denmark
   Estonia
   Finland
   France
   Germany
   Greece
   Hungary
   Ireland
   Italy
   Latvia
   Lithuania
   Luxembourg
   Malta
   Netherlands
   Norway
   Poland
   Portugal
   Romania
   Slovakia
   Slovenia
   Spain
   Sweden
   Switzerland
   Other *(Thank and close)*

2. Can you please provide a brief overview of the certification and registration system in your Member State?
   a. How it is organised (centrally or regionally)?
   b. Who are the key actors and how are they involved?
   c. Are you using official supervision for field inspection, where legislation provides for it? If yes, to what extent, and if not, why is that?
3. Please name and describe the role of the relevant enforcement authority (or authorities) in your Member State with a mandate to enforce the obligations contained in the Directives.

**VCU tests for agricultural crops**

Four criteria are defined in Commission Directive 2003/90/EC for the Value for Cultivation and Use (VCU) tests: (1) Yield, (2) Factors in the physical environment, (3) Resistance to harmful organisms, (4) Quality.

4. How is the final result for VCU tests calculated?
    a. How are the findings of the VCU integrated into a final score?
    b. Do you use index-weighting or do you consider single key characteristics?
5. How are the sustainability criteria addressed? Are they included in calculations for the final score of VCU?
6. Are there any overriding criteria or exceptions? Please provide any examples of cases where the presence of superior characteristics (special traits not usually considered in the VCU test, e.g. traits facilitating processing) compensate for other inferior characteristics (e.g. lower yield).
7. Is there a separate system for organic VCU?
    a. If yes, how is organic VCU organised?
    b. If no, how do you test varieties developed for the purpose of organic agriculture?
8. Would you support the option for one year of examinations (DUS and VCU) to be conducted by the breeder under official supervision? Why/why not?

**Conservation and amateur varieties (as per Directives 2008/62/EC and 2009/145/EC) and preservation seed mixtures (Directive 2010/60/EU)**

9. What are the requirements for the registration of conservation varieties?
10. What are the requirements for the registration of amateur varieties?
11. What quantity (in terms of area or amount in kg) of conservation varieties are being produced in your Member State? Where possible, please break this down by variety.
    a. What is the difference between actual and maximum possible production?
    b. How has this changed over the past 5 years?
12. What quantity (in terms of area or amount in kg) of amateur varieties are being produced in your Member State? Where possible, please break this down by variety.
    a. What is the difference between actual and maximum possible production?
    b. How has this changed over the past 5 years?
13. What quantity (in terms of area or amount in kg) of preservation seed mixtures are being produced in your Member State? Where possible, please break this down by mixture.
    a. What is the difference between actual and maximum possible production?
    b. How has this changed over the past 5 years?

**Enforcement and control**

14. What measures has your Member State put in place to enforce the Directives relevant to the production, use and marketing of plant reproductive material?
15. Do you feel that you have sufficient resources for inspection and enforcement?
16. Do you think that there are sufficient systems in place to enable cross-border cooperation on enforcement?

17. Do you think that harmonising controls across Member States (in relation to the above-mentioned Directives) would be beneficial?
18. Are you familiar with the Official Control Regulation (EU) 2017/625?
    a. Yes
    b. No
    c. Unsure
19. [If yes] Would you see any additional benefit to the PRM marketing directives being included in scope of the Official Control Regulation? Why/why not?

**Home gardeners**

20. Do you conduct marketing controls on seeds marketed to non-professional or home gardeners? If so, how are these controls conducted?
21. Are any controls conducted on the sales of seed online? If so, how are these controls conducted?
22. Are you aware of any issues currently experienced by **home gardeners** in relation to the identity, health and quality of seed?
    a. Yes
    b. No
23. [If yes to Q21] Can you provide further details on the extent of these issues and how these have been reported (e.g. have you received this information through controls, through complaints or through another channel)?
24. Do you hold any information on the proportion of registered varieties which are marketed exclusively to home gardeners (e.g. **not** marketed to commercial users)?
    a. Yes
    b. No
25. [If yes to Q23] Can you please share this information? We are interested in any quantitative or qualitative information available.

**Digitalisation[70]**

26. To what extent do you rely on digital processes for traceability? How has that changed in the past 5 years?
27. What are the risks and opportunities from digitalisation?

## Part 2

This survey aims to collect information on the costs and timelines for technical examinations, certification activities, post-controls, the management of variety reference collections and how these differ by species. The survey is likely to require collaboration of colleagues from different departments to complete; a template is provided to facilitate the collation of data requested.

[70] In the context of this ICF study, digitalisation refers to the increasing use of digital technologies in support of the registration, certification, monitoring and management of Plant Reproductive Material. This may include, for instance, the use of blockchain technology to facilitate seed traceability and information sharing, the use of tablets in field inspections or the use of satellite imagery and drones for monitoring purposes.

Please respond the following questions in relation to the Directive(s) you are familiar with.

1. Which country are you responding on behalf of?

   Austria
   Belgium
   Bulgaria
   Croatia
   Cyprus
   Czech Republic
   Denmark
   Estonia
   Finland
   France
   Germany
   Greece
   Hungary
   Ireland
   Italy
   Latvia
   Lithuania
   Luxembourg
   Malta
   Netherlands
   Norway
   Poland
   Portugal
   Romania
   Slovakia
   Slovenia
   Spain
   Sweden
   Switzerland
   Other *(Thank and close)*

**Costs and timelines**

2. What fees are charged for each of the following:
   a. registration procedure
   b. technical examinations (i.e. DUS and VCU tests)
   c. certification activities (i.e. field inspection, sampling, testing and authorisation of seed and plant material)
   d. post-controls

   Do these differ for conservation and amateur varieties?

   If possible, please use the spreadsheet available online here [add link][71] to break down the fees by species and/or types of varieties, where appropriate. Alternatively, you can complete the relevant tab in the spreadsheet, also shared in the email invite to this survey, and return to us via email.

[71] Please note this is password-protected and hence only accessible to recipients of the email invite containing the password.

3. Is there any cost recovery for applicants for technical examinations?
    a. Yes
    b. No
4. [If Q3=YES] How is cost recovery calculated and financed? If appropriate, please break this down by species or types of varieties (e.g. amateur).
5. [If Q3=YES] What percentage of the full costs are covered by fees? If appropriate, please break this down by species or types of varieties (e.g. amateur).
6. What is the timeline for issuing decisions on an application following the completion of DUS and VCU tests? If appropriate, please break this down by species or types of varieties (e.g. amateur).
    a. If not covered above, at what frequency are applications considered?
7. What was the total number of applications for each of the following years: 2017, 2018, 2019?

    If possible, please use the spreadsheet available online here [add link] to break this down by species. Alternatively, you can complete the relevant tab in the spreadsheet, also shared in the email invite to this survey, and return to us via email.
8. How frequently are newly registered varieties reported to the Common Catalogue?

**Variety reference collections**

9. How are variety reference collections managed for:
    a. agricultural species
    b. vegetable species
    c. ornamental species
    d. fruit species
    e. vine

    Options provided:

1. Living Variety collections
2. Databases with characteristics and descriptions
3. Image collections
4. Walking reference collections
5. DNA-databases

If other, please specify below.

10. Are there any differences between the management of variety reference collections for seed and vegetatively propagated species? If so, please specify.
11. Are biochemical and molecular techniques used for managing variety reference collections? If so, which techniques are used for what purpose?
12. Do you cooperate with other Member State regarding variety reference collections? For which ones and in what way?
13. How many varieties are included in the variety reference collections?

    If possible, please use the spreadsheet available online here [add link] to break this down by species. Alternatively, you can complete the relevant tab in the

spreadsheet, also shared in the email invite to this survey, and return to us via email.

**Hobby Gardener Survey**

**Background questions**

7. Publication privacy settings

I agree with the personal data protection provisions.

8. In which country are you located?

- Austria
- Belgium
- Bulgaria
- Croatia
- Cyprus
- Czech Republic
- Denmark
- Estonia
- Finland
- France
- Germany
- Greece
- Hungary
- Ireland
- Italy
- Latvia
- Lithuania
- Luxembourg
- Malta
- Netherlands
- Poland
- Portugal
- Romania
- Slovakia
- Slovenia
- Spain
- Sweden
- Other *(We are sorry. You do not meet the criteria to complete this survey. We thank you for your time)*

9. Do you purchase seeds, young plants and/or other plant propagating material for personal use?
   a) Yes
   b) No

10. Are you affiliated with an amateur gardeners' association, club or group?
    a) Yes – please specify the name of the association and/or group [open text box]

b) No

*11.* Where do you carry out your gardening? *Please select all that apply.*

a) In your own garden/land
b) In an allotment or community garden
c) Other - please specify

12. To what extent do you agree or disagree with the following reasons why you are involved in gardening.

a) Enjoyment (i.e. as a hobby)
b) To grow edible produce for myself / my family
c) To improve and/or maintain the appearance of my garden/private land
d) To sell plants and/or edible produce (online or in-person e.g. in farmers markets)
e) To sell seeds, young plants and/or other plant propagating material (online or in-person)
f) To socialise with others (e.g. within a gardening association / community allotment or project)
g) To grow plants and/or edible produce for competitions

*Scale:*

Strongly agree
Slightly agree
Neither agree nor disagree
Slightly disagree
Strongly disagree
Not applicable

6b. Are there any other reasons that you're involved in gardening that are not specified above? *If yes, please specify them below.*

**Experiences with plant reproductive material (PRM)**

13. Which of the following types of plants do you grow as a hobby gardener? Please select all that apply.

a) Vegetables (other than potatoes)
b) Potatoes
c) Fruit plants
d) Vines (for grapes)
e) Ornamental plants
f) Fodder plants (crops cultivated primarily for animal feed)
g) Cereal plants (grain crops, e.g. maize, wheat, oats)
h) Oil and fibre plants
i) Beet plants (sugar beet or beet cultivated primarily for animal feed)
j) Herbs

14. Where do you source the majority of the seeds, young plants and/or other plant propagating material for the plants you grow? Please select all that apply.

a) Shops (e.g. garden centres, supermarkets)

b) Online through EU websites
c) Online through non-EU websites
d) Local gardening networks (e.g. from other hobby gardeners, farmers markets, allotment sales) or community seed banks
e) Other – please specify

15. To what extent do you consider the garden produce that you grow to be important in meeting your dietary needs?

a) Not at all important
b) Not very important
c) Moderately important
d) Quite important
e) Extremely important
f) Not applicable – I do not grow edible produce

16. To what extent do you agree or disagree with the following statements on seeds, young plants and/or other plant propagating material?

a) There is a good diversity of choice of seeds, young plants and/or other plant propagating material available for me to purchase
b) Seeds and other plant propagating material I have purchased in the past met my expectations in terms of plant quality[72] and health once grown
c) Seeds and other plant propagating material I have purchased in the past met my expectations in terms of plant identity[73] once grown

*Scale:*

Strongly agree
Slightly agree
Neither agree nor disagree
Slightly disagree
Strongly disagree
Don't know / Not applicable

17. [If respondent has selected 'slightly disagree' or 'strongly disagree' in response to 10a] What would you like to see in terms of seeds, young plants and/or other plant propagating material diversity? Are there specific varieties or species of seeds that are not available? *(Open text box)*

18. [If respondent has selected 'slightly disagree' or 'strongly disagree' to 10b or 10c] Your responses above indicate that you have encountered problems linked to the quality and identity of seeds, young plants and/or other plant propagating material, could you please explain what those were? Did they relate to specific varieties or species of seeds? *(Open text box)*

19. How important are each of the following factors to you when you are buying seeds, young plants and/or other plant propagating material? *Please rank them in order of importance, where 1 is most important and 5 is least important.*

[72] By quality, we mean that seeds germinate, that the yield is satisfactory and that packages contain only the seed purchased.
[73] By identity, we mean that the plant grown corresponds to the plant detailed in the packaging/marketing information.

a) The **diversity** of varieties available for hobby gardeners to buy
b) The **price** of varieties available for hobby gardeners to buy
c) The **identity** of varieties available for hobby gardeners (i.e. the seeds planted are what is expected based on the packaging)
d) The **health and quality** of varieties available for hobby gardeners
e) Availability of varieties with **cultural or historical significance** (e.g. heirloom or conservation varieties)

20. If you have any further comments or additions please add them to the text box below.

**Survey with maintainers**

1. What types of plant reproductive material do you market and/or maintain? Please tick all that apply.
   - Vegetable seed
   - Fodder plant seed
   - Cereal seed
   - Beet seed
   - Oil and fibre plants
   - Seed potatoes
   - Fruit plant propagating material
   - Vine propagating material
   - Vegetable material other than seed

2. Do you breed, sell or market varieties for the hobby gardener market?
   a. Yes
   b. No
   c. Don't know

*If yes, survey continues. If no or don't know, survey closes.*

3. What type of business are you involved in? [tick all that apply]
   a. Seed or other PRM breeding and production
   b. Business-to-Business seed/PRM sales
   c. Selling/marketing seed or other PRM to end consumers

4. How many different varieties (in total) do you market/maintain? If possible, please break this down by species/sector. If you cannot provide exact answers, please provide best estimates or ranges.

5. [If 3a is selected] In which Member State(s) are these varieties registered?

- Austria
- Belgium
- Bulgaria
- Croatia
- Cyprus
- Czech Republic
- Denmark
- Estonia
- Finland
- France
- Germany
- Greece
- Hungary
- Ireland
- Italy
- Latvia
- Lithuania
- Luxembourg
- Malta
- Netherlands
- Poland
- Portugal
- Romania
- Slovakia
- Slovenia
- Spain
- Sweden

6. [If 3b or c] Have you had any challenges in securing PRM for the hobby gardener market?
    a. Yes
    b. No
    c. If yes, what were those?

7. Approximately how much of your business is for the hobby gardener market?
    a. 100%
    b. 75% or more
    c. 50% or more
    d. 25% or more
    e. Less than 25%
    f. Don't know

8. How has the number of varieties available for hobby gardeners changed in the past 10 years?
    a. Significantly increased

b. Somewhat increased
c. No change
d. Somewhat decreased
e. Significantly decreased
f. Don't know

9. Of the varieties you breed/sell/market, are any varieties marketed **exclusively** to hobby gardeners (i.e. not marketed to commercial producers)?
   - Yes
   - No
   - Don't know

*If yes, survey continues. If no or don't know, go to Q17*

10. How many varieties do you market **exclusively** to hobby gardeners? If you cannot provide exact answers, please provide best estimates or ranges, as either a number or a percentage.

11. Does the current legislation limit what you can market to hobby gardeners?
   - Yes
   - No
   - To some extent
   - Don't know

   If Yes or To some extent - please explain

12. To your knowledge, are these varieties ever marketed to commercial producers (e.g. by other marketers)?
   - Yes
   - No
   - Don't know

*13.* How many of these varieties are registered as conservation varieties[74]? *Please provide your best estimate.*

*14.* How many of these varieties are registered as amateur varieties[75]? *Please provide your best estimate.*

[74] as per Directive 2008/62/EC and 2009/145/EC
[75] as per Directive 2009/145/EC

15. What differentiates any varieties sold exclusively to hobby gardeners from those sold to commercial producers?

16. Do hobby gardeners have different preferences as compared to commercial customers?
    - Yes
    - No
    - Don't know

If yes, please explain.

17. Do you have any further comments relevant to the market for hobby gardeners?

**Forest Reproductive Material survey**

**General questions**

1. Please choose which of the following best describes you and/or your organisation:
    a. National Competent Authority
    b. Research institute or academia
    c. Industry/Forestry association
    d. FRM company
    e. International organisation
    f. NGO
    g. Nursery
    h. Other – please specify

2. [If 1a] Which country are you responding on behalf of?
   [If 1b-h] In which country are you based?
    - Austria
    - Belgium
    - Bulgaria
    - Croatia
    - Cyprus
    - Czech Republic
    - Denmark
    - Estonia
    - Finland
    - France
    - Germany
    - Greece
    - Hungary
    - Ireland
    - Italy
    - Latvia
    - Lithuania
    - Luxembourg

- Malta
- Netherlands
- Poland
- Portugal
- Romania
- Slovakia
- Slovenia
- Spain
- Sweden
- Other *(Thank and close)*

**Current problems and needs related to FRM**

3. There is currently a problem with controlling for the **identity** of forest reproductive material.
    a. Strongly agree
    b. Agree
    c. Neither agree nor disagree
    d. Disagree
    e. Strongly disagree
    f. Don't know

4. [If a, b or c selected to Q3] To what extent do the following contribute to challenges in controlling for the identity of forest reproductive material?
    - There is insufficient information on basic material
    - Documentation on FRM identity (such as supplier's documents) is not uniformly completed across Member States.
    - Not enough information on FRM and its identity is collected and/or shared by Member States when a product is marketed.
    - Guidance is needed for users on how to identify and record the identity of FRM in relevant documentation
    - Member State authorities do not have sufficient resources to conduct controls on identity and/or enforce measures.
    - Other [please specify]

    a. To a great extent
    b. To some extent
    c. Not at all
    d. Don't know

5. [If 1a or 1b] Would the use of genetic markers be a feasible approach for your Member State to help ensure FRM identity?
    a. Yes
    b. No
    c. Don't know

    ➔ If no, please explain why this would not be feasible

6. There is currently a problem with the **traceability** of forest reproductive material[76].
    a. Strongly agree
    b. Agree

[76] I.e. our ability to trace FRM from basic material to final use (plantation)

c. Neither agree nor disagree
d. Disagree
e. Strongly disagree
f. Don't know

7. Would it be feasible for users of forest reproductive material to keep records of where FRM is planted and share this data with National Competent Authorities?
    a. Yes
    b. No
    c. Maybe
    d. Don't know
    ➔ If no, please explain why this would not be feasible
    ➔ If maybe, please specify under which conditions

8. Does the current approach to documenting seed sources (such as the supplier's document and Master Certificate) in Europe allow for easy comparison between seed sources?
    a. Yes
    b. Somewhat
    c. No
    d. Don't know

9. Would it be feasible to make:
    a. Master Certificate's Code/Reference Number public at a national level (e.g. on a Member State's official website)?
        i. Yes
        ii. No
        iii. Don't know
        ➔ If no, please explain why this would not be feasible
    b. Master Certificates public at a national level (e.g. on a Member State's official website)?
        iv. Yes
        v. No
        vi. Don't know
        ➔ If no, please explain why this would not be feasible

10. Are you familiar with the FOREMATIS database?
    a. Yes
    b. No

11. [If yes to q10] Do you think it would be feasible to include the following types of information in FOREMATIS:
    - Master Certificate Code/Reference Number
    - Coordinates of planting sites
    - Monitoring information (e.g. information on how trees are performing)
    - Import information
    - Other – please specify

    a. Yes
    b. No
    c. Don't know
    ➔ If no to any, please explain why this would not be feasible

12. Do you have any further recommendations as to how traceability could be improved?

13. There is currently a problem with conserving the **genetic diversity** of forest reproductive material.
    a. Strongly agree
    b. Agree
    c. Neither agree nor disagree
    d. Disagree
    e. Strongly disagree
    f. Don't know

14. [If 13a, 13b or 13c] To what extent do each of the following issues contribute to the problem of conserving genetic diversity?
    - Harvesting only a limited selection of seed stands and/or seed orchards
    - Harvesting only a limited selection of seed trees in seed stands and/or seeds orchards
    - Distributing /selling only a limited selection of seed stands
    - Higher price of small seed stands (as opposed to e.g. seed orchard seeds)
    - Intensive use of a single seed source (e.g. to support tree improvement)
    - Restrictions and/or recommendations on the use of FRM in certain regions
    - Limited private sector access to certain state-owned FRM
    - Limited transfer of FRM across borders
    - Intensive use of clones
    - Regulation limiting the ability of forest enterprises to use their own forest genetic resources (contract production)
    - Other – please specify

    a. To a great extent
    b. To some extent
    c. Not at all
    d. Don't know

15. [If 1a or 1b] Does your Member State have any requirements regarding the number of trees that must be selected as a seed source or stand (e.g. to support genetic diversity)?
    a. Yes
    b. No
    c. Don't know

    ➔ If yes, what are these requirements?

16. [If 1a or 1b] Has your Member State developed any additional requirements relevant to the collection, marketing or use of FRM to support **genetic diversity**?
    a. Yes
    b. No
    c. Don't know

    ➔ If yes, what are these requirements?

17. In your experience, do nurseries struggle to access certain types of seed?
    a. Yes

b. No
c. Don't know

➔ If yes, could you please provide further details on what seed nurseries struggle to access and why?

18. Are you aware of any problems related to the fact that the Directive only covers certain tree species intended for forestry purposes?
    a. Yes
    b. No
    c. Don't know

➔ If yes, what are these problems?

19. [If yes to 15] Is there a rationale for expanding the scope of the Directives beyond certain tree species intended for forestry?
    a. Yes
    b. No
    c. Don't know

➔ If yes, what should the scope be expanded to?

20. [If 1a or 1b] Are there any challenges specific to regulating FRM supply chains that are transnational? E.g. FRM collected from basic material collected in one country and plants grown in another country
    a. Yes
    b. No
    c. Don't know

➔ If yes, can you describe these challenges?

21. When considering what type of FRM to purchase, to what extent would the following information be helpful in order to make informed planting decisions? [Options: Very helpful, Helpful, Somewhat helpful, Not at all helpful, Don't know]
    Related to FRM

- genetic diversity
- identity
- expected genetic gain (if qualified/tested FRM)
- information on the current ecological zones for which FRM are expected to be suited
- information on the current and future ecological zones and conditions for which FRM are suited, based on FRM performance
- availability
- categories
- collection year
- number of clones/families (if qualified/tested FRM)
- contact details of seed harvesting company

Related to seed stands

- size
- age
- growth
- photos of typical seed trees
- coordinates and altitude
- genetic origin if basic material was translocated
- site conditions (climatic details including frost, risk, water storage capacity, site index)

- owner's contact details
- Other – please specify

Of the options selected above, which are the top 3 types of information that would be most helpful to have?

22. If relevant information to help make appropriate planting decisions were provided on FRM **before** purchase, would this be helpful?
    a. Yes
    b. No
    c. Don't know

23. [If yes to 22] Which of the following is your preferred format for this information? *Please rank from 1 to 3, where 1 is your most preferred and 3 is your least preferred format.*
    1. Included in price lists/catalogues
    2. As a printed information sheet at the point of purchase
    3. Online (e.g. via a link or QR code)

    Other – please specify

24. Do you think there is a need for an EU harmonised approach to supplier's documents[77]?
    a. Yes
    b. No
    c. Don't know
    ➔ Please explain your answer

25. How much information do you believe it is important to include on supplier's documents?
    a. The same amount of information as is currently included
    b. Less information than is currently included (e.g. a link to the Master Certificate Code)
    c. More information than what is currently included
    ➔ If b or c, please explain

[77] Supplier's documents are provided to users of FRM on purchase and contain information on the identity of a lot of FRM. Examples of supplier's documents in different Member States can be found at: http://www.efna.eu/country-listing.html

## Annex 5: Participants to the surveys by Member State

*Table 6. Countries participating to the NCA survey*

| Country | Participation in Part 2 |
|---|---|
| Austria | ✓ |
| Belgium | ✓✓[78] |
| Bulgaria | ✓ |
| Croatia | ✓ |
| Cyprus | ✓ |
| Czech Republic | ✓ |
| Denmark | ✓ |
| Estonia | ✓ |
| Finland | ✓ |
| France | ✓ |
| Germany | ✓ |
| Greece | ✓ |
| Hungary | ✓ |
| Ireland | ✓ |
| Italy | ✓ |
| Latvia | ✓ |
| Lithuania | ✓ |
| Luxembourg | ✓ |
| Netherlands | ✓ |
| Norway | ✓ |
| Poland | ✓ |
| Portugal | ✓ |
| Romania | ✓ |
| Slovenia | ✓ |
| Spain | ✓ |
| Sweden | ✓ |
| Switzerland | ✓ |
| **Total** | **28** |

[78] Responses were received by 2 different NCAs in Belgium. The final figure of 28 includes both.

*Table 7. Participants to the hobby gardener survey*

| Country | Number of participants |
|---|---|
| Austria | 831 |
| Belgium | 58 |
| Bulgaria | 15 |
| Croatia | 0 |
| Cyprus | 4 |
| Czech Republic | 1446 |
| Denmark | 19 |
| Estonia | 7 |
| Finland | 402 |
| France | 97 |
| Germany | 1943 |
| Greece | 62 |
| Hungary | 15 |
| Ireland | 9 |
| Italy | 21 |
| Latvia | 70 |
| Lithuania | 2 |
| Luxembourg | 23 |
| Malta | 4 |
| Netherlands | 24 |
| Poland | 2 |
| Portugal | 4 |
| Romania | 3 |
| Slovakia | 330 |
| Slovenia | 1 |
| Spain | 38 |
| Sweden | 533 |
| Norway | 66 |
| Switzerland | 60 |
| **Total** | **6089** |

*Table 8. Participants to the FRM survey*

| Country | Number of Participants |
|---|---|
| Austria | 3 |
| Belgium | 7 |
| Bulgaria | 1 |
| Croatia | 1 |
| Cyprus | 1 |
| Czech Republic | 8 |
| Denmark | 2 |
| Estonia | 1 |
| Finland | 6 |
| France | 12 |
| Germany | 10 |
| Greece | 1 |
| Hungary | 0 |
| Ireland | 1 |
| Italy | 4 |
| Latvia | 0 |
| Lithuania | 2 |
| Luxembourg | 1 |
| Malta | 0 |
| Netherlands | 4 |
| Poland | 3 |
| Portugal | 0 |
| Romania | 0 |
| Slovakia | 3 |
| Slovenia | 2 |
| Spain | 2 |
| Sweden | 5 |
| Other | 0 |
| Norway | 0 |
| Switzerland | 0 |
| **Total** | **80** |

# Annex 6: Interview topic guide

**Background**

1. Please briefly describe your role and how it relates to plant reproductive materials.

   *Probe to understand stakeholder type, geographical scope of knowledge, what PRMs their organisation covers and how they fit into the PRM sector (e.g. scale of the organisation and whether they relate to the commercial seed industry, home gardeners or another part of the PRM sector)*

2. How familiar are you with the PRM Marketing Directives?

**Challenges and developments in the PRM sector**

3. What do you see as the key problems currently affecting the production and marketing of plant reproductive materials?

   a) For the issues mentioned, are there any differences across national (by MS), regional and local levels?
   b) To what extent are these impacted by legislation?
   c) Regarding the key problems you have identified, who is (most) affected by these issues? In what ways and to what extent?

4. Have these changed since 2013 (interviewer following up on those problems raised by the interviewee)?

   a) If so, in what way? What do you think the key reasons are for these changes?
   b) If not, why do you think this is?

5. How might this situation be improved? Who would need to take action (e.g. EC, national competent authorities, breeders)?

6. Do you anticipate that technical developments (e.g. the development of new gene editing technologies, such as CRISPR, greater use of data/monitoring to inform breeding etc) in the breeding sector will change the situation as you describe it? How?

7. In what ways do you think digitalisation (including things such as blockchain technology, digital sequencing information (DSI)) could be used in the PRM sector to improve transparency and traceability?

   a) What benefits might this bring and to whom?
   b) Are there any risks or possible concerns to the introduction of digital technologies?

8. Do you anticipate that growing concerns about sustainability and conservation will change the situation as you describe it? How?

9. What role do you think the EU should play in addressing current and emerging issues and why?

**PRM legislation**

10. [NCAs] How familiar are you with the issue of regulated non-quarantine pests?

11. [NCAs] What approach do you currently take when consulting regulation in relation to Union regulated non-quarantine pests (Union RNQPs)?
    a) Would you review both the marketing and Implementing/Plant health directives?
    b) Has this duplication caused any issues in the past year in terms of understanding or practical implications in the implementation of the certification and controls? If so what are those and how have they been addressed? (e.g. it may be that different teams within the NCA address these, that it created confusion or that it required inspector training)
    c) If the full list of Union RNQPs was maintained in the marketing directives, to what extent would that impact your approach?
    d) Are there any inconsistencies concerning the regulation of Union RNQPs? If so, where? What impact does this have?

12. [Stakeholders other than NCAs] Do you have experience registering varieties in the EU?
    a) If so, for which species in which MS? How would you describe the process? (e.g. was it easy/straightforward, complicated, time-consuming)
    b) What influenced your decision to register in [Member State]?
    c) If you have experience in multiple MS or with different species, what were the main differences in the process?

13. [If experienced with registration] Would you see a benefit to allowing one year of examinations (DUS and VCU) to be conducted by the breeder under official supervision?

14. Are you aware of any issues or challenges related to the control and enforcement of the marketing Directives?

15. [NCAs] Are you familiar with the Official Control Regulation?

16. [NCAs if familiar with OCR] How does the existing control framework for PRM legislation compare to the control framework that exists under the Official Control Regulation?
    a) Are there any aspects of the OCR that would be beneficial if applied to the control of the marketing directives?
    b) Are there any aspects of the OCR that would not make sense in the context of the marketing directives?

17. [NCAs if familiar with OCR] What is the impact of the marketing Directives not being included in the scope of the Official Control Regulation (2017/625)?

18. [NCAs – if knowledgeable on RNQPs and OCR] Does the inclusion of Union RNQPs in the Official Control Regulation create any benefits or challenges in relation to the control measures on certification laid out in the marketing directives? [If challenges are identified explore how these can be addressed]

**Hobby gardening**

19. How do the incentives, motivations for and risks of private gardening differ from those of commercial producers across the EU?

20. What are your thoughts on the current registration system? How well does this work for varieties exclusively aimed at hobby gardeners?

    a) Is there a case for a lighter or no variety registration system for varieties aimed exclusively at hobby gardeners?

21. In what ways do current legal requirements impact the diversity of plant reproductive materials available for hobby gardeners?

22. Do you expect that reducing the requirements for variety registration for varieties aimed exclusively at hobby gardeners would have an impact on the diversity of varieties available? If so, in what way? If not, why not?

    a) Do you expect this would have any other impacts on PRM available for hobby gardeners?

**Conservation, preservation and sustainability**

23. To what extent are conservation, "amateur" and preservation seed mixtures used today in the EU? How has this changed since 2013?

    a) What are the key reasons for this?

24. Do you have any experience of registering either conservation or amateur varieties?

    a) If so, how would you describe the process?
    b) Do you know if this differs from the process in other Member States?

25. To what extent have the existing marketing Directives influenced the current situation? In what ways?

    a) What other factors help to explain the current level of conservation, sustainability and preservation of the natural environment?

26. What are the advantages or disadvantages of limiting maintenance, production and marketing of conservation varieties to the region of origin?
27. Do you know to what extent preservation seed mixtures have been used?

    a) To what extent they have contributed to conservation goals (e.g. through use on Natura 2000 sites)?

**Wrap up**

28. Is there something else you would like to add or any documentation you mentioned you would like to share with us?

# Annex 7: FRM workshop note

## Introduction

This document provides an overview of the key points emerging from the discussion that took place in the virtual workshop on key issues around the production and marketing[79] of Forest Reproductive Material (FRM), the conservation and use of forest genetic resources and the genetic diversity of forest reproductive material. The workshop took place on **Wednesday 23 September** and is part of a wider study ICF is carrying out for the European Commission's DG SANTE on options to update existing legislation on the production and marketing of plant reproductive material.

A list of expert participants is provided in Table 9.

*Table 9. Workshop participants*

| Name | Organisation |
|---|---|
| Frank Wolter | ANF - Administration de la nature et des forêts, Luxembourg |
| Dusan Gomory | Technical University in Zvolen, Slovakia |
| Jan Kowalczyk | IBL Forest Research Institute, Poland |
| Andreas Drouzas | Aristotle University of Thessaloniki, Greece |
| Claes Uggla | SFA- Swedish Forest Agency, Sweden |
| Bent Leonhard | EFNA - European Forestry Nursery Association, Denmark |
| Thomas Geburek | Head of institute for Forest reproductive genetics, Austria |

The note below is structured by the workshop sessions. Topics covered include issues related to the production, marketing, conservation and use of FRM, challenges for FRM users and options to harmonising supplier's documents. The workshop agenda can be found in Annex 7.1.

## Key discussion points

### Current problems and needs

#### *Production and marketing*

The key issues raised related to the identity and traceability of FRM. The two issues were closely linked and gave rise to a discussion on existing levels of control (mandatory or voluntary) that may support promote increased accountability and improve practices along the production chain and marketing of FRM.

#### *Identity*

- The importance of FRM identity and the severity of the implications when FRM identity is not guaranteed need to be further emphasised and better understood.
- There is a need for improved control for the identity of FRM throughout the production and marketing of FRM. However, resource constraints, both in terms of personnel and financial resources, limit the ability of NCAs to control and enforce measures.

[79] Marketing in this context means display with a view to sale, offering for sale, sale or delivery to another person including delivery under a service contract. The Regulations cover the marketing of selling see and collecting/producing FRM for marketing at a later date (Forestry Commission, 2019).

- Documentation on FRM identity is not uniformly completed across Member States (MS) and is not adequately controlled for. It may be possible to address this at an EU level.
  - For instance, in Slovakia, the issue is that NCAs are not able to enforce documentation control at a national level.
  - Similarly, in Austria, master certificates appear to be comprehensive on paper, but there are no checks for compliance from the NCAs.
  - Improved communication between ministers, policy officers, academics, and research institutes is needed in order to identify tools and provide guidance for users on how to identify and record the identity of FRM in relevant documentation.
- Some MS have introduced schemes, voluntary or mandatory, to improve issues around FRM identity and control, however these are not universal. Standardising schemes could help to prevent fraud.
- A minimum requirement on genetic variation was discussed as a potential solution on identifying and controlling FRM identity. Genetic markers are used as a voluntary approach, however it was thought unlikely that this approach would be made mandatory, as it is not relevant for all countries (e.g. Nordic countries). However, Member States should be strongly encouraged to record genetic DNA markets to ensure detailed information is supplied regarding the FRM identity. There was agreement that the identity must be better controlled regardless of the system implemented to draw meaningful conclusions on the use of FRM.
- There is a need for standardisation: when recording and uploading data to FOREMATIS, there are differences between Member States on the definition of planting 'area', including how to measure the area (e.g. radius) and how to classify the area (e.g. circular). It would be useful to see harmonised information on what is on the market and if the material is suitable for certain locations.
- New technologies give rise to new challenges. Not all new technologies are currently taken into account in the Regulations (e.g. somatic embryogenesis[80]). Although the Directive addresses how to deal with clones (amount, basic materials etc.), genetic embryos are not covered by the existing regulation.

***Traceability***

- There is a need to trace where the FRM is planted. Keeping records of FRM from basic material to final use (plantation) allows assessing provenance performance under different environmental and management conditions, which in turn would allow transfer guidelines to be developed indicating the most appropriate material for each site and use.
- There is a need to have a standardized characterization of all seed sources in Europe to allow easy comparison between the seed sources and the potential planting site.
- FOREMATIS could be helpful if harmonised. There are also issues with information being incomplete, outdated or erroneous.

***Conservation***

The main issues raised related to seed production and collection, the use and transfer of FRM. The discussion highlighted the need to balance conservation and tree

[80] *Somatic embryogenesis* is an artificial process by which plants can regenerate bipolar structures from a somatic cell – i.e*. ordinary plant tissue.*

improvement, ensuring a mix of FRM is both harvested and used, and the importance of using both native and non-local FRM to adapt to the impacts of climate change.

***Seed production and collection***

- A balance needs to be struck between conservation and tree improvement, as the two are sometimes portrayed as contradictory. The intensive use of a single seed source to support tree improvement can limit the gene pool of forest trees species. Tree improvement can be supported by selecting more than one tree as a seed source.
- The harvesting and distribution of seed stands is another key issue. There is a need to avoid collecting seeds from related materials by ensuring appropriate distances between trees during harvest. When it comes to different numbers of seed stands, there is also a need to ensure that seed material harvested and sold on the market are representative. Seeds should be evenly distributed across seed stands to improve genetic diversity. In many Member States, there is a high number of seeds collected that will never be used.
  - For example, Denmark holds records of approved seed stands, as well as records of what has been harvested in the past 5-10 years. It is then possible to see which of these seeds have been bought and sold. These lists show that although there is a very long list of approved seed stands, only a small number are harvested in response to market demands.
- FRM are harvested for the market. However, the decision on how much seed is to be harvested needs to go beyond what is desirable for the market. Decision makers need to make sure enough seeds are harvested to tackle climate change. Without transfer of FRM, EU forests would not be able to adapt to climate change. The market will respond to decision makers if there is a clear direction.
- How seed orchards are harvested is important. For species where seed mostly comes from a seed orchard, collecting harvest clones would reduce the genetic diversity.
- Conservation should be stressed in the Directive; it is currently a secondary issue. It should be integrated in every aspect of FRM, including the transfer of FRM, improvement, genetic variation and genetic diversity combined with other practical issues.

***Use***

- Different basic materials are used at different rates. It is important to conservation that basic material is not only maintained, but also that is used. In some MS, seed-orchard seeds are used almost as an exclusive source of FRM in some species (e.g. larch), which is a threat for genetic diversity.
- Another issue relates to seed laboratories, where seeds are sorted in different sized fractions, which can impact on the genetic variation of seeds. *[Further information on this point would be appreciated]*
- Conservation could be facilitated by FOREMATIS. FOREMATIS would be particularly useful for documenting the transfer of material across different Member States, however FOREMATIS requires improvement regarding the level and type of information recorded. It would be useful to know what material is being imported and what material is being used. It would help decision makers assess the situation and draw the link between traceability and documentation.
- Given that adaptation to ecological conditions within a single tree generation is probably weak, special attention should be given to genetic diversity, so as to have greater potential for successful adaptation.

- One participant raised a concern regarding the security of future seed supply and who has access to the 'best' seeds. Increased competition in the seed industry may impact the ability to transfer FRM across borders. *[Further information on this point would be appreciated]*

***Transfer of FRM***

- The words "autochthonous" and "non-local" should be used carefully. They should not be put in opposition to one another. Both are important considering the current uncertainty of climate change effects and the capacity of trees to react to it. They are complementary. Non-local trees are capable of outperforming native (autochthonous) trees, however, monitoring information on both is needed to ensure they are used appropriately. FOREMATIS could record this but it would need to include the following information: monitoring activities, how well trees are performing, growing parameters of basic material. This would help decision makers make the right choices
  - In Greece, for example, some non-native trees initially appeared to outperform local populations, but many years later died due to extreme weather events. It would be useful to have learnings from previous users.
- Forestry practitioners' experience on the performance of transferred FRM is useful for future end-users. In addition, there is a need for forestry practitioners to record information about the origin and transfer of FRM to facilitate successful future use. Foresters should be encouraged to keep records of the origin of FRM permanently. The best way would be establishing a Europe-wide electronic system, where the coordinates of the seed source and the coordinates of the planting site could be kept and would be available for further evaluation. This would not help immediately but would be useful for the future.
- In transferring FRM to other regions, special precautions should be taken for phytosanitary issues as well as to avoid "genetic pollution".

***Use of FRM***

Participants emphasised the need for record-keeping on the use of FRM in order to inform end users on what material to use. This information has become even more important as a result of climate change, but there is currently no provision in the regulations requiring Member States to record information on where FRM is planted.

- Keeping records of origin is extremely important. If users of FRM need to make future decisions on the usability of certain FRM, the most reliable source of data would be via records of origin.
- Additional information would be ideally available to users *prior* to the purchase of FRM. Currently, price lists from nurseries only show how old the FRM is. It would be useful for nurseries to offer information on what FRM they have, including the type of seed and provenance. This would improve transparency on the market, and support the appropriate use of the FRM. In addition, having this information in the price list would make forest owners more aware of the diversity of the forest material.
- There is a need for a simple system at a European level to include information on basic material, coordinates of seed source and planting sites etc. It would also be helpful if would allow prospective users to ask the forest manager for information such as whether the material was damaged or is growing well. Currently this information is lost and different MS have different requirements and practices. The following examples were provided:

- In Slovakia, it is law to record it, but after 10 years it is deleted. They do not know what material is preferred.
- Sweden do not record any FRM used in the forests. A project has recently started aiming to develop a voluntary system for managers to report data about where they are using the FRM via an online platform.
- In Poland, keeping information about the origin of FRM is obligatory as part of the standard information in SILP State Forest - but has only been recorded for the past 20 years[81].

- One problem in the private sector is that there is limited access to certain state-owned FRM. This material could be important for helping to address climate change.

## Choosing the appropriate planting materials

### *User information needs*

The following information was considered important in informing decisions on appropriate planting materials:

- genetic origin
- genetic diversity
- identity
- size
- growth and performance
- availability
- FRM category and breeding value
- collection year
- coordinates of seed source
- soil conditions of the seed source would also be useful as they cannot be readily derived from the geographical coordinates like the climatic conditions
- growing parameters of basic material / environmental conditions under which certain FRM perform
- 'planter's guide' including information on where plant materials do well / recommendations on performance in different ecotypes or climate zones
- forest owner contact details

This information would allow lessons learnt by previous users to be distributed to potential users. FOREMATIS could be used to record this information, and this could inform users whether certain materials are applicable to certain sites. If FOREMATIS were used for this purpose, it would also be beneficial to record data on natural populations. This could be combined with the data on planted materials to provide better information to users on appropriate planting materials. The more that is known about basic materials and characteristics, the better users will be able to adjust to issues, such as droughts and flooding, resulting from climate change.

### *Barriers to receiving information and possible solutions*

The key barrier identified was the lack of a common, functional, information system in the EU to record and collate necessary information related to FRM. The current information available on FOREMATIS was considered inadequate. It was highlighted by one participant that it will be difficult to secure the collection of any information, if that is not an obligatory part of the Master Certificate.

[81] The State Forest Information System (SILP) has been implemented in all forest districts in Poland since 1996.

Potential solutions identified:

- FOREMATIS is a good basis to build on but needs additional and updated information. The user is not always aware of different provenances and different uses of FRM. In addition, mixed provenances can cause data recording issues, whereby it can be difficult to distinguish between different FRMs. FOREMATIS could either be extended to include more information or be linked to national databases. The former option is preferable but would require standardising information across MS.
- Record-keeping: authorities should work together with foresters to ensure more information is recorded and there is a better characterization of FRM. An additional categorisation of the material would be helpful, but a suitable platform for recording the data is needed. Providers of FRM can also provide helpful information.
- Deployment zones can be a solution, but those would be needed for both species and provenance. It is only possible to allocate Deployment Zones for provenances if appropriate records are available. Currently, there is no data to provide to users and nurseries to help facilitate Deployment Zones.
- Deployment Zones should be mentioned in the accompanying documents at the time of purchase of a material, so end users know where they can plant the material effectively.
- Many Member States have provenance recommendations. Austria have recommendations for Deployment Zones, but these are based on assumptions that performance is more less identical in a similar environment. However, these recommendations are based on the assumption that the material is autochthonous, meaning only basic assumptions can be drawn and do not include the role and use of non-local trees.

### Supplier's documents

The discussion identified suggestions on the type of information that could helpfully be included in the supplier's document. The need for simplification and harmonisation of the supplier document was also discussed. Participants also highlighted the need to improve the information available to the end user prior to the purchase of FRM.

- Information on FRM should be available to the end user before the purchase of FRM, rather than afterwards. More focus should be put on the information available to forest owners in the price lists – such as species, counts of seedlings etc. – as this is the information that forest owners consider when purchasing FRM. This issue is less relevant to the supplier document, but the same information could also be included in FOREMATIS, and on the delivery slip through the master certificate.

  For the information that should be available to end users in advance, it would be important and feasible to include:

  - the size of the material
  - how many individual materials have been used
  - the origin of the FRM
  - whether it is natural
  - data on previous use (e.g. resistance to snowfall/snowstorms)
  - initial conditions
  - where it can be used
  - genetic diversity (which is generally harder to record).

- Supplier documents themselves should be kept as simple as possible, and the information included should be available elsewhere so that users can check the information before purchase. Forest managers are unlikely to search for this type of information unless it is provided to them. Participants indicated that as long as the Master Certificate Code is included (or a similar reference ID), users would be able to use this to look up further information. In Germany and Austria, the supplier document is in the form of an invoice or delivery slip.
- Supplier documents should be harmonised. At present, each Member State has a different way of recording data on their supplier document, which can make the documents difficult to read and understand. One participant suggested that this could be done by including a standardised A4 sheet, summarising the most important information. However, this contradicts the above point that the supplier's document should be kept as simple as possible.

## Annex 7.1 Workshop agenda and Background Information

This document provides a brief overview of our understanding of the key issues around the production and marketing[82] of Forest Reproductive Material (FRM), the conservation and use of forest genetic resources and the genetic diversity of forest reproductive material. This document does **not** offer a comprehensive review of issues or literature on the subject; its purpose is to act as a basis for further discussion during the workshop. Topics covered include issues related to the production, marketing, conservation and use of FRM, challenges for FRM users resulting from climatic changes and options to harmonising supplier's documents.

**Current problems and needs**

***Our understanding of issues related to the production and marketing of FRM***

- Identity: the identity of the FRM is not guaranteed along the production chain or upon marketing of FRM. Some Member States (MS) have introduced voluntary or mandatory schemes to improve this issue, however these are not universal.
- Traceability: traceability remains an issue with the free marketing of FRM. It can be difficult for end-users to obtain data on FRM found in other MS. Despite the development and use of FOREMATIS as a tool to determine the suitability of a particular material for a specific site, some issues remain with reference to the completeness of the information included on the platform. Further information and development is needed on FOREMATIS, including size of the basic material, number of clones/families, reference to 'tested' or 'qualified' to deployment zones, clarity on what constitutes a shrub/tree and land coverage.

***Our understanding of issues related to the conservation of FRM***

- Conservation issues are not directly addressed in current FRM EU Directives or Regulations. Conservation issues relate to:
- The way seeds are produced and collected: a balance should be achieved between tree improvement and conserving biodiversity. Some examples of specific issues include:
  - The intensive use of a single seed source to support tree improvement can limit the gene pool of forest trees species.

[82] Marketing in this context means display with a view to sale, offering for sale, sale or delivery to another person including delivery under a service contract. The Regulations cover the marketing of selling see and collecting/producing FRM for marketing at a later date (Forestry Commission, 2019).

  - Nurseries tend to throw away smaller seeds because these seeds need more fertiliser and/or suppress the smaller plants of the lot, causing a loss of genetic diversity.
  - The number of trees to be harvested in a seed stand significantly affects genetic diversity. Hence, in certain MS the minimum number of trees to be harvested is determined by national legal norms.
- The use of basic material: different basic materials are used at different rates. For example, for a certain species within a Member State, some basic material may be used more than other available basic material. It is important to conservation that basic material is not only maintained, but also that is used.
- The extent to which FRM is transferred across borders: adaptability is not necessarily the highest in autochthonous or local tree populations and FRM is frequently traded across borders. However, there is limited understanding of the cross-border transfer of FRM. This information could be helpful to improve understandings of biodiversity.

***Our understanding of issues related to the use of FRM***

- The use of FRM is very often restricted or recommended to the region of provenance where respective seeds were harvested. This recommendation assumes that the growth potential of FRM is shaped by the ecological conditions. However, there are studies and examples from MS that may challenge this assumption, suggesting that:
- Autochthonous trees vs non-local trees: forest trees in Europe are not necessarily autochthonous, despite the location of harvested seeds. Many studies note that certain non-local FRM sometimes outperform autochthonous FRM.
- Adaptation: adaptation to ecological conditions within a single tree generation is probably weak. When considering epigenetic effects (which can speed up evolutionary processes), it remains unlikely that the environment has a strong effect within a single tree generation.

***Points for further discussion at the workshop***

- What are the current problems and needs related to the production and marketing of FRM, and the conservation and use of forest genetic resources and the genetic diversity of forest reproductive material? Do you agree with the ones listed above? Are there any additional?
- Have there been any changes to these problems and issues in recent years? If so, what have these changes been?
- If there have been changes, what are the key reasons for this change?
- If there have not been changes, why do you think this is?
- Are there any issues that we missed, or something you expected to see included above?
- Is there anything you disagree with in the above?

**Choosing the appropriate planting materials in terms of current and expected environmental and climatic conditions**

- To choose the most appropriate FRM in a changing environment, the reaction norms of FRM must be known. However, the field data needed to estimate these functions is currently sparse. In addition, the need to estimate how the planting site will develop in the future is essential and will most likely require the use of ecological or climatic models which currently lack the correct data to develop.

- Deployment zones[83] could be useful if they are estimated based on the performance of FRM. However, current deployment zones are most often based on ecological regions. The development of deployment zones could be informed through data (latitude, longitude, altitude etc), however there are potential issues yet to be determined with the feasibility of this approach. Assisted migration, or moving plants to a different habitat in a way that mimics natural population or range expansion, and monitoring the results of this could also be used to extend and improve deployment zones.
- National and international research projects exist that seek to help users of FRM to choose appropriate planting materials. Recent approaches to forest management meant to address climate change employ technologies such as remote sensing, virtual mapping, laser scanning and digitalization. These technologies can be used for Active Adaptive Management[84]: by gathering data on growth rates, site conditions and source material, users could receive more accurate information on the suitability of FRM. This could be used and implemented across all MS, assuming FRM identity and traceability is assured.

**Points for further discussion at the workshop**

- What are the key barriers / challenges that users of FRM are faced with when making a choice on the appropriate planting materials? Do you agree with the ones listed above? Are there any additional?
- In what ways could users be supported in making informed choices on the use of appropriate FRM?
- Is there a need to trace where the FRM is planted?
- Could the use of deployment zones help to achieve this aim?
- Please provide any specific examples and evidence in support of your responses either before or after the workshop.

## Supplier's documents

The formats used for supplier's documents[85] differ significantly between MS. However, per the regulations, all supplier's documents are required to include certain information. This includes:

- Master certificate code and number [Master Certificates are issued by NCAs after the seed harvest and include information on the year the seed was harvested and location and identity of the seed.]
- Botanical name
- Category [source identified, selected, qualified, tested]
- Purpose [multifunctional forestry, other]
- Type of basic material [seed source, stand, seed orchard, parents of families, clone, clonal mixture]
- Register reference or identity code for region of provenance

Full information on what is meant to be included can be found here.

Information that is currently *optional* for inclusion includes:

[83] An area that indicates where a specific species would be suitable to plant
[84] The process of learning from previous practices and policies carried out to improve overall learning and development of future management options.
[85] Supplier's documents are provided to users of FRM on purchase and contain information on the identity of a lot of FRM. Examples of supplier's documents in different Member States can be found at: http://www.efna.eu/country-listing.html

- Date of dispatch of FRM
- Full address of supplier
- Name and address of the receiver
- Origin of basic material if non-autochthonous or non-indigenous

**Points for further discussion at the workshop**

- Is there any information not currently included in supplier's documents that would be beneficial to include? We are interested in both short-term and longer-term improvements.
- Are there any improvements specific to the supplier's document that could help users better choose appropriate planting materials? We are interested in both short-term and longer-term improvements.
- Is there a need to harmonise the approach to supplier's documents used by different MS? If so, how could this be done? Do you see any challenges with this?
- Would it be beneficial to have a standardised template for supplier's documents (e.g. something like that used for the Information Document included in the Annex to the regulation here)?

## References

The references listed below have been reviewed to inform this document and the Workshop topic guide. Please provide any relevant literature that has not been included in the below list.


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# Annex 8: PRM market overview

This section provides an overview of the PRM industry landscape and how it has evolved in recent years, including a discussion on key developments and their impacts for stakeholders. The analysis presented in this section is informed by a review of available literature as well as discussions with industry experts.

## PRM market stakeholders

The PRM market constitutes stakeholders involved in commercial and not-for-profit activities. Combined they reflect the wide range of stakeholder groups who produce, market and use PRM for different purposes.

Users of PRM include agricultural farmers (who use both commercially produced PRM and their own farm-saved seed[86] to produce crops), the landscape industry, and home gardeners, who may purchase PRM to produce home grown food or for the cultivation of ornamental plants. Users of FRM include the forestry industry, the agricultural sector (including those involved in agroforestry), as well as private and public landowners involved in the maintenance of forested land. These actors may also play a role in producing and distributing PRM or FRM. These stakeholder groups are expected to have divergent motivations, needs and uses (Louwaars et al., 2013; Louwaars 2018).

In addition to the commercial seed market, PRM for certain varieties of cereals, fibre plants, oil plants and fodder plants may come from farm-saved seed. This can comprise significant proportions of the market for certain crops in some countries. In certain areas of the EU, farmers buy certified seed and use their farm saved seed periodically. This depends in part on the price of the grain.

Community seed banks, including networks, libraries and archives for seeds or other PRM are another not-for-profit category of stakeholders that plays an important role in maintaining genetic diversity In Europe, community seed banks tend to be grassroots initiatives with a focus on conservation, exchange and diversity, although there is wide heterogeneity in the size, goals, structures and activities of different groups. For example, in southern and western Europe, community seed banks tend to be led by farmers, while in northern and central Europe, they tend to be led by home gardeners. In 2018, around a quarter of community seed bank initiatives were informal networks, while others have become associations, foundations or corporations (DIVERSIFOOD, 2018).

## PRM market size and structure

The PRM sector covers seeds, propagating materials for fruit, vine and vegetable plants, ornamental plants and forest reproductive materials (FRM). There is little published market and economic data on the sector. Jansen et al. (2019) estimated that for the FRM sector, around 30 million plants and 400,000 kg of seed are traded in Europe annually. Study authors emphasised that this is likely to be an underestimate due to a lack of detailed data and transparency in this market.

For the PRM sector, the commercial seed market is substantial. In 2019 the market was worth an estimated 10 billion EUR in the EU (OECD, 2018) - up from 7 billion EUR in

[86] Seed that was grown on the farmer's own holding and that the farmer saved to be resown on their own holding. Article 14 of Council Regulation (EC) No 2100/94 on Community plant variety rights provides a derogation from the obligation to obtain the authorisation of the holder of the plant variety right concerned, authorising – under conditions - the "*use for propagating purposes in the field, on their own holding the product of the harvest which they have obtained by planting, on their own holding, propagating material of a variety other than a hybrid or synthetic variety, which is covered by a Community plant variety right.*"

2013 – and represents around 20% of the global market (European Parliament, 2013 and European Commission, 2013; Market Data Forecast, 2020[87]). The European market is mostly dominated by France, Germany, Italy, Spain and the Netherlands: these five Member States represent two thirds of the EU market by value.

The value of farm-saved seed is largely missed from these estimates but can comprise a significant proportion of the market for certain crops including cereals, fibre plants, oil plants and fodder plants. in certain EU Member States This is particularly the case when looking at the global market and developing countries but is also relevant in Europe. For example, a study from 2011 noted that 50% of all seeds in Germany, 40% of winter wheat, winter barley and rye in Belgium, France, Germany, Hungary and the UK and 94% of seed potatoes in Poland were farm-saved seed (European Parliament, 2011). While farmers' rights to use farm-saved seed is upheld by EU legislation, farmers are not permitted to sell or distribute farm-saved seed to others , and are required to pay royalties to breeders for the use of farm-saved seed of protected varieties (although small farmers are exempt from this requirement). The EU commercial seed market supply chain involves around 7,000 organisations (OECD, 2018), of which 97% are based in only ten Member States. Around half of the organisations are based in Poland, Romania, Hungary and the UK (Mammana, 2014). The seeds supply chain employs approximately 52,000 individuals (Euroseeds, 2019). It constitutes four main stages of activity[88]:

- research and development and breeding of new varieties of plant,
- seed production,
- seed conditioning or processing, and
- seed distribution (Fernandez-Cornejo, 2004, as cited in OECD, 2018, and Euroseeds, 2020).

At the early stages of the supply chain – plant breeding - activity is generally concentrated in a relatively small number of organisations. Moving downstream in the supply chain, the market becomes less concentrated and there are a greater number of small and medium sized organisations involved in seed production and distribution (OECD, 2018). However, large organisations often own multiple brands. There is little data on the small and medium-sized enterprises (SMEs) involved in the sector, which makes it difficult to document the structure of the industry (as noted in European Parliament, 2013; Mammana, 2014).

## Market consolidation and its impacts

### *Market consolidation*

At a global level, a number of mergers and acquisitions have occurred in recent years, most notably in relation to the 'Big Six' (Monsanto, Syngenta, DuPont, BASF, Bayer, Dow) (Bonny, 2017, Lianos et al., 2016 and Howard, 2015). The acquisitions consolidated the global market drastically, particularly in the US where the merger of Dow Chemical and Du Point held a 41% market share in the US for corn seed and related genetics (Lianos et al., 2016). A similar trend has been observed in the EU over the last two decades, where four of the largest companies for crop seed and biotechnology more than doubled their market share from 21% in 1994 to 58% in 2013 (European Commission, 2013). It is estimated that five companies control 95% of the EU vegetable seed market. In addition, the maize seed sector accounts for 26% of the EU seed

[87] https://www.marketdataforecast.com/market-reports/europe-seed-market

[88] Generally, the companies involved in developing new varieties will differ from the ones involved in the seed production, and distribution. Of the activities listed, seed production and processing is often integrated with the seed business, except for self-pollinated crops (e.g. wheat, barley, peas) where it is integrated with the distribution business.

market, but is also controlled by five companies (equating to a market share of 51.4%) (Lianos et al., 2016).

The seed and wider PRM industry are made up of diverse companies in terms of size, crops and geographical area. Limited information is available on the companies active in the European market. There are a large number of SMEs and micro companies operating in the EU (European Parliament, 2013), particularly in certain Member States such as Romania, Poland and Hungary where 90% of seed companies are SMEs (Mammana, 2014, European Parliament, 2013). **There is significant variation in the concentration of the market by PRM type and Member State**. For example, seed markets for sugar beet, cotton, sunflower, maize, and rapeseed tend to be more concentrated, while the markets for potato, soybean and wheat and barley appear much less concentrated (OECD, 2018). In the EU, five companies constitute around three quarters of the market share for maize, and eight companies nearly all of the sugar beet market (99%) (Mammana, 2014).

Although market concentration rates within the EU have increased over the last 20 years, they remain lower than elsewhere in the world (particularly the United States), which it is suggested is largely due to EU competition law being more receptive to concerns about large mergers (Douglas, 2018). Douglas (2018), further noted that whilst the United States competition laws are considered to be more powerful in comparison to the EU, enforcement has been more vigorous in the EU, which has slowed the concentration process.

***The impacts of market consolidation***

The effect of increased market concentration has been widely debated in the literature (e.g. Bonny 2017; Fugeray-Scarbel and Lemarie 2016; Mammana 2014). Three key issues stand out – the potential effect of market concentration on prices, innovation and choice.

**The extent to which consolidation leads to higher seed prices for farmers is not clear.** Many farmers in the EU have seen an increase in prices (OECD, 2018). For example, farmers faced an overall increase in price of seed and planting stock by 30% between 2000 and 2010 (Lianos et al., 2016). However, this overall trend does not appear to be consistent across Europe: some Member States have seen increased prices (CZ, LV, MT) whereas others have seen a decrease in prices (FI, SK) (OECD, 2018). In this context it is important to note that seed prices are determined by multiple factors, including the costs of R&D, production and distribution, the influence of weather and other factors on supply, as well as changes in market demand. The influence of market concentration is not clear. Analysis by the OECD found no strong evidence of a link between market concentration and average seed prices (OECD, 2018). However, in the US GMO market Shi et al. (2010) show that industry concentration does have a significant impact on price and Ciliberto et al. (2019) show that seed manufacturers appropriate 56% of the economic surplus provided by GM traits.

**Potential impacts on innovation and research and development** (OECD, 2018): R&D investments concentrated in a small number of major players have the potential to stifle innovation by SMEs. Market consolidation provides a platform for greater creation of "*complementary varieties, traits and chemicals*" that are exclusive and do not interoperate with competitor products. This can result in barriers for smaller companies or new entrants who would also be required to invest in similar areas of R&D to compete. There is concern that this could result in higher prices, less innovation and less choice of seed (OECD, 2018).

**Market consolidation may reduce farmer choice** (OECD, 2018): Market consolidation has seen a small number of larger companies take over smaller companies. This gives farmers the illusion that they have a choice of many different

suppliers, however many of these suppliers are owned by the same few organisations (European Parliament, 2013). Seed variety choice is affected by market concentration. The extent to which retailers evaluate, register in their catalogue and promote varieties has a huge impact on their access to the market and their diffusion.

### Other recent developments impacting the sector

**Intellectual Property (IP) Rights:** IP rights are having an increasing influence on the competitiveness of the global and EU seed industry. A widely used sui generis system of intellectual protection of varieties is the Community Plant Variety Rights system[89] and the national plant variety rights system. Varieties cannot be patented and an applicant cannot circumvent this prohibition by claiming the seeds or other propagation material instead of the plant variety. However, biological material isolated from its natural environment or produced by a technical process may be the subject of an invention and may be patentable (if the patentability criteria are met). Often, the owners of patented seed traits exert market power through cross-licensing agreements. In turn, this impacts the ability of SMEs to access these traits and remain competitive. To reduce issues relating to IP and market power, competition laws could adapt to protect farmers from being exploited and SMEs from being unable to compete (Lianos et al., 2016). The Commission's Notice of 2016 (2016/C 411/03)[90] provides that products resulting from essentially biological processes are excluded from patentability under the EU Biotech Directive[91]. Some Member States amended their national laws accordingly. The case law of the European Patent Office (cf. G 3/19) recently confirmed this exclusion under the European Patent Convention, so that it now applies to all European patent applications.

**Technology:** Digital agriculture is changing the global seed market, particularly 'precision farming', which is a growing global trend. These technologies are being developed and used principally by larger companies. As a result, SMEs can find it increasingly challenging to compete (Lianos et al., 2016).

**Genetically Modified Organisms (GMOs)**: large seed companies across the USA and Europe have jointly worked towards promoting GMOs in agriculture (Bonny, 2017). However, within the EU, GMOs continue to face public scepticism and strict regulation which has limited growth in this market segment.

**Climate Change:** Climate change is affecting the agricultural sector, impacting yields, pest prevalence and its geographical distribution[92]. Higher temperatures also lead to faster disease cycles, which has increased the demand for varieties that are resistant to such pests (Singh et al., 2013). It is expected that climate warming will shift crop production in Europe northwards, including cereal, pea, canola, soybean and sunflower, and it is expected that production in the Mediterranean region will reduce (Hampton et al., 2016). This is likely to shift the geographical distribution of seed variety and other PRM market demand.

[89] https://www.iprhelpdesk.eu/sites/default/files/newsdocuments/Fact-Sheet-Plant-variety-protection_0.pdf

[90] Commission Notice on certain articles of Directive 98/44/EC of the European Parliament and of the Council on the legal protection of biotechnological inventions.

[91] Directive 98/44/EC

[92] For example, in 2003, Europe experienced an extreme climate event, where temperatures were up 6 degrees and there was a rainfall deficit of 300mm. As a result, Italian crop yield for maize dropped 36% (Singh et al, 2013).

## Annex 9: Forest reproductive material figures

*Figure 13. Controlling for the identity of FRM (Q3, n=80)*

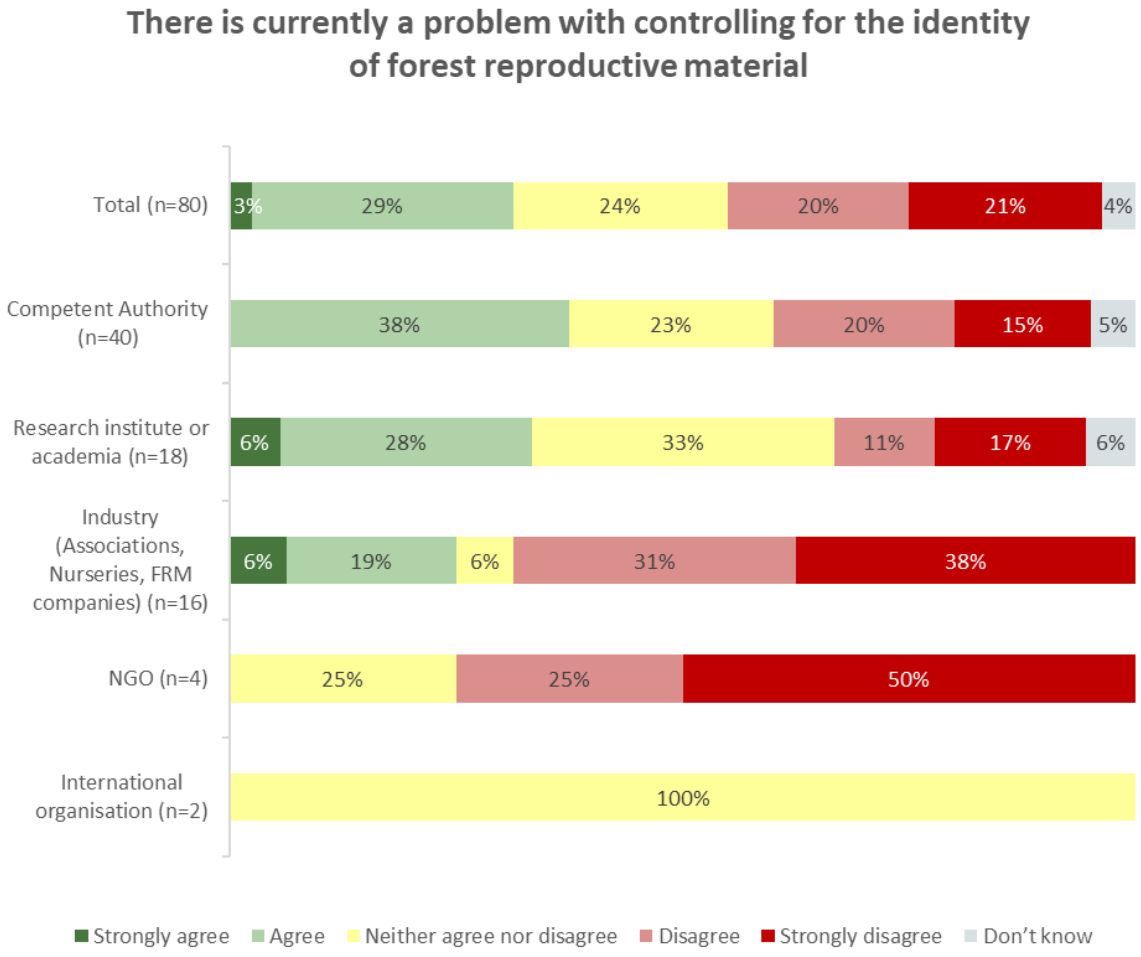


*Figure 14. Traceability of FRM (Q6, n=80)*

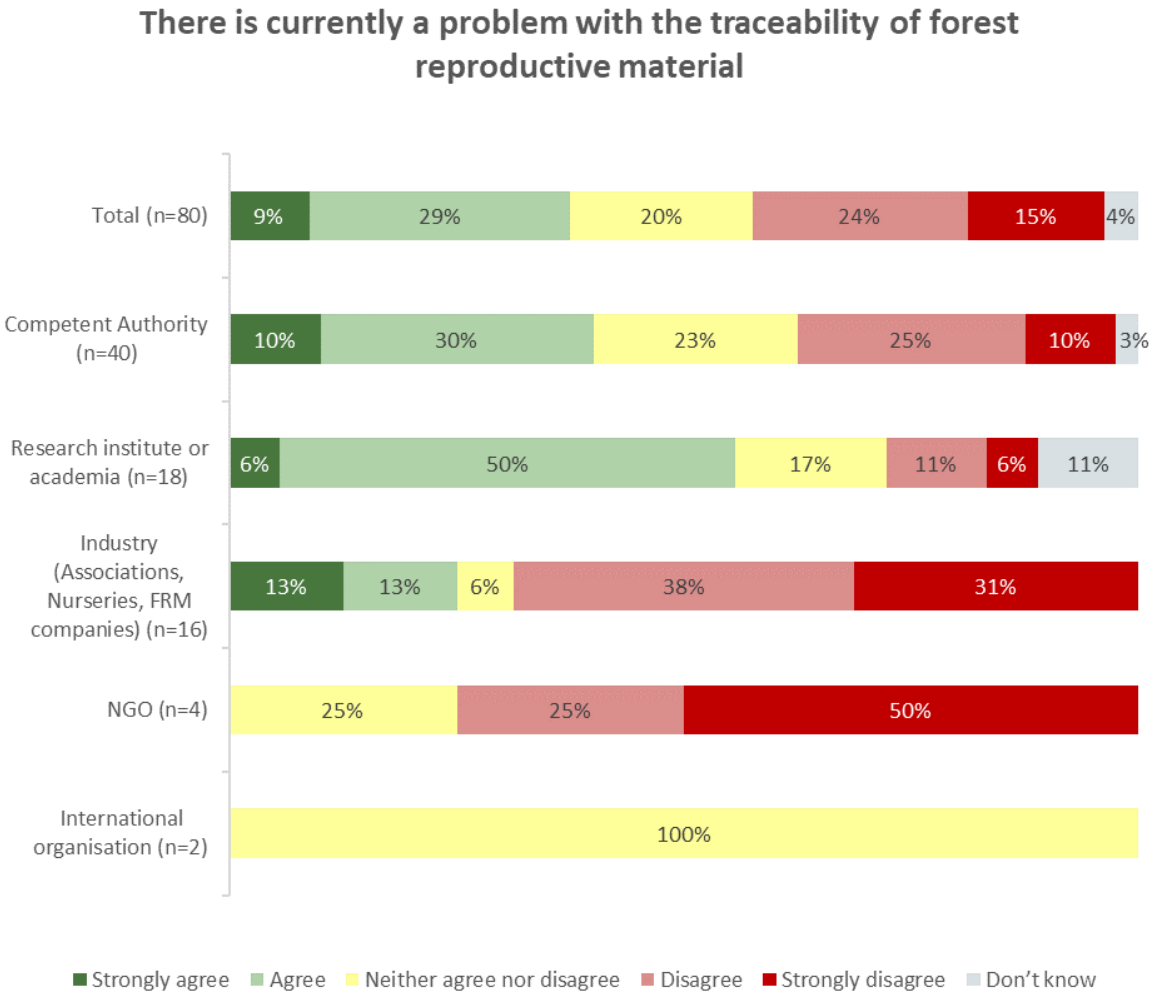


*Figure 15. Drivers of problems related to the identity of FRM (Q4, n=44)*

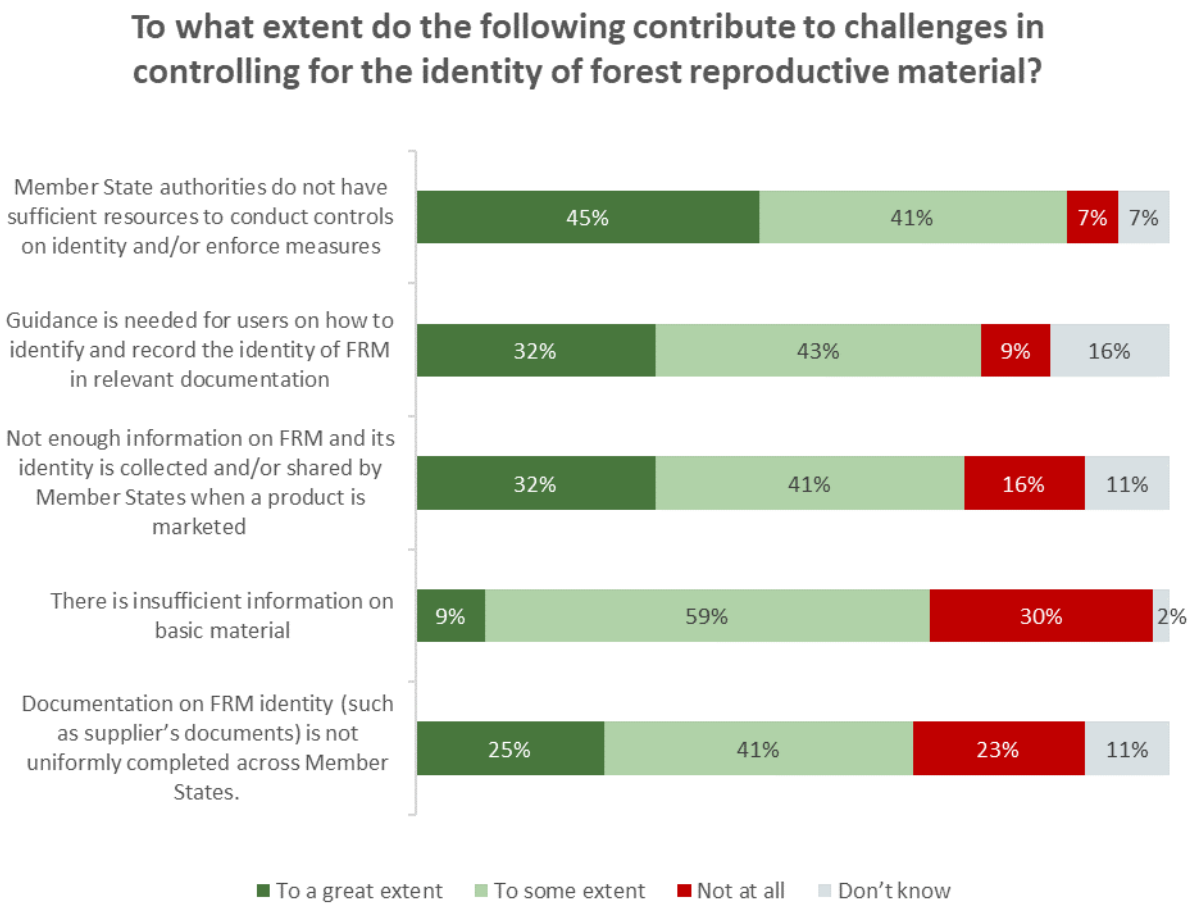



*Figure 16. Feasibility of genetic markers (Q5, n=56)*

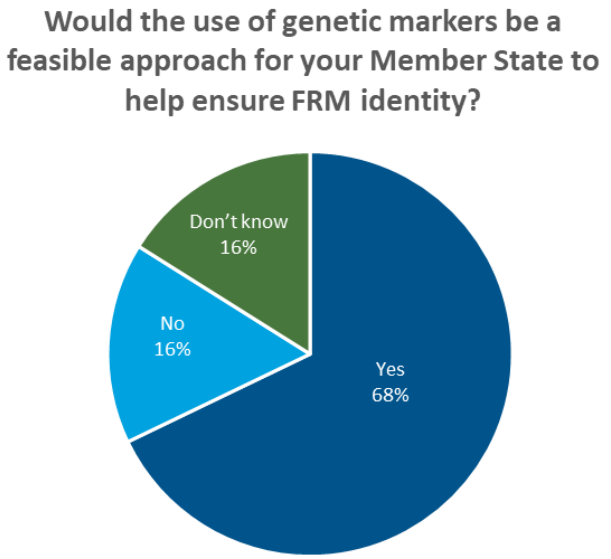


*Figure 17. Feasibility of keeping records of planting (Q7, n=80)*

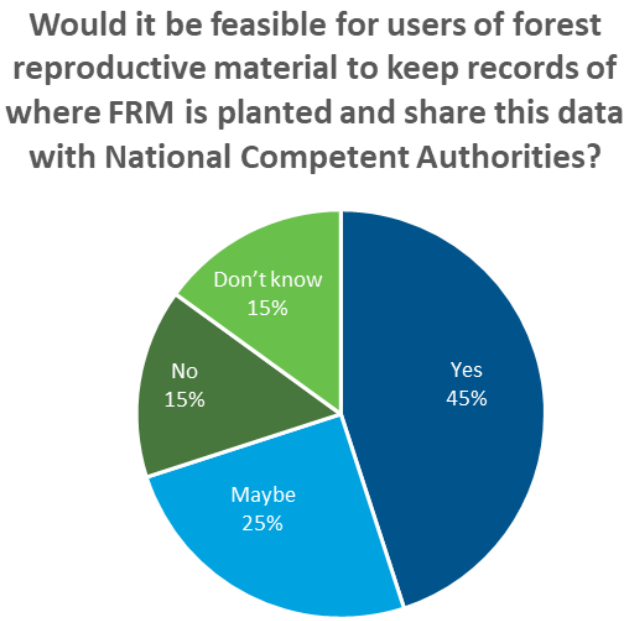



*Figure 18. Feasibility of options to make Master Certificates public (Q9, n=80, 'Don't know' responses excluded)*

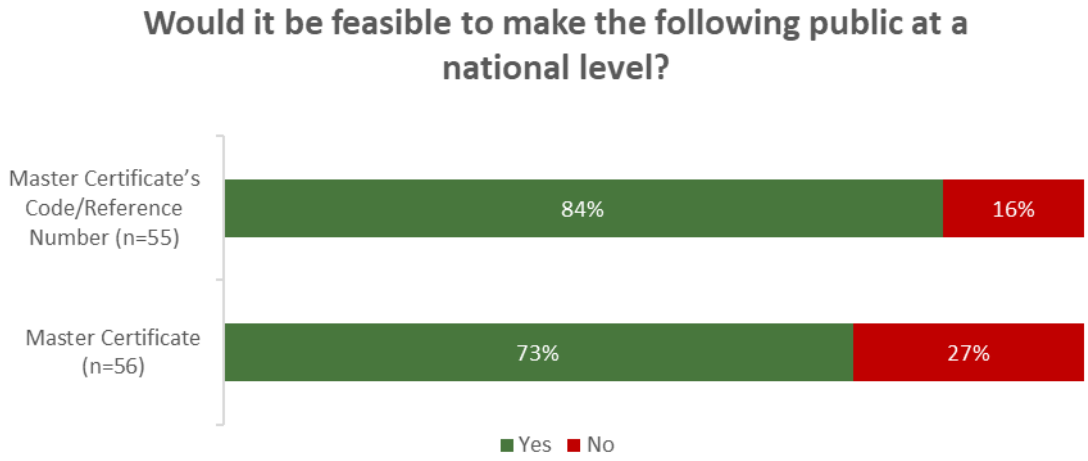


*Figure 19. Conserving the genetic diversity of FRM (Q13, n=80)*

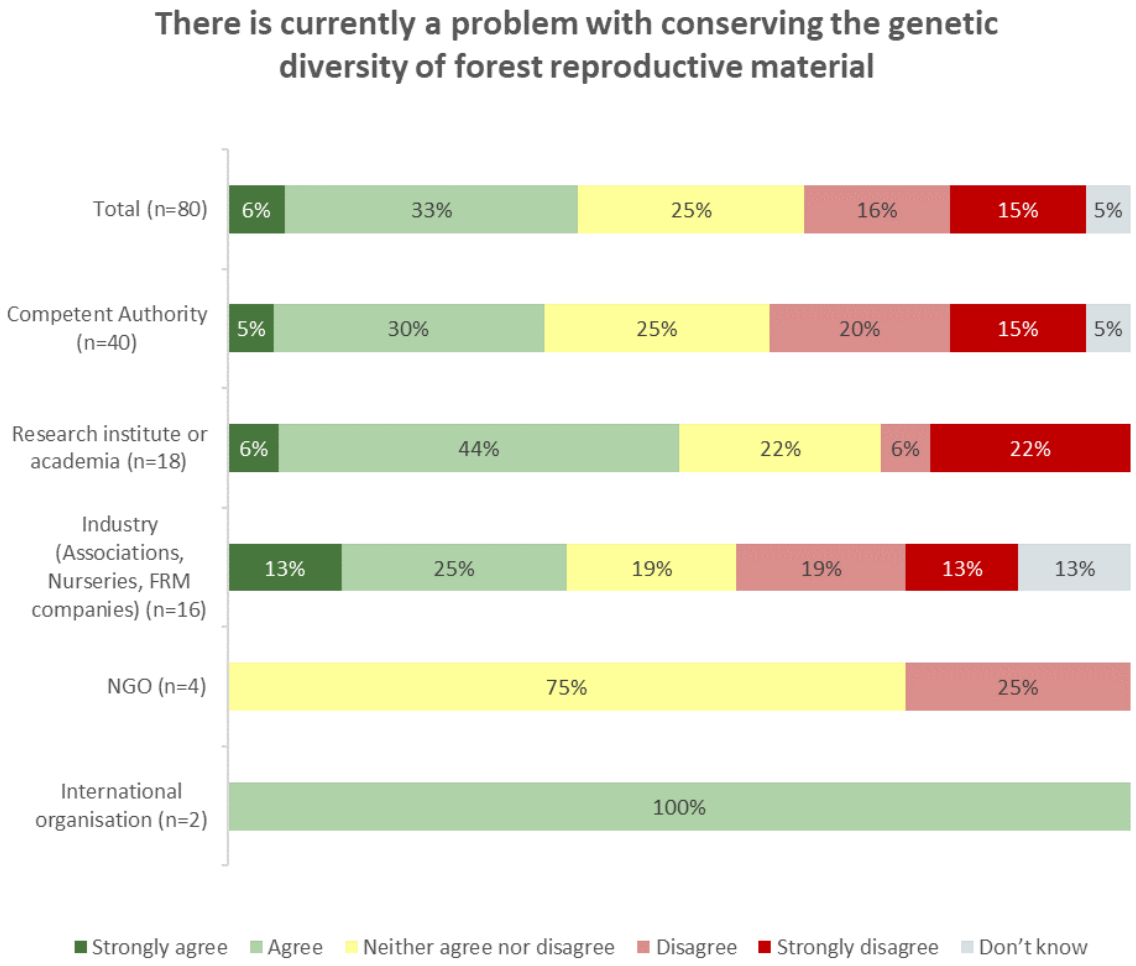


*Figure 20. Drivers of problems related to genetic diversity of FRM (n=51)*

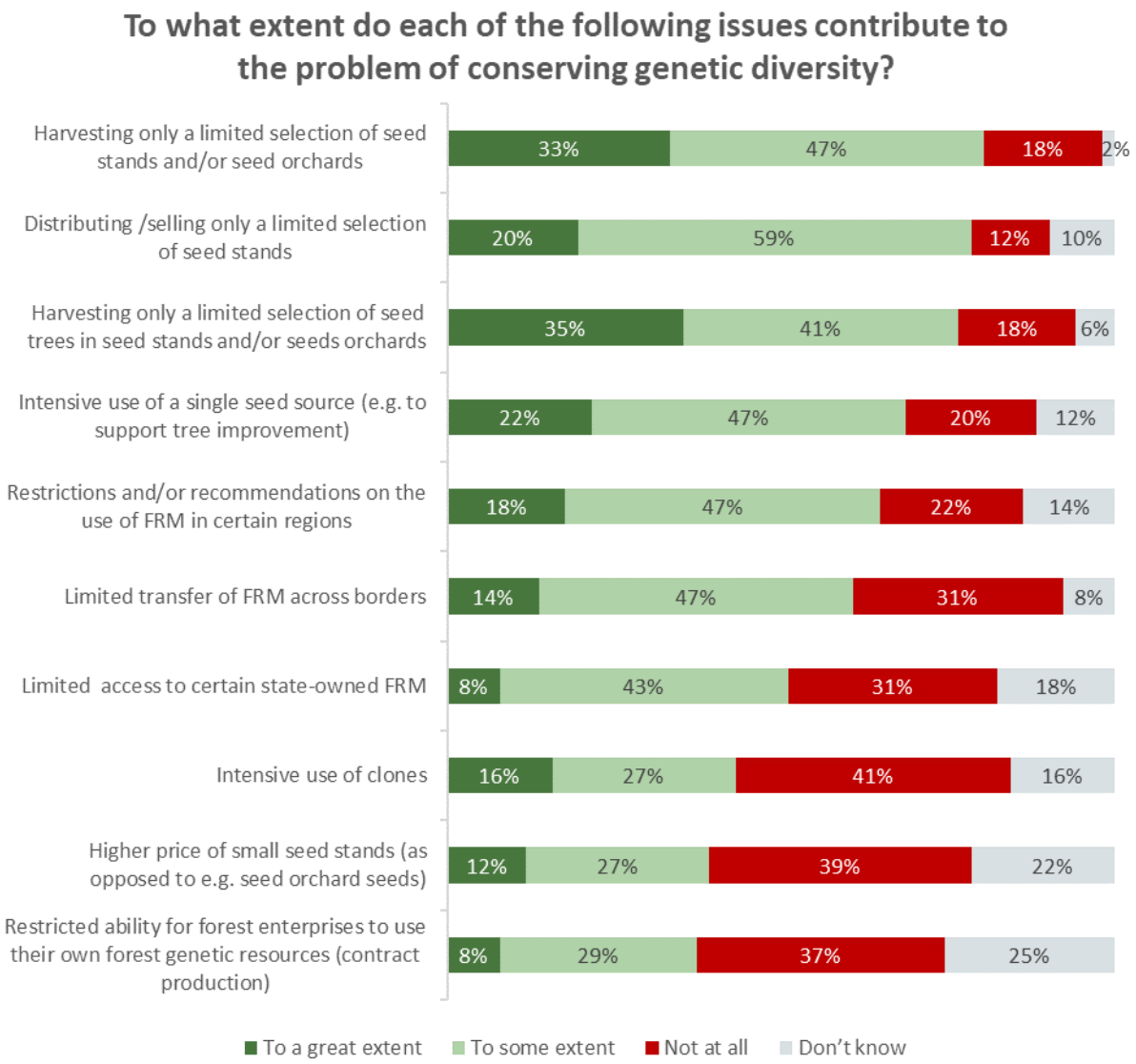



*Table 10. Requirements for minimum number of trees to be selected as a seed source or stand*

| Country | Requirement |
|---|---|
| Austria | Different requirements depending on tree species: the minimum is 20 for the main tree species, 10 for the others |
| Belgium | Minimum of 20 trees |
| Bulgaria | Requirements regarding the minimum age, area and for some species, the number of trees. |
| Croatia | Seed stand: minimum of 50 trees<br>Seed source (type tree or group of trees): minimum of 25 for seed collecting |

| | |
|---|---|
| Czech Republic | Minimum of 40 trees and a minimum area of 1 hectare |
| Finland | Minimum of 10 trees |
| France | Minimum of 20 trees, 20 metres apart from one another |
| Germany | Minimum of 40 trees for the main tree species, 20 trees for secondary tree species |
| Greece | Minimum of 30-50 trees |
| Lithuania | Seed stand: minimum of 50 trees<br>Seed source: minimum of 5 trees |
| Netherlands | Minimum of 30 trees |
| Poland | Seed stand: minimum of 150 trees for "selected" category<br>Seed source: minimum of 2 trees for "source-identified" category |
| Slovakia | Seed stand: minimum of 40 trees<br>Seed source: minimum of 10% of trees in a stand |

*Figure 21. Nurseries access to seeds (Q17, n=80)*

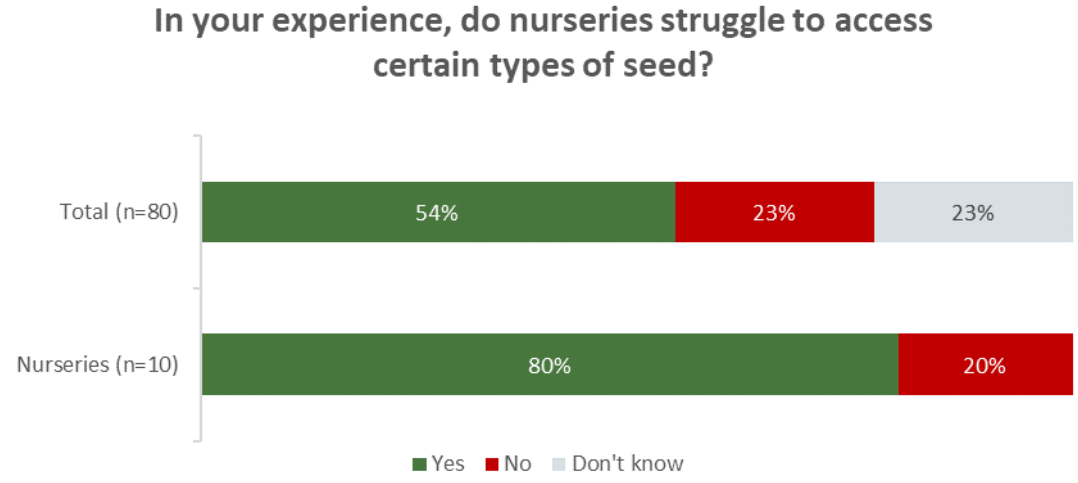


*Figure 22. Most helpful types of information (Q21, n=80)*

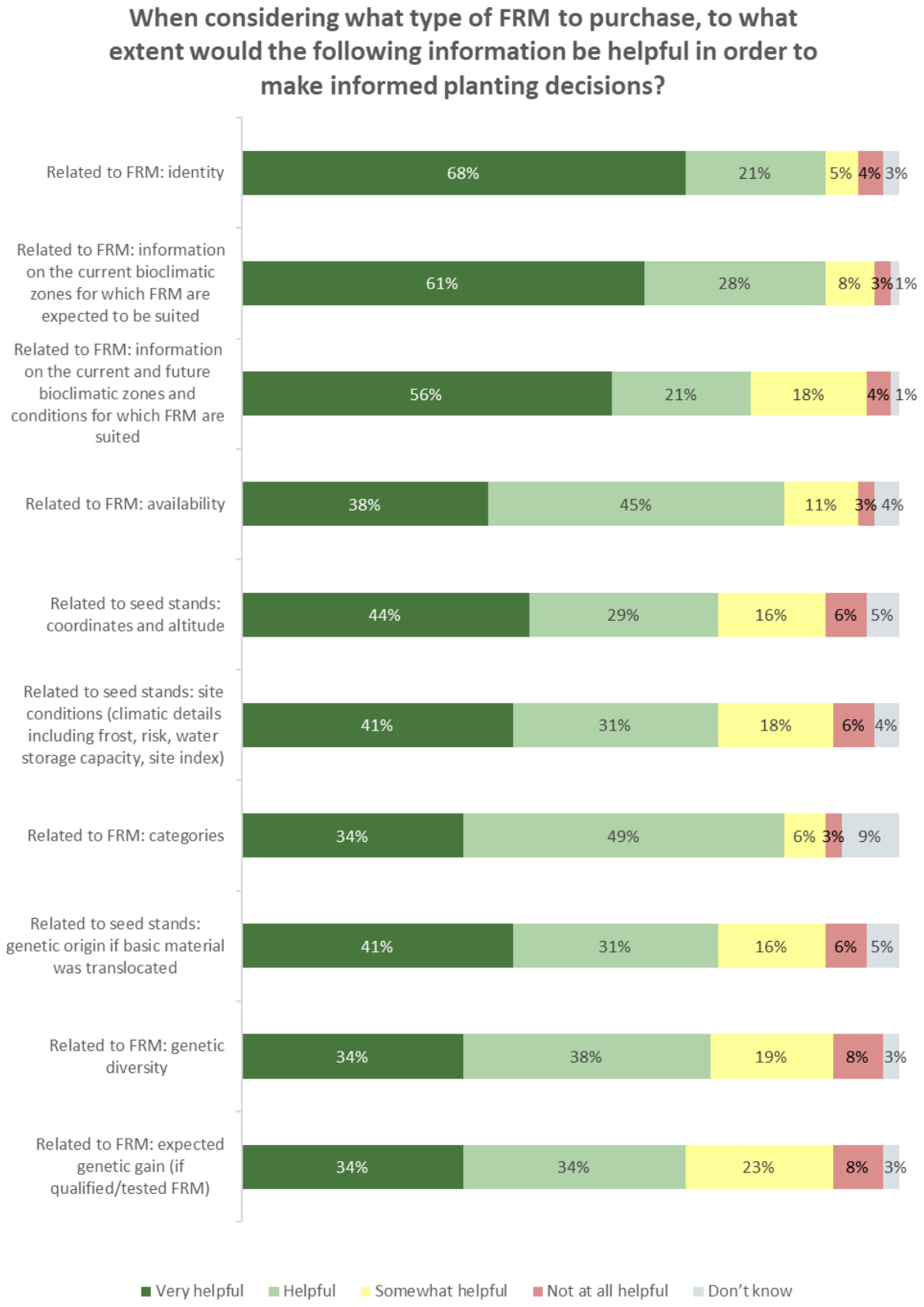
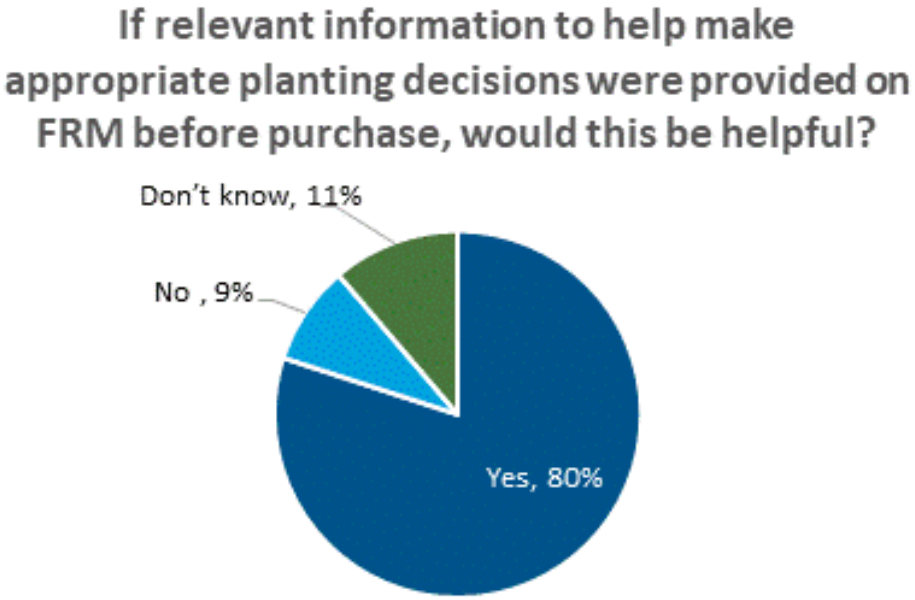


*Figure 23. Providing information before purchase (Q22, n=80)*



## Annex 10: Validation survey results

| The registration and certification process for new varieties | Strongly disagree | Disagree | Neither agree nor disagree | Agree | Strongly agree | Total responses | No opinion - (n) excluded |
|---|---|---|---|---|---|---|---|
| Problem: PRM registration and certification processes take a significant amount of time to complete. They generate burdens for National Competent Authorities (NCAs) and hinder market access for new varieties, disincentivising innovation. | 16% | 30% | 20% | 20% | 5% | **80** | 8 |
| Driver: The problem is driven by multiple administrative (e.g. NCA, staff resources), technical (e.g. years required for technical examination) and practical (e.g. testing infrastructure / conditions) constraints. | 15% | 28% | 14% | 32% | 5% | **82** | 6 |
| Driver: The significance of the problem is compounded as varieties in the process of registration cannot be marketed and are subject to restrictions on seed multiplication | 15% | 26% | 19% | 22% | 7% | **78** | 10 |

| Differences in registration and certification administration | Strongly disagree | Disagree | Neither agree nor disagree | Agree | Strongly agree | Total responses | No opinion - (n) excluded |
|---|---|---|---|---|---|---|---|
| Problem: There are differences in how registration and certification is administered across Member States: this is a problem particularly for Value for Cultivation and Use (VCU) tests (relevant for agricultural species) which differ significantly between Member States, in terms of how results are | 7% | 14% | 17% | 36% | 8% | **72** | 16 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| calculated and assessed, as well as how long tests take, which undermines the EU level playing field. | | | | | | | |
| Driver: The Directives afford Member States flexibility in their approach. For example, Commission Directive 2003/90/EC sets out the criteria Member States should use for VCU testing, but Member States determine how VCU results are calculated and how these (and any additional) criteria are considered. | 1% | 3% | 22% | 45% | 6% | **68** | 20 |

| **Variable costs across Member States** | **Strongly disagree** | **Disagree** | **Neither agree nor disagree** | **Agree** | **Strongly agree** | **Total responses** | **No opinion (n) - excluded** |
|---|---|---|---|---|---|---|---|
| Problem: There are differences in how Member States calculate fees (and share costs) for variety registration and PRM certification, which undermines the EU level playing field and can have a disproportionate effect on SMEs and non-conventional players. | 4% | 18% | 26% | 40% | 12% | **77** | 11 |
| Driver: There are no common rules in the Directives on how fees for registration and certification should be calculated and charged or how costs should be shared between operators and NCAs. As such Member States employ different systems | 5% | 5% | 24% | 58% | 8% | **78** | 10 |

| **Testing for non-conventional varieties** | **Strongly disagree** | **Disagree** | **Neither agree nor disagree** | **Agree** | **Strongly agree** | **Total responses** | **No opinion (n) - excluded** |
|---|---|---|---|---|---|---|---|
| Problem: The application of the Distinctness, Uniformity, Stability (DUS) testing and Value for Cultivation and Use (VCU) testing required under the | 7% | 25% | 20% | 28% | 20% | **71** | 17 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| legislation can result in operators having to adhere to requirements that do not accurately portray the needs of non-conventional varieties unnecessarily affecting the time, costs, and ability of operators to get new non-conventional varieties registered and certified. | | | | | | | |
| Driver: There is insufficient flexibility in how new non- conventional varieties are categorised and the requirements that are applied to them. | 12% | 21% | 15% | 36% | 16% | **73** | 15 |
| Driver: Use and application of derogations for conservation varieties is variable across Member States, and come with unique restrictions. | 3% | 14% | 22% | 49% | 11% | **63** | 25 |

| **Control and enforcement** | **Strongly disagree** | **Disagree** | **Neither agree nor disagree** | **Agree** | **Strongly agree** | **Total responses** | **No opinion - (n) excluded** |
|---|---|---|---|---|---|---|---|
| Problem: The interpretation of the control requirements, and extent of enforcement, of the marketing directives varies across Member States resulting in inconsistent and potentially insufficient control and enforcement. | 4% | 17% | 16% | 47% | 16% | **75** | 13 |
| Driver: There is no legal framework providing Member State NCAs with a robust and comprehensive set of rules, powers and tools for control and enforcement of PRM legislation. | 4% | 20% | 20% | 49% | 7% | **74** | 14 |
| Driver: Terminology used to describe aspects of the control requirements of the legislation is ambiguous and is interpreted differently across Member States. | 3% | 21% | 23% | 47% | 6% | **70** | 18 |

| Coherence with plant health legislation | Strongly disagree | Disagree | Neither agree nor disagree | Agree | Strongly agree | Total responses | No opinion - (n) excluded |
|---|---|---|---|---|---|---|---|
| Problem: There is a lack of coherence between the PRM marketing legislation and the Plant Health Regulation, particularly the language and requirements regarding Union regulated non-quarantine pests (RNQPs) which causes confusion and increases administrative burdens. | 1% | 13% | 20% | 49% | 16% | **75** | 13 |
| Driver: There is no straightforward mechanism available to enable and maintain harmonisation between the PRM Directives and the plant health regulation with regards to RNQP requirements. | 0% | 16% | 18% | 51% | 14% | **76** | 12 |

| To what extent do you agree that the following are problematic differences between Member States implementation of the PRM marketing directives, which impact on the EU level playing field: | Strongly disagree | Disagree | Neither agree nor disagree | Agree | Strongly agree | Total responses | No opinion - (n) excluded |
|---|---|---|---|---|---|---|---|
| Differences in the effectiveness (including speed) of registration systems | 3% | 24% | 33% | 33% | 7% | **72** | 16 |
| Different approaches to calculating VCU results | 6% | 24% | 25% | 40% | 4% | **67** | 21 |
| Different approaches to incorporating sustainability criteria | 6% | 9% | 32% | 40% | 13% | **68** | 20 |
| Different approaches to registering organic varieties | 8% | 18% | 32% | 29% | 14% | **66** | 22 |
| Different approaches to managing variety reference collections | 4% | 10% | 36% | 39% | 11% | **72** | 16 |
| Differences in registration/certification costs and cost recovery | 4% | 19% | 20% | 44% | 13% | **79** | 9 |
| Different approaches to updating the Common Catalogue | 6% | 10% | 32% | 44% | 8% | **71** | 17 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Different approaches to control and enforcement of the legislation | 1% | 12% | 21% | 51% | 16% | **77** | 11 |

| **To what extent do you agree with the following statements regarding the consequences of Union regulated non-quarantine pests (RNQPs) being listed in the Plant Health Regulation 2016/2031:** | **Strongly disagree** | **Disagree** | **Neither agree nor disagree** | **Agree** | **Strongly agree** | **Total responses** | **No opinion - (n) excluded** |
|---|---|---|---|---|---|---|---|
| Including RNQPs in both pieces of legislation causes confusion regarding which list should be consulted by NCAs. | 1% | 13% | 24% | 41% | 21% | **71** | 17 |
| The lack of harmonisation makes it difficult for NCAs to determine what requirements to apply. This increases the burden on NCAs. | 3% | 14% | 23% | 40% | 20% | **70** | 18 |
| The issue is accentuated in Member States where the PRM marketing directives and the Plant Health Regulation fall under the remit of different NCAs. | 0% | 3% | 22% | 51% | 24% | **67** | 21 |

| **To what extent do you agree with the following statements regarding the consequences of PRM not being included within the scope of the Official Control Regulation (2017/625):** | **Strongly disagree** | **Disagree** | **Neither agree nor disagree** | **Agree** | **Strongly agree** | **Total responses** | **No opinion - (n) excluded** |
|---|---|---|---|---|---|---|---|
| The legal framework for the PRM marketing directives remains flexible, enabling Member States to take different approaches towards control and enforcement | 0% | 13% | 22% | 52% | 12% | **67** | 21 |
| Aspects of the legal framework which are open to interpretation result in differences in the extent and nature of control and enforcement across Member States | 0% | 11% | 23% | 55% | 11% | **65** | 23 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| There remains no power of EU audit of Member State approaches, limiting the extent to which EU intervention can support improvements and more coherent control and enforcement across Member States | 0% | 11% | 28% | 54% | 8% | **65** | 23 |
| There remain inefficiencies in control and enforcement as approaches are not harmonised between PRM marketing and related areas e.g. plant health, food | 3% | 16% | 30% | 44% | 7% | **61** | 27 |
| The control and enforcement requirements remain simpler and therefore less burdensome than they would if PRM was included in the Official Control Regulation | 6% | 15% | 31% | 37% | 11% | **65** | 23 |

| **To what extent do you agree with the following statements regarding digitalisation* to support improved traceability and product assurance:** | **Strongly disagree** | **Disagree** | **Neither agree nor disagree** | **Agree** | **Strongly agree** | **Total responses** | **No opinion - (n) excluded** |
|---|---|---|---|---|---|---|---|
| Traditional barriers to 'digitalisation', particularly low levels of digital literacy and poor connectivity in rural areas, have lessened significantly in recent years | 1% | 6% | 16% | 48% | 11% | **72** | 16 |
| Digital transformation of the agri- food sector will involve significant transaction and infrastructure costs | 1% | 10% | 27% | 34% | 6% | **69** | 19 |
| Digitalisation-induced improvements in traceability also offer opportunities to increase the speed, and reduce the burden of transactions within the EU market | 1% | 0% | 20% | 50% | 10% | **72** | 16 |
| Other digital solutions beyond blockchain can also enhance traceability and transparency (e.g. DOIs, QR codes), are simpler to implement, but do not offer the same security benefits as blockchain | 2% | 3% | 32% | 23% | 3% | **56** | 32 |

| **To what extent do you agree with the following statements regarding the availability and diversity of varieties available to amateur gardeners:** | **Strongly disagree** | **Disagree** | **Neither agree nor disagree** | **Agree** | **Strongly agree** | **Total responses** | **No opinion - (n) excluded** |
|---|---|---|---|---|---|---|---|
| Improvements to the diversity of seeds available to amateur gardeners could include enhanced availability and access to traditional, regional and local seed varieties and organic varieties. | 4% | 7% | 26% | 39% | 24% | **74** | 14 |
| The current EU seed regulatory framework somewhat restricts the potential number and diversity of varieties available for the amateur gardening sector. | 5% | 21% | 25% | 32% | 18% | **73** | 15 |
| A lighter regulatory regime that enables amateur gardeners to freely share, exchange and sell/buy seeds from other gardeners, would contribute to maintaining and improving PRM diversity. | 9% | 20% | 21% | 29% | 20% | **75** | 13 |
| A lighter regulatory regime that reduces the costs of registering amateur varieties and addresses limits on amateur variety marketing, would contribute to maintaining and improving PRM diversity. | 5% | 16% | 26% | 36% | 16% | **74** | 14 |
| Adopting a lighter regulatory regime for varieties aimed exclusively at amateur gardeners may increase risks to the assurance of PRM identity, quality and health, which would need to be managed. | 5% | 11% | 14% | 48% | 22% | **73** | 15 |

| **To what extent do you agree with the following statements regarding conservation varieties and preservation seed mixtures:** | **Strongly disagree** | **Disagree** | **Neither agree nor disagree** | **Agree** | **Strongly agree** | **Total responses** | **No opinion - (n) excluded** |
|---|---|---|---|---|---|---|---|
| There has been some growth in the European markets for conservation varieties and preservation seed mixtures. | 2% | 12% | 27% | 42% | 17% | **59** | 29 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Differences in the criteria and the costs for the acceptance/authorisation of conservation and amateur varieties and preservation seed mixtures across Member States, do not explain the differences in the scale of the markets across Member States. | 2% | 8% | 21% | 62% | 8% | **53** | 35 |

| **The use of conservation varieties and preservation seed mixtures remains limited due to the following reasons:** | **Strongly disagree** | **Disagree** | **Neither agree nor disagree** | **Agree** | **Strongly agree** | **Total responses** | **No opinion (n) excluded** |
|---|---|---|---|---|---|---|---|
| The quantitative limits imposed under Directives 2008/62/EC, 2009/145/EC and 2010/60/EU do not suppress the annual production of conservation varieties in Member States. | 9% | 18% | 32% | 29% | 11% | **65** | 23 |
| PRM legislation, despite the derogations permitted under Directives 2008/62/EC, 2009/145/EC and 2010/60/EU, constrains the availability and use of conservation varieties and preservation seed mixtures for conservation activity. | 7% | 22% | 31% | 24% | 15% | **67** | 21 |
| Region of origin rules enable achievement of a 'premium price' for local varieties and support transparency and traceability in the market. | 7% | 17% | 27% | 42% | 8% | **60** | 28 |
| Region of origin rules result in reduced genetic variability in restored plant populations, which can limit population resilience to climatic and other shocks. | 10% | 28% | 31% | 19% | 12% | **68** | 20 |
| The concept of 'region of origin' is ambiguous and is interpreted differently across Member States. | 0% | 9% | 29% | 44% | 18% | **66** | 22 |

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