MEF4CAP

Monitoring and Evaluation Frameworks for the Common Agricultural Policy

[15 June 2021]

Deliverable D3.1: Review of current monitoring systems

Review of current monitoring systems

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No. 101000662.

Document control page

Document control page	
Deliverable	D3.1: Review of current monitoring systems
Document title	Review of current monitoring systems
Version	V1.0
Responsible author	Alberto Gutiérrez García, ITACyL
Contributors	David A. Nafría Gracía, ITACyL
Date of delivery	M6
Type	Nature: R – Report / Dissemination Level: CO - Confidential
Language	English (UK)
Rights	Copyright "MEF4CAP – Monitoring and Evaluation Frameworks for the Common Agricultural Policy"
Status	( ) In progress ( ) For review ( ) Approved

Version history			
Version	**Implemented by**	**Date**	**Description**
V1.0	ITACyL; EIRZ; WUR; Teagasc	28.06.2021	
V2.0	ITACyL	28.10.2022	This revision addresses Project Officer's comments and suggestion.

Contents

Executive summary

The assessment of Common Agriculture Policy (CAP) achievements is challenging due to the ambitious objectives that the Policy pursues. During the period 2014-2020, the Common Monitoring and Evaluation Framework (CMEF) was implemented to carry out this task.

The main purpose of this deliverable is to summarize the lessons learned from the implementation of the CMEF in terms of data use to set up a baseline that eases the definition and identification of the most suitable pathways to fulfil the new data needs in the upcoming Performance Monitoring and Evaluation Framework (PMEF).

The CMEF is based on a set of metrics whose absolute value or variation is meant to measure the degree of accomplishment of CAP objectives. The general impact of the Policy is measured with indicators that make use of aggregated data coming from several sources at world and European level. Direct results and outputs of the Policy are monitored and evaluated by means of indicators that need data collected at farm and/or beneficiary level. These last indicators use two types of sources to fulfil their data needs —statistical and administrative registers. While on the one hand statistical sources are based on surveys over a sample of farms and usually collect data on social-economic and structural domains, administrative sources, on the other hand, store all the required information for beneficiaries to obtain CAP support.

Starting from the analysis of the different data sources used in the practical implementation of CMEF, this deliverable finds some requirements for the new potential data sources to fulfil. New data sources have to deliver its information timely otherwise, indicators making use of this information could give partial or wrong signals of CAP achievements. Some of the most valuable statistical data sources need to enhance their scope to address the data requirements in different domains mainly regarding environment. In this regard, administrative databases also need to be adapted to integrate new information coming from different data acquisition technologies spanning different themes such as economics or environment. Interoperability between administrative and statistical databases is key to fully explode the synergies between them not only for monitoring and evaluation purposes but also to reduce collection burden in terms of time and costs. Finally, the information delivered by the potential data sources need to be useful beyond CAP scope.

There are some research projects that are opening (or already opened) the way to fill in these data requirements. FLINT (Farm Level Indicators for New Topics in policy evaluation) project, for instance, enhances the scope and methodology of the Farm Accountancy Data Network (FAND) incorporating data on sustainability (environmental, economic, innovative and social) collected at farm level. An example of initiatives innovating administrative data sources and workflows is the on-going NIVA (New IACS Vision in Action) project. NIVA aims at the modernisation of IACS and brings forward the efficient use of digital solutions and e-tools, methodologies and harmonised data sets for monitoring agricultural performance.

On the other hand, operational experiences using remote sensing for the control of area-based aids have showed the capability of these technology to acquire new data and incorporate them in the general workflow of CAP direct payments controls, the so-called Checks by Monitoring (CbM). Nevertheless, not all CAP measures can be monitored remotely and other technologies, apart from remote sensing, need to be explored to retrieve information regarding environment and climate. Additionally, the shift towards

this new paradigm will require resources and expertise which need to be carefully assessed by paying agencies.

List of tables

List of figures

Objectives and overview

MEF4CAP is a H2020 project with the main purpose of delivering an innovation agenda and roadmap for future monitoring of EU agriculture Policy. The Common Agricultural Policy (CAP) 2022-2027 is targeted towards a wider range of objectives covering broader domains such as agriculture sustainability, agri-environmental, food security among others. This fact entails new data requirements to measure the effects and the performance of the Policy. Performance is the key idea in the new monitoring and evaluation framework of the CAP (PMEF). At the same time, new technical developments, are enhancing the capability of providing, retrieving and integrating new data that are called to achieve those data needs for CAP monitoring and evaluation. MEF4CAP brings together insights on the expected needs for assessing the performance of the future CAP and on the newest technologies to address those data requirements. We define a pathway as the combination of data acquisition technologies that potentially provide data for CAP monitoring and evaluation. This is precisely the main objective of MEF4CAP's Work Package 3.

Work package 3, *Current systems and future pathways*, is structured in three main tasks: i) the review of current monitoring systems, ii) the potential of current systems, and iii) ICT developments and identification of potential pathways. The present deliverable elaborates on the first task, trying to set up a baseline with the current methodologies and data sources on which to build new pathways on top. The deliverable is divided in two sections. The first one summarizes the lessons learned from the implementation of the Common Monitoring and Evaluation Framework (CMEF) in terms of data use and, the second focuses on the identification and description of the data sources used in CMEF.

Section 1, therefore, gives an overview of the main elements in the CAP 2014-2020 and the linkages between them (i.e., intervention logic). Following, we explain the main elements in CMEF and then, we show how the different data sources have been use and the problems encountered in this regard when implementing the framework. Finally, in this section, we review the most relevant reports that have informed on the performance of the CMEF, on the effectiveness of some instruments and data sources to quantify the achievements of the Policy objectives and on how new technologies help in the control of area-based aids under direct payment scheme.

Section 2 is focused on the different data sources that CMEF uses. We elaborate a summary of these data sources and we present a brief description of those involved in CMEF's indicators. An insight of the interoperability degree is also presented. This section finally describes some projects, initiatives and programs that improve the effectiveness of the monitoring and evaluation framework.

The last section summarizes the main findings from the review in terms of data use and states the baseline for the new potential data sources to fulfil the monitoring and evaluation data requirements.

1. Background of CAP 2014-2020 Common Monitoring and Evaluation Framework

This section elaborates on CAP 2014-2020 Common Monitoring and Evaluation Framework. First, it briefly describes how CAP 2014-2020 was articulated presenting the main objectives of the Policy and the intervention logic it followed to achieve them. Following to this background, the section reviews the CMEF itself by setting up some important concepts for its implementation.

The EC and European Court of Auditors (ECA) issued several reports assessing, the performance of the CMEF to capture the global impact of CAP, whether some of Policy measures really achieve their goals and if the data source employed are adequate. In this direction, the section will review the EC 's report on the performance of the CAP 2014-2020 and the CMEF and three relevant ECA's reports evaluating both the use of statistical data to quantify the effects of the Policy on farmer's income and the effectiveness of some CAP measures to achieve its objectives. ECA also reported in 2020 on the use of new imaging technologies to monitor and control the area-based direct payment schemes, the so-called Checks by Monitoring (CbM). These reports are focused on different themes of the policy and shed light on how the data sources employed have performed for the evaluation of those Policy aspects. Since these reports are focused on different themes of the Policy (economic and environmental), they shed light on the suitability of the various data sources employed for CAP monitoring and evaluation purposes. Finally, the review summarizes the common weaknesses and difficulties detected in these reports.

1.a. CAP 2014-2020 Objectives and Intervention Logic

The design of the CAP 2014-2020 highlighted a number of key challenges facing the agricultural sector. These were identified as economic (including food security and globalisation, a declining rate of productivity growth, price volatility, pressures on production costs due to high input prices and the deteriorating position of farmers in the food supply chain), environmental (relating to resource efficiency, soil and water quality and threats to habitats and biodiversity) and territorial (where rural areas are faced with demographic, economic and social developments including depopulation and relocation of businesses) (European Commission, 2013). As such, the general objectives of the CAP 2014-2020 were identified as follows:

- **Viable food production**: to contribute to food security by enhancing the competitiveness of EU agriculture while providing the means to address the challenges faced by the sector related to market disruptions and the functioning of the food chain.
- **Sustainable management of natural resources and climate action**: to ensure the long-term sustainability and potential of EU agriculture by safeguarding the natural resources on which agricultural production depends.
- **Balanced territorial development**: to contribute to the socio-economic development of rural areas, while fostering the right conditions for safeguarding structural diversity throughout the EU (European Commission, 2013).

These key areas were further disaggregated to ascertain more specific objectives as illustrated in Figure 1. There follows some discussion of the overall pillar structure of the policy in the achievement of these objectives.

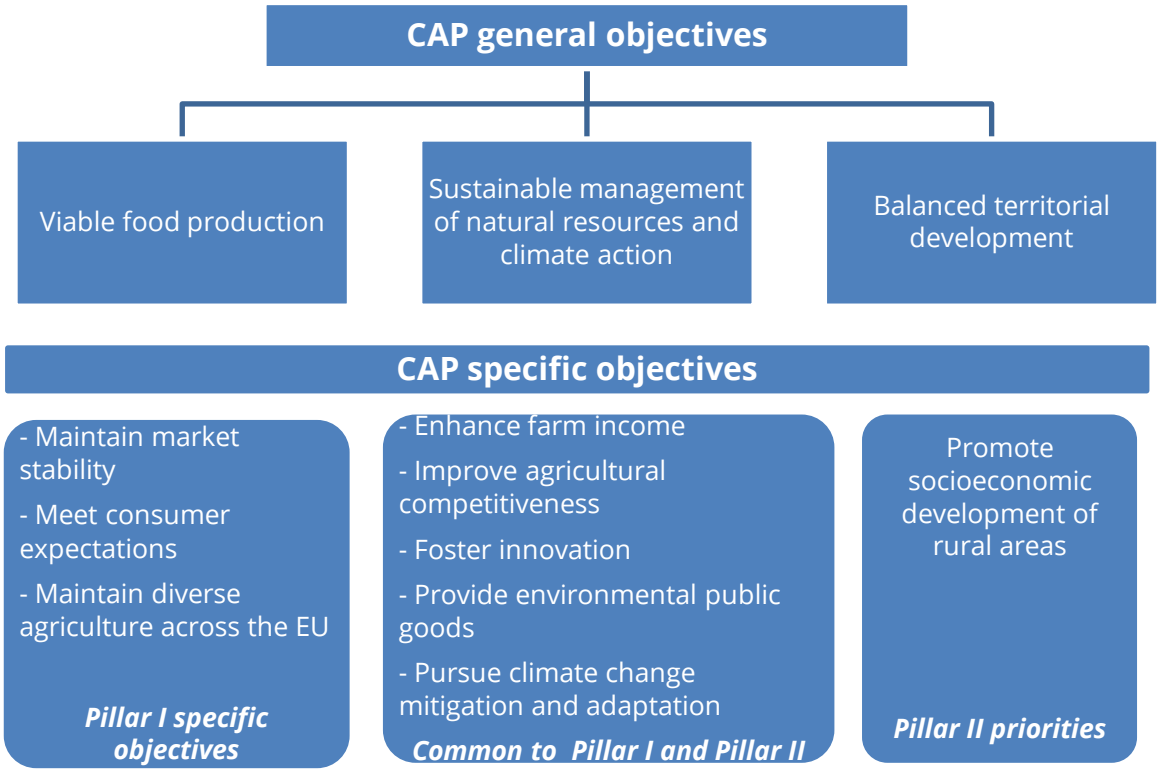

Figure 1: Based on EU Commission (2015) schematic of CAP general and specific objectives

1.a.1. Pillar I and Pillar II instruments and measurements

The CAP 2014-2020 retains a two-pillar structure, although the reform allowed for increased links between pillars. This offers a more holistic and integrated approach to policy support and more effective monitoring and evaluation. Both pillars are aimed at meeting the objectives of the CAP more effectively, with better targeted instruments of Pillar I complemented by regionally tailor-made and voluntary measures of Pillar II.

Pillar I comprises income support (direct payments) and market measures (to tackle specific market situations and to support trade promotion) from the European Commission (2015a and 2018b). These are outlined below.

- **Income support** for farmers and assistance for complying with sustainable agricultural practices. Direct (annual) payments to farmers were introduced to help stabilise farm revenues in the face of volatile market prices and weather conditions. Originally, direct payments were coupled to production, but this aspect of the policy became problematic, since producers found themselves having to maintain production to secure the payment, even when this production was not economic viable. Consequently, direct payments to support farm incomes were largely decoupled from production and are instead coupled to land. Yet, a small number of coupled payments remained. Under the CAP 2014-2020, over 70% of the CAP budget is allocated to income support measures. 30 % of direct payments are provided subject to strict standards relating to food safety, environmental protection and animal health and

welfare and were linked to compliance with sustainable agricultural practices beneficial to soil quality, biodiversity and the environment in general, such as crop diversification, the maintenance of permanent grassland or the preservation of ecological areas on farms (greening).

- **Market-support measures**: These are in the form of safety-net provisions. Such measures exist to address adverse conditions which tend to destabilise markets. There has been a trend away from government intervention in agricultural markets globally, including in Europe. The EU still uses some market management tools, but their usage has been in decline. Intervention and safety net mechanisms still exist to put a floor on prices, but tend to be used sparsely. Export subsidies have been abolished. Production quotas for milk and sugar have been eliminated in 2015 and 2017 respectively. However, market measures are still required to deal with periods of excess supply or supressed demand. Under the CAP 2014-2020, less than 5% of the CAP budget is allocated to market measures.

Some flexibility for Member States (MS) was also introduced in the budgeting and implementation of Pillar I instruments, taking into account of the wide diversity of agriculture, agronomic production potential and climatic, environmental as well as socio-economic conditions and needs across the EU.

Pillar II considers the **rural development** component of the CAP, with the objectives of achieving balanced territorial development and sustaining a farming sector that is environmentally sound, as well as promoting competitiveness and innovation. As such **six priorities** for rural development were identified:

- Fostering knowledge transfer and innovation in agriculture, forestry and rural areas.
- Enhancing farm viability and competitiveness of all types of agriculture, and promoting innovative farm technologies and the sustainable management of forests.
- Promoting food chain organisation, animal welfare and risk management in agriculture.
- Restoring, preserving and enhancing ecosystems related to agriculture and forestry.
- Promoting resource efficiency and supporting the shift toward a low-carbon and climate-resilient economy in the agriculture, food and forestry sectors.
- Promoting social inclusion, poverty reduction and economic development in rural areas.

Rural development programmes (RDPs) under Pillar II are measures, that make up close to 25% of CAP expenditure, intended to help farmers modernise their farms and become more competitive, protect the environment and contribute to the diversification of farming and non-farming activities and the vitality of rural communities. These programmes are part financed by the EU and subject to national co-funding. They consist of a long list of diverse supports including:

- Knowledge transfer training and related information.

- Advisory and farm management services.
- Product quality schemes.
- A range of investment supports, actions to prevent or mitigate the impact of natural disasters or to restore productive capacity following natural disasters.
- Measures to promote farm business development.
- Measures to improve services in rural areas.
- Measures to support afforestation, forest management and the production of forest products.
- Support for the formation of producer groups and organisations.
- Measures to address the environment and climate.
- Supports for conversion and maintenance of organic farming.
- Payments for area considered to have a high nature value or which face natural constraints.
- Payments to support animal welfare.
- A range of measures to support co-operation among farmers.
- Support for the development of risk management and income stabilisations tools.

Broadly, Pillar II supports less favoured areas (renamed Areas under Natural Constraints), young farmers, knowledge transfer and advisory services, agri-environment schemes and organic farming, animal welfare, investments in agriculture infrastructure, cooperative approaches, innovation, marketing of food products and community-led development (CLLD). An overview is included in table 1 below.

Table 1: CAP 2014-2020 Actions addressed under Pillar I and Pillar II

Pillar I	Targeted action	Pillar II*
Green payment	Environment	Agri-environment climate Organic, Natura 2000
Top-up payment	Young Farmer	Business development grants Higher investment aid
Top-up payment	Areas with Natural Constraints	Area payments
Alternative simplified scheme	Small Farmer	Business development grants
Improved legal framework	Producer Co-operation	Aid for setting up producer groups Cooperation and short supply chain

*Only main measures that target the specific issue under Pillar II are mentioned. Source: DG Agri and Rural Development (European Commission, 2013)

1.a.2. Intervention Logic

Beneath the three CAP general objectives and the nine specific objectives (European Commission, 2015b) there are several instruments under Pillar I and measures under Pillar II to practically achieve these objectives (Figure 1). Going into details, five of these nine specific objectives are addressed by both Pillar I instruments and Pillar II measures. Two of the remaining four are addressed by Pillar I instruments and the final two specific

objectives are addressed by Pillar II measures. The logical link between the objectives, the underlying drivers of the problem, and the available policy options (measures and instruments) to achieve the objectives is the so-called intervention logic. The intervention logic is used in both prospective Impact Assessments and retrospective Evaluations (European Commission, 2015b, p. 90).

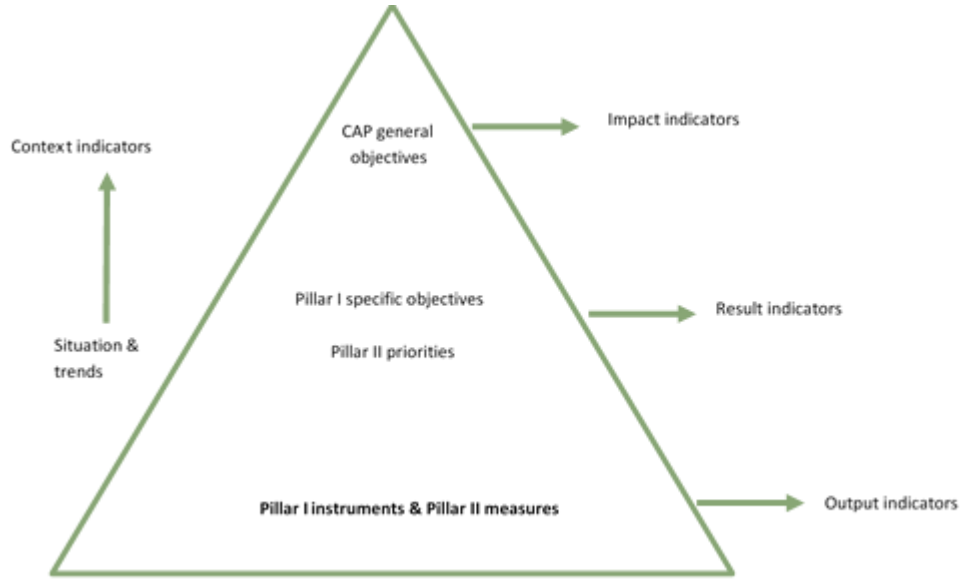

Figure 2: Common Monitoring & Evaluation Framework Indicator Hierarchy

Based on this intervention logic, three levels of indicators are established to assess the effectiveness of general objectives, specific objectives (priorities) and instruments and measurements (Figure 2).

The bottom level indicators are so-called **output indicators** (84 indicators). Output indicators relate to particular policy interventions. Hence, they assess individual Pillar I **instruments** (direct payments and market management measures) and Pillar II **measures**. They represent what the European Commission describes as the "*direct product*" of the instrument or measure. The output indicators for direct payments include such things as the number of farmers in receipt of each type of farm payment and the number hectares to which the various payments apply. The output indicators also include the number of farmers and the land area in environmental focus areas or in areas of natural constraint. The output indicators for market measures include the extent of usage of intervention and private storage and export refunds. There are also some Pillar I indicators for horizontal measures, including the amount of land subject to cross-compliance or in organic farming, as well as the number of farmers availing of advisory services.

Above these output indicators are a set of **results indicators** (41 indicators) which are used to assess the effectiveness of policy in the achievement of CAP specific objectives. The results indicators are therefore linked to the CAP **specific objectives**. Result indicators looks at the direct immediate effect of the instrument or measure, such as the number of jobs that might have been created due to a measure. Examples of Pillar I results indicators include the share of income provided by direct support payments, the extent of income volatility, the extent of EU exports, EU commodity prices relative to world price levels, the share of output that is organic, and the extent of crop diversity. Pillar II results indicators (25 indicators, 19 of them also referred to as target indicators) include the number of projects funded, the number of individuals trained, the number of

farms in receipt of rural development programme funding, the proportion of farms in risk management schemes, the percentage of land in schemes designed to deliver water or soil improvements, the number of animals covered by investments to reduce emissions of greenhouse gases or ammonia and jobs created in supported projects.

At the top level are a set of **impact indicators** (16 indicators, 13 of them are also context indicators) which are used to assess the effectiveness of policy in the achievement of the CAP's **general objectives**. The impact indicators are therefore linked to the CAP general objectives. Impact indicators go beyond the direct immediate effect of instruments and measures and look at the longer-term impact, such as developments in the unemployment rate. Impact indicators include, a range of socio-economic indicators such as farm income levels, agricultural productivity, commodity and consumer price variability and a range of broader economic measures, such as the unemployment rate and GDP per capita. There are also a range of environmental indicators, relating to biodiversity, water and soil.

Beyond the output, result and impact indicators are a set of so-called **context indicators** (45 in total), which include standard socio-economic indicators for the wider economy and specific socio-economic indicators for agriculture and forestry, along with environmental indicators relating to agriculture and forestry.

1.b. Common Monitoring and Evaluation Framework for CAP 2014-2020

The Treaty on European Union includes the objective of promoting economic, social and territorial cohesion and solidarity between Member States and recognise the need to monitor regularly the progress made towards achieving these objectives (Protocol No 28). However, the broad array of EU policies and interventions entail different levels and approaches of monitoring procedures. In the case of CAP, the obligation of monitoring and evaluate each measure is aimed at the improvement of policy quality and at the demonstration of its achievements (EU No 1306/2013). With these purposes, the European Commission proposed the CMEF which is based on a set of common indicators (EU No 834/2014) explained in section 1.a.2.

The absolute value or the variation of these indicators informs about the degree of accomplishment of CAP objectives. These indicators are computed by means of data collected through different sources. Most of these data are collected, to the extent possible, through existing channels. These channels range from communications and notifications from MS to, among many others, Eurostat statistics, Farm Accountancy Data Network statistics, European Environmental Agency data and World Bank information.

The information coming from MS's communications and notifications is available at least annually. "*Yet, a few data items, e.g. those based on Eurostat's Farm Structure Survey (FSS), some environmental information collected from different sources or those reported only in the enhanced annual implementation report and ex post evaluations, are collected with a larger interval*" (European Commission, 2017, p. 36).

The CMEF of the CAP 2014-2020 points out different actions to carry out depending on the implementation stage of the Policy such as monitoring, ex ante evaluation, Annual Implementation Reports (AIR) and ex post evaluation.

1.b.1 Monitoring

The general idea of the monitoring is the systematic collection of data to compute indicators which provide with signals of the extent of achievement of the objectives and the progress in the use of allocated funds to the management and main stakeholders of an on-going intervention. According to the Organisation for Economic Co-operation and

Development (OECD), policy monitoring may be understood as "*a continuous process of collecting and analysing data to compare how well a project, program, or policy is being implemented against expected results*" (OECD-DAC, 2002, p. 30).

1.b.1.a Pillar I

The monitoring of the implementation of the measures and instruments under Pillar I is based on output indicators. The information needed for these indicators is available in the databases used by the EC and MS for the implementation of these measures:

- Information System for Agricultural Market Management and Monitoring (ISAMM).
- Clearance Audit Trail System (CATS) – used for audit, includes the beneficiaries of direct income support (Pillar I) as well as the beneficiaries of support for areas facing natural under RDPs (Pillar II).
- Information System for Agriculture Refund Expenditure (AGREX).

The information on the implementation of direct payments and market measures is transmitted via the system of funds' transfers between EU and MS. MS transmit each month their monthly declarations of expenditure based on article 18(1) of Regulation (EU) No 1306/2013. These data are transmitted on 12th of the month n+1 for the month n (European Commission, 2020d, p. 5). The information of the payments made to each beneficiary must include details on the basis for that payment. Therefore, depending on the type of instruments, these can include for example the Utilised Agricultural Area (UAA), the number and type of animals or the volume of products stored.

In June of the year n+2 the EC publishes a report on the implementation of direct payments. These reports do not include information concerning greening of direct payments. It includes following set of data at the MS level (and the total EU):

- Potentially Eligible Area (PEA).
- Utilised Agricultural Area.
- Determined area.
- Number of admissible applicants.
- Direct payment expenditure per hectare of PEA for each category of payment entitlement.
- Basic payment scheme - Allocations from the national/regional reserve and share of allocations from the reserve for the different categories of farmers.
- Reduction of payments and capping of basic payment.

Decisions on Transitional National Aid (TNA) and implementation data on payments and beneficiaries. TNA are not EU direct payments. These are temporary and complementary payments for new member states to support sectors that used to benefit from state support before accessing the EU and which are not supported within the CAP regulations.

1.b.1.a Pillar II

The keystone for Pillar II monitoring is AIR. This report is prepared by each Managing Authority (MA) of the total 112 RDPs. The first AIR, for the budgetary years 2014 and 2015, was due by the end of June 2016. The following AIRs are due by the end of June of the following year (table 2).

Table 2: Timetable of providing EC with AIRs

CAP pillar II budgetary year	AIR due in year
2014	2016
2015	
2016	2017*
2017	2018
2018	2019*
2019	2020
2020	2021
2021	2022
2022	2023
2023	2024
2024	2025
2025	2026
2026	2026

*AIRs with additional information on the progress in achieving expected results.
Source: Own elaboration based on EC (2017), p. 45 and art. 7 point 14 of the regulation 2220/2020.

The monitoring part of the AIRs is mainly presented in the obligatory tables that MA have to fill in based on the information stored in their databases. These data relate to key information on implementation of the programme and its priorities:

- Committed expenditure by measure and focus area.
- Realised output indicators by measure and focus area.
- Breakdown for relevant outputs and measures by type of area, gender and/or age.
- Progress towards targets.
- Monitoring of transitional measures.
- Achievement of the performance framework indicators.

Other parts of AIRs provide information concerning:

- Progress in implementing the evaluation plan.
- Issues which affect the performance of the programme and the measures taken.
- Steps taken to implement technical assistance and programme publicity requirements.
- Description of implementation of sub-programmes.

The information included in the Enhanced AIR, submitted in 2017 and 2019, is more detailed on the level of the indicators showing the results of the RDP implementation than the information reported in 2016 and 2018 reports.

1.b.2. Evaluation

1.b.2.a. Pillar I

Despite the inclusion of the Pillar I measures in the CMEF, it is not part of the in-depth evaluation process. The EC (DG AGRI) ensures relevant, timely and high-quality evaluations

under Pillar I. The evaluations done under its responsibility are carried out on the basis of a multi-annual evaluation plan (European Commission, 2017). On the other hand, MS conduct studies for the purposes of their policy towards the farming sector, but the extent and frequency of such studies is not regulated by the EU regulations.

1.b.2.b. Pillar II

To support MS in the evaluation of Pillar II, the European Evaluation Helpdesk for Rural Development published in 2015 a working paper entitled "*Common evaluation questions for rural development programmes 2014-2020*" (European Commission, 2015c). In this document, there are 30 questions which are aimed at showing the progress, impact, achievements, effectiveness, efficiency and relevance of rural development policy. The questions are grouped as follow:

- Focus area-related evaluation questions (section 1.b.2.a).
- Evaluation questions related to other aspects of the RDP (section 1.b.2.b).
- Evaluation questions related to Union level objectives (section 1.b.2.c).

The answers to these questions are to be included in both the evaluation results in the Enhanced AIRs (in 2017 and 2019) and in the ex post evaluation.

The document links each question to the CAP objective it is targeted to, proposes judgment criteria to evaluate the success of the RDP intervention and identifies the most suitable CMEF indicators that provide evidence to answer the question. Table 14, in appendix 2, summarizes these three elements and, jointly with appendix 1 tables 7 through 13, gives an overview of the data sources involved in answering the questions.

The Helpdesk's document also proposes, "*In case the common indicators have not been sufficient to provide answers*", collecting additional information to ease the RDP evaluation process. In the following sections we gather the proposed additional information to help in the identification of data gaps in the current CMEF.

1.b.2.b.a. Focus area-related evaluation questions

This group of questions is aimed at capturing the contribution of the interventions under the respective focus area (set of measures and sub/measures) in terms of programme results. CMEF target and complementary result indicators are expected to provide evidence to answer these questions.

1. *Focus area 1A: To what extent have RDP interventions supported innovation, cooperation and the development of the knowledge base in rural areas?*

Additional information suggested by the Helpdesk:

- % of innovative projects out of all RDP supported projects.
- Number and types of partners involved in cooperation projects.
- Number of supported innovative actions implemented and disseminated by EIP operational group.

2. *Focus area 1B: To what extent have RDP interventions supported the strengthening of links between agriculture, food production and forestry and research and innovation, including for the purpose of improved environmental management and performance?*

Additional information suggested by the Helpdesk:

- % of cooperation operations continuing after the RDP support including for the purpose of improved environmental management and performance.

3. *Focus area 1C: To what extent have RDP interventions supported lifelong learning and vocational training in the agriculture and forestry sectors?*

Additional information suggested by the Helpdesk:

- % of trainees receiving certificates from recognized educational and training institutions via activities supported by RDP out of the total number of participants.

4. *Focus area 2A: To what extent have RDP interventions contributed to improving the economic performance, restructuring and modernization of supported farms in particular through increasing their market participation and agricultural diversification?*

Additional information suggested by the Helpdesk:

- Economic farm size structure of supported farms.

5. *Focus area 2B: To what extent have RDP interventions supported the entry of adequately skilled farmers into the agricultural sector and in particular, generational renewal?*

Additional information proposed by the Helpdesk:

- % of adequately skilled farmers in the agricultural sector of the RDP territory.

6. *Focus area 3A: To what extent have RDP interventions contributed to improving the competitiveness of supported primary producers by better integrating them into the agri-food chain through quality schemes, adding value to the agricultural products, promoting local markets and short supply circuits, producer groups and inter-branch organization?*

Additional information proposed by the Helpdesk:

- Agricultural output on supported farms.
- Margin of primary producers in the final price of agricultural products.
- % of primary producers introducing quality schemes with RDP support.
- Definition of local markets.
- Definition of short supply circuits.

7. *Focus area 3B: To what extent have RDP interventions supported farm risk prevention and management?*

No additional information is proposed.

8. *Focus area 4A: To what extent have RDP interventions supported the restoration, preservation and enhancement of biodiversity including in Natura 2000 areas, areas facing natural or other specific constraints and HNV farming, and the state of European landscape?*

Additional information suggested by the Helpdesk:

- Number of flora and fauna species on contracted land.

9. *Focus area 4B: To what extent have RDP interventions supported the improvement of water management, including fertilizer and pesticide management?*

Additional information suggested by the Helpdesk:

- Information on water quality of the land under management contracts.

10. *Focus area 4C: To what extent have RDP interventions supported the prevention of soil erosion and improvement of soil management?*

Additional information suggested by the Helpdesk:

- Information on soil erosion of the land under management contracts.

11. *Focus area 5A: To what extent have RDP interventions contributed to increasing efficiency in water use by agriculture?*

No additional information was proposed.

12. *Focus area 5B: To what extent have RDP interventions contributed to increasing efficiency in energy use in agriculture and food processing?*

No additional information was proposed.

13. *Focus area 5C: To what extent have RDP interventions contributed to the supply and use of renewable sources of energy, of by-products, wastes, residues and other non-food raw material for purposes of the bio-economy?*

Additional information suggested by the Helpdesk:

- Total investments for the use of renewable energy supported by the RDP.
- Renewable energy used in supported holdings.

14. *Focus area 5D: To what extent have RDP interventions contributed to reducing GHG and ammonia emissions from agriculture?*

No additional information is proposed.

15. *Focus area 5E: To what extent have RDP interventions supported carbon conservation and sequestration in agriculture and forestry?*

Additional information proposed by the Helpdesk:

- Information on carbon conservation and sequestration of the land under management contracts.

16. *Focus area 6A: To what extent have RDP interventions supported the diversification, creation and development of small enterprises and job creation?*

Additional information proposed by the Helpdesk:

- % of small enterprises in the non-agricultural sector created with the RDP support.
- % of new small enterprises created with the RDP support.

17. *Focus area 6B: To what extent have RDP interventions supported local development in rural areas?*

Additional information proposed by the Helpdesk:

- Number of projects/initiatives supported by the Local Development Strategy.

- % of RDP expenditure in Leader measures with respect to total RDP expenditure.

18. *Focus area 6C: To what extent have RDP interventions enhanced the accessibility, use and quality of information and communication technologies (ICT) in rural areas?*

Additional information proposed by the Helpdesk:

- % of rural households accessing ICT with the RDP support.

1.b.2.b.b. Evaluation questions related to other aspects of the RDP

These questions are related to additional objectives pursued by the RDPs and are aimed at capturing "*the results achieved by technical assistance, national rural networks and the complementarities and synergies among rural development priorities and focus areas supported within the programmes (Operational performance)*".

19. *To what extent have the synergies among priorities and focus areas enhanced the effectiveness of the RDP?*

Additional information proposed by the Helpdesk:

- Positive and negative interactions among the supported RDP measures.
- Secondary effects of supported RDP measures.

In this case, to measure these interactions and effects, the Helpdesk also suggests that "*MAs of RDPs and evaluators shall identify the methodology, information and data needed to capture and evaluate the complementarities among RDPs measures for capturing the interactions among the different RDP measures*".

20. *To what extent has technical assistance contributed to achieving the objectives laid down in Article 59 of Regulation (EU) No 1303/2013 and Article 51(2) of Regulation (EU) No 1305/2013?*

There is no CMEF indicator available to answer this question.

The additional information suggested by the Helpdesk is:

- Number of staffs involved in RDP management.
- Skills of staff involved in RDP management.
- Types and number of capacity building activities.
- Functionality of the IT system for programme management.
- Number of RDP communication and dissemination activities.
- Number of people receiving information about the RDP.
- Information on the use of evaluation results.
- The length of the application and payment process.

21. *To what extent has the NRN contributed to achieving the objectives laid down in Article 54(2) of Regulation (EU) No 1305/2013?*

Additional information proposed by the Helpdesk:

- Number of stakeholders (by type) participating in the implementation of the RDP due to activities of the NRN (including those through LAGs).
- Number of RDP modifications based on evaluation findings and recommendations from thematic working groups organized by the NRN.
- % of RDP implemented projects encouraged by NRN activities.
- Number persons that have been informed about the rural development policy and funding opportunities through the NRN communication tools.
- % of innovative projects encouraged by NRN out of the total number of innovative projects supported by the RDP(s).

1.b.2.b.c Evaluation questions related to European Union level objectives
This group of questions is aimed at capturing the contribution of the RDPs in terms of impacts to both the overall EU2020 objectives (questions 22 through 26) and the CAP objectives (questions 27 through 30). CMEF impact, context and complementary result indicators are used to provide evidences to answer these questions.

22. *To what extent has the RDP contributed to achieving the EU 2020 headline target of raising the employment rate of the population aged 20 to 64 to at least 75 %?*

Additional information proposed by the Helpdesk:

- Employment rate of the population aged 20-64.

23. *To what extent has the RDP contributed to achieving the EU2020 headline target of investing 3 % of EU's GDP in research and development and innovation?*

Additional information proposed by the Helpdesk:

- RDP expenditure in R&D as a % of the GDP.

24. *To what extent has the RDP contributed to climate change mitigation and adaptation and to achieving the EU 2020 headline target of reducing greenhouse gas emissions by at least 20 % compared to 1990 levels, or by 30 % if the conditions are right, to increasing the share of renewable energy in final energy consumption to 20 %, and achieving 20 % increase in energy efficiency?*

Additional information proposed by the Helpdesk:

- Additional information on ecosystem services.
- There is no data suggested to answer the part of the question related to the contribution of RDP to climate change mitigation and adaptation.

25. *To what extent has the RDP contributed to achieving the EU 2020 headline target of reducing the number of Europeans living below the national poverty line?*

There is no additional information suggested for this question.

26. *To what extent has the RDP contributed to improving the environment and to achieving the EU biodiversity strategy target of halting the loss of biodiversity and the degradation of ecosystem services, and to restore them?*

There is no additional information suggested for this question.

27. *To what extent has the RDP contributed to the CAP objective of fostering the competitiveness of agriculture?*

There is no additional information proposed.

28. *To what extent has the RDP contributed to the CAP objective of ensuring sustainable management of natural resources and climate action?*

There is no additional information proposed.

29. *To what extent has the RDP contributed to the CAP objective of achieving a balanced territorial development of rural economies and communities including the creation and maintenance of employment?*

There is no additional information proposed.

30. *To what extent has the RDP contributed to fostering innovation?*

Additional information proposed includes two elements:

- Definition of innovation.
- Quantitative and qualitative information on innovation.

Regarding the concept of innovation, the document remarks that Managing Authorities will define Innovation at the RDP level considering the programme context and will identify the additional information needed to answer this question according to their specific definition of innovation.

1.c. Lessons learned from the reports evaluating CMEF performance

The European Commission (EC) shall issue two reports on the implementation of the CMEF and the results of the CAP 2014-2020 performance. The first of these two reports was released on December 2018 and the second are to be ready on December 2021. In this section we review the first report to extract the EC's findings on the implementation of CMEF.

On the other hand, the European Court of Auditors (ECA) has issued several reports evaluating both the efficiency of the data used to quantify the effects of CAP on farmer's income —the Farm Accountancy Data Network (FADN) and Economic Accounts for Agriculture (EAA) and the effectiveness of Basic Payments Scheme and Greening measurements to achieve CAP objectives. In 2020, ECA has also reported on the use of new imaging technologies to monitor and control the area-based direct payment schemes (CbM).

1.c.1. First report on the implementation of the CMEF and first results on the performance of the Common Agricultural Policy

The EC issued the "*Report on the implementation of the Common Monitoring and Evaluation Framework and first results on the performance of the Common Agricultural Policy*" (European Commission, 2018b) in December 2018. This report evaluates the implementation of the CMEF, assesses the performance of the CAP and finally, links the lessons learnt with the upcoming PMEF included in the post-2020 CAP proposals. In this section, we review the parts on the CMEF implementation and on the lessons learnt from it.

The first part of the report puts in context the CMEF and remarks that the framework covered first and second pillars and horizontal measures. Following, it gives an overview on the indicators that CMEF is based on and makes some remarks on the sets of the data sources they use. In this sense, the report states that "*the collection of data is based on existing channels in order to avoid creating additional administrative burden for beneficiaries and Member States*". The Commission finds that this fact, the use of existing data sources, jointly with the level of detailed data for certain indicators, have an impact on the timing and frequency of data (indicators) availability. The report gives a couple of examples on this regard: Eurostat's Farm Structure Survey whose results are available 1.5 year after the reference year and soil quality data that are collected on a 5-year interval.

After giving this background, the report shows some obstacle encountered during the CMEF implementation. One of them is the excessive number of indicators and sub-indicators to obtain "*an immediate impression of the achievements of the CAP*". Another obstacle that the EC finds is that not all indicators are suitable for the purpose they were aimed at since they are not available on a yearly basis and/or are available with a certain delay. Therefore, they cannot be used for early monitoring. Additionally, the report points out that some indicators are missing and gives an example in this regard with those indicators related to climate change.

The EC indicates some practical problems encountered during the Annual Implementation Report submission. In this regard, the EC explains that a validation process before AIR submission to warn MS about possible errors was developed in 2018. Following, the report remarks the need for adjustment of some indicators in terms of definition, coverage or reporting frequency. This action was required for MS to report the value of some indicators on partially implemented operations (e.g. investments and support for young farmers) avoiding, this way, the underestimation of the values compared to the actual performance, particularly for such measures that may last several years.

The lack of both data and data comparability for all Member States is remarked in the report. Examples of these issues are the indicators on High Nature Value and Farmland Bird Index. Finally, the report states that "*the possibility to measure via surveys the contribution of Rural Development measures to water and energy savings in agriculture has not yet been taken up due to, amongst others, the limited implementation period*".

The final part of the report gives key ideas of the next monitoring and evaluation framework for the post-2020 CAP proposal. Post-2020 CAP, as the report states, will shift emphasis from compliance and rules towards results and performance and will give more flexibility to MS to decide how to meet best the common objectives. The new PMEF will set out a single set of objectives that will be evaluated multi-annually on the basis of impact indicators, while the follow-up of the annual policy performance will rely on the full list of result indicators. Output indicators should annually link expenditure with the performance of policy implementation. In the report, the Commission, based on the experience from the last CAP cycle, proposes reducing the number of indicators. Consequently, future indicators should be better targeted. In this sense, 101 indicators have already been selected "*to reflect as closely as possible whether the supported interventions contribute to achieving the objectives*". This also reflects the shift from prioritising the use of available data toward the use of more accurate data to assess the contribution of CAP interventions to Policy objectives achievement. The Commission foresees that the quality of the notifications submitted by MS will improve and that "*the certification bodies will have to ensure the reliability of the performance reporting on outputs and results*". The Commission also expects for data sharing between existing sources and

new technologies to enhance future data availability for monitoring and evaluation purposes.

1.c.2. European Court of Auditors' Report on Economic Accounts for Agriculture and Farm Accountancy Data Network

In 2016, the European Court of Auditor (European Court of Auditors, 2016) issued a special report assessing whether the Commission's performance measurement in relation to farmers' incomes is well designed and based on sound data. The incomes and standard of living of farmers are an important element in the EU treaty and the common agricultural policy (CAP). Almost one third of the EU budget is still directly or indirectly dedicated to supporting farmers' incomes and thus contributing to ensuring a fair standard of living for farmers.

The Court concludes that the Commission's system for measuring the performance of the CAP in relation to farmers' incomes is not sufficiently well designed and the quantity and quality of statistical data used to analyse farmers' incomes has significant limitations. Both FADN and EAA do not measure disposable income of farm households, which would facilitate assessing the achievement of the treaty objective of ensuring a fair standard of living for farmers.

With respect to the statistical data on farmers' incomes, the Court recommends to develop a more comprehensive framework for providing information on disposable income and for comparing farmers' incomes with incomes in other sectors of the economy. They recommend to further develop the EAA and FADN so that their potential can be better used and to enhance the present quality assurance arrangements established by the Member States.

1.c.3. European Court of Auditors' Report on Greening Scheme

The European Court of Auditors issued in 2017 the report "*Greening: a more complex income support scheme, not yet environmentally effective*" (European Court of Auditors, 2017) focused on the impact of the greening measures. Overall, they concluded that greening is unlikely to significantly enhance the CAP's environmental and climate performance. This is caused by the absence of a complete intervention logic for the green payment. The green payment remains, essentially, an income support scheme. Greening is unlikely to provide significant benefits for the environment and climate, mainly because of the significant deadweight which affects the policy. Greening led to changes in farming practices on only around 5% of all EU farmland.

To overcome these limitations the court recommends the development of a complete intervention logic for the CAP's contribution to the environmental and climate-related objectives of the EU. Farmers should only have access to CAP payments if they meet a set of basic environmental norms. Specific, local environmental and climate-related needs can be addressed through stronger programmed action regarding agriculture that is based on the achievement of performance targets and funding based on the costs incurred and income foregone in relation to actions and practices going beyond the environmental baseline. This poses higher monitoring demands on costs of practices and incomes.

1.c.4. European Court of Auditors' Report on Basic Payment Scheme for farmers

The 2013 reform of the Common Agricultural Policy introduced a new basic payment scheme for farmers. This scheme aims to provide a basic income support to farmers and thus contribute to viable food production in the EU, without distorting production

decisions. In 2018, the European Court of Auditors (European Court of Auditors, 2018) further evaluates the fair standard of living and the contribution of the basic payment scheme.

The basic payment support is a significant source of income for many farmers but has inherent limitations. It does not take account of market conditions, use of agricultural land or the individual circumstances of the holding, and it is not based on an analysis of the overall income situation of farmers. As a scheme essentially related to areas, basic payment support tends to favour larger farms.

For the future the Court recommends that the Commission analyse the factors impacting income for all groups of farmers, their income support needs and the value of the public goods that farmers provide, and that it links the proposed measures to appropriate operational objectives and baselines against which the performance of the support could be compared

1.c.5. European Court of Auditors' Report on Report on Using new imaging technologies to monitor the Common Agricultural Policy

The main purpose of this ECA's Report is to examine whether the Commission has effectively encouraged the widespread use of the new imaging technologies for CAP monitoring and whether MS have taken adequate action to deploy them. The ECA also try to identify examples of good practice in the context of CAP monitoring (European Court of Auditors, 2020).

The report focuses on the use of the above-mentioned technologies for the control of the area-based aids under Pillar I direct payments —CbM.

The significant potential benefits from the use of Copernicus Sentinel data and other imaging technologies for monitoring area-based aids is remarked in the report. These potential benefits are not only for administration by reducing administrative burden and improving cost effectiveness but also for farmers by improving the information for farm management systems and by helping them to meet the requirements to obtain certain subsidies.

An important remark in the report is the "*Slower progress in meeting the challenge of using new technologies to monitor environmental and climate requirements*". Cross-compliance and rural development agri-environment-climate are these requirements. Cross-compliance rules are based on standards for Good Agricultural and Environmental Condition (GAEC) of land while agri-environment measures are meant to encourage farmers for the voluntary undertaking of environmentally friendly practices which are diverse across the EU. The ECA reviewed and informally assessed the use of Sentinel data for agri-environment-climate measures (table 3) and cross-compliance requirements (table 4) monitoring. In this regard, the main finding is that many requirements are too complex for monitoring with Sentinel data alone.

Table 3: Measures/indicators for CAP schemes vs. imaging technologies

Measures/indicators	Remarks
Presence of a catch crop Presence of a nitrogen-fixing crop Fallow land	Can be monitored by Sentinel data
Presence of two species of plants in the catch crop Landscape elements (rows of trees, hedges, ponds, canals) less than 20m wide	Cannot be monitored by Sentinel data
Identification of extensive grazing on grassland, or crop cultivation in greenhouses, as is the absence of agricultural activity (e.g. land abandonment)	They are difficult for monitoring with Sentinel satellites
Checking the status of yellow-flag parcel	The high number of inconclusive parcels (in particular, small parcels) may result in higher workload for paying agency
Presence of green cover during certain time periods Crop rotation Buffer strips (> 20 m wide) Ban on burning arable stubble Retention of landscape features (hedges, trees in line, groups of trees, etc.) depending on their size/width Mowing of grassland in a certain period (e.g. 2 weeks) Ban on tillage	Cross-compliance and rural development agri-environment-climate eligibility conditions that can be monitored by Sentinel data
Buffer strips (< 20 m wide) Ban on the use of pesticides on buffer strips Ban on cutting of hedges and trees during the bird breeding/nesting season Retention of landscape features (ditches, isolated trees, traditional stone walls) Cultivation-free strips and flower strips of limited size Removal of hay bales after mowing Control of invasive species	Cross-compliance and rural development agri-environment-climate eligibility conditions that cannot be monitored by Sentinel data

Source: studies based on (European Court of Auditors, 2020).

Table 4: Cross-compliance measures and indicators that can be monitored remotely

Minimum soil cover (GAEC 4)	Min. land management reflecting site specific conditions to limit erosion (GAEC 5)	Maintenance of soil organic matter level (GAEC 6)
Crop residues/stubble cover. Sown vegetation. Permanent grassland /grass cover/green cover	Limits on the crops to be planted Ban ploughing during a certain period	Ban stubble burning except for plan health reasons Crop rotation

Source: based on (European Court of Auditors, 2020, p. 42).

The ECA gathers some PA's concerns on the use of such technologies. One of these concerns is "*the risk of not being able to reach conclusions on a large number of parcels using automation, especially if these would have to be followed up with field visits*". This situation

could lead to increase the burden of on-the-field controls. The second concern is on the risk of incorrect identification of compliance that could lead to overpayments and the subsequently "*uncertainty about the Commission's conformity clearance procedure in the context of the new approach*". In this sense, the report remarks that the Commission took steps to clarify the CbM audit procedure. Another PA's concern is the difficulty of monitoring some agricultural activities with Sentinel satellite data. To solve this problem the Commission allowed the use of geo-tagged photos as additional evidence.

The above-mentioned concerns show that there are some gaps in terms of data acquisition and data use knowledge. These gaps may be removed in post-CAP 2020 situation. As for data acquisition, the ECA remarks that the EC made available the use of several Data and Information Access Services (DIAS) platforms that provides with both Copernicus Sentinel data access and cloud processing capabilities.

Regarding data use knowledge, the ECA's report points out several Horizon 2020 projects and ESA funded projects aimed at easing the acquisition, processing and use of Copernicus Sentinel data:

- Three H2020 projects such as RECAP (2016-2018), Sensagri (2016-2019) and EO4AGRI (2018-2020) whose purpose is to monitor agriculture using Copernicus Sentinel data.
- A key project started in June 2019 is 'New IACS Vision in Action' (NIVA) whose objective is "*to modernise the integrated administration and control system used by paying agencies, by making efficient use of digital solutions and e-tools to reduce administrative burden and improve environmental performance*".
- Sen4CAP – ESA project that will "*provide algorithms, products, workflows and examples of good practice for generating satellite-derived markers and information relevant to CAP monitoring*"

Despite having these tools, the report remarks that "*Moving to checks by monitoring requires significant changes to IT systems and not all paying agencies consider that they currently have the necessary resources and expertise to do so*".

The ECA highlights three key challenges for proposing new measures and indicators:

- The new monitoring approach while faced with uncertainty about the post-2020 CAP.
- Innovative IT solutions, such as the processing of time series of Sentinel data (high volume of data) and machine-learning algorithms (rather than standard image-processing tools).
- Achieving potential synergies between agencies by working together.

Tables 5 and 6 present selected performance indicators for the post-2020 CAP with proposal for more detailed monitoring for three impact indicators (I.10, I.13 and I.20).

Table 5: Performance indicators for the post-2020 CAP

Types of indicators	Role	Examples
Output indicators	They *"are used to link expenditure to outputs. They are used for annual performance Clearance*".	Number of hectares covered by a ban on spraying plant protection products
Result indicators	They *"are used to link outputs to specific objectives, for setting targets (realised by approved interventions) and for monitoring implementation progress (performance review)"*	Share of agricultural land farmed without plant protection Products
Impact indicators	They *"contribute to evaluating performance of the CAP in relation to CAP specific objectives (mid-term and ex-post evaluation)*".	Concentration of plant protection residues in surface water

Source: based on (European Court of Auditors, 2020, p. 43).

Table 6: Proposals of modification of measures and indicators for CAP monitoring

EU Specific objectives	Impact indicators	Proposals
Contribute to climate change mitigation and adaptation, as well as sustainable Energy	I.10 Contribute to climate change mitigation: Reducing GHG emissions from agriculture	Their monitoring can be based on Sentinel data combined with *"existing surveys/databases managed by the MS (e.g. Land Parcel Identification System), Eurostat (e.g. Land Use/Cover Area frame statistical Survey) and the European Environmental Agency".*
Foster sustainable development and efficient management of natural resources such as water, soil and air	I.13 Reducing soil erosion: Percentage of land in moderate and severe soil erosion on agricultural land	
Contribute to the protection of biodiversity, enhance ecosystem services and preserve habitats and landscapes	I.20 Enhanced provision of ecosystem services: share of UAA covered with landscape features	

Source: based on (European Court of Auditors, 2020) and (European Commission, 2018a).

Summing up outcomes from the ECA's special report:

- The use of Copernicus Sentinel data and other imaging technologies for monitoring area-based aids has significant potential benefits for farmers and administrations.
- Some CAP measures and indicators cannot be monitored remotely.
- Moving to CbM requires significant changes in IT systems and not all paying agencies consider that they currently have the necessary resources and expertise.
- There is a slower progress in meeting the challenge of using new technologies to monitor environmental and climate requirements.

1.c.6 Common issues encountered related to CMEF's data sources.

The previous sections presented a review of several reports analysing both the effect of different measures stablished during CAP 2014-2020 cycle and the usefulness of various data sources employed for CAP monitoring and evaluation. In this section, we summarize the common weaknesses and difficulties encountered in these reports related to the data sources employed in the CMEF.

One of the findings we found in the previous review is that the data sources used for some indicators are collected from existing channels in order to reduce administrative and beneficiaries' burden. This fact makes some indicators unsuitable for the purpose they were established. The level of detail and delivery frequency of data are regarded as the critical elements for this issue. This difficulty impact in both the economic and environmental themes of the Policy.

As for the economic aspect of the Policy, the review finds that there are data gaps to measure some indicators and that enhanced methodologies to collect detailed data at holding level are needed. These methodologies should ensure the comparability of data between farms and should considered external data (markets, for instance) to capture the real effect of the Policy measures.

The environmental aspect of the Policy is in which the examined reports find more missing indicators and data sources. One of the critics to the employed indicators is that they don't really capture the Policy impact on environment because they are designed to quantify some not well targeted measures. This issue brings to the front the fact that the new monitoring and evaluation framework would benefit from a better targeted set of indicators quantifying the impact of better oriented measures. Another issue encountered is that these environmental indicators are data demanding and require many sources to compute their metrics and capture the real impact of the Policy.

New data acquisition technologies jointly with data analysis and data exchange developments are called not only to fulfil the data gap encountered across indicators but also to reduce data collection burden on both data providers and administration. Nevertheless, some difficulties have been encountered when assessing pilot experiences on controlling area-based CAP schemes. These difficulties, although related to subsidies control, are envisaged to impact similar way on CAP monitoring and evaluation. One of these difficulties is related to the need of combining several technologies and data sources to measure the indicator's data requirements (there is no one-fit-all technology). Data quality control issue presented in several reports, is particularly important when new data acquisition technologies are used because they could require new cross-check control systems.

2. Review of data sources used in CMEF

The Common Agriculture Policy 2014-2020, as explained previously, has been monitored and evaluated by means of the CMEF which sets up a set of indicators aimed at the different levels of the Policy –general and specific objectives, instruments and measurements. The calculation of each indicator requires different type of data which are summarized in section 2.a. Following to this synthesis, a brief description of the most relevant sources is done in section 2.b.

2.a. Current Indicator Framework

2.a.1. Context indicators

Table 7 in appendix 1 summarizes context indicators that characterize the background in which the policy is to be implemented. There are 45 context indicators and eleven of them correspond as well to impact indicators. In the table, indicators are grouped by the aspect they are aiming at –Socio-economic (C1 to C12), Sectorial (C13 to C30) and Environment (C31 to C45).

15 different data sources have been identified. Eurostat's datasets are involved in almost all indicators. In fact, this is the only source required for Socio-economic indicators. On the other hand, environmental indicators are the ones that require more data sources. A part from Eurostat, the most relevant data sources providers are the European Environmental Agency (EEA), the Copernicus program (CORINE Land Cover) and Joint Research Centre's (JRC) initiatives LUCAS and European Soil Data Centre (ESDAC). The FADN is also relevant for both Sectorial and Socio-economic indicators (C27 and C33).

2.a.2. Impact indicators

Impact indicators measure the impact of policy interventions at longer term and are aimed at CAP general objectives –viable food production, sustainable management of natural resources and climate action, balanced territorial development. Table 8 in appendix 1 summarizes the required data sources for these indicators, grouped by objective.

In this case, 11 different data sources were identified for the 16 impact indicators. The main data source is Eurostat's database which is used by all indicators except for I04 (EU commodity price variability), I07 (emissions from agriculture) and I12 (soil organic matter in arable land). By contrast, the set of indicators aimed at measuring the achievement of the objective on Balanced territorial development only requires data from Eurostat.

The indicators combining more data sources are those related to sustainable management of natural resources and climate action. Among others, these indicators need data from the EEA, United Nations Framework Convention on Climate Change (UNFCC), Copernicus program, JRC's initiatives LUCAS and ESDAC and Pan-European Common Bird Monitoring Scheme (PECBMS).

Indicators on viable food production, besides Eurostat's database, also make use of the FADN (Total factor productivity in agriculture). Under this objective, EU commodity price variability uses some other European and international sources as EU marketing and price monitoring dashboard, FAOSTATS, and prices from international agriculture and livestock markets.

2.a.3. Result indicators (Pillar I)

Result indicators measure immediate effects of the CAP interventions and are aimed at the specific objectives of the Policy. Table 9 in appendix 1 summarizes indicators and data sources that focus on Pillar I objectives.

In this case, seven different entities provide information to compute these indicators. Among these entities, the most important one is Eurostat. All indicators except R.08 (EU commodity prices compared to world prices) and R.15 (net greenhouse gas (GHG) emissions from agricultural soils) use Eurostat's database. The indicator on variability of farm income (R.02) also requires statistical data but in this case, it extracts the information from the FADN. The indicator on EU commodity prices compared to world prices (R.08) uptakes information from some International organizations such as FAO or third countries entities such as United States Department of Agriculture (USDA).

MS communicate the required information to the EC by means of the Information System for Agricultural Market Management and Monitoring (ISAMM). Some indicators (R.05, R.06, R.07, R.13, R.14) use this database as source of data.

2.a.4. Output indicators (Pillar I)

Table 10 in appendix 1 gathers the 58 output indicators for Pillar I. The information for these indicators is mainly collected by the MS, stored in administrative databases and communicated to the Commission. EU regulation sets up the rules on what and when the required information has to be communicated (EU No 639/2014, EU No 2016/1240, EU No 612/2009, EU No 657/2008, EU No 2015/561, EU No 2016/1150 and EU No 1306/2013).

The Clearance of Audit Trail System (CATS) is a valuable source of information to compute these indicators because it stores information on individual beneficiaries. A part from these data sources, DG AGRI also collects information from Eurostat's database for organic farming statistics and other databases, not explicitly mentioned in the fiches, such as DOOR for quality products, MPP database for promotion programs, e-Bacchus for the wine sector, e-Spirits for spirit drinks and even from ISAMM.

2.a.5. Output indicators (Pillar II)

The purpose of Pillar II output indicators is to quantify the effects of the different measures established under this Pillar. The Information needed for these indicators is recorded at operation (project) level by the Managing Authority (MA)/ PA in their operations database. Beneficiary application form, Local Action Group (LAG) and National Rural Networks (NRN) reports and the Integrated Administration and Control System (IACS) are the different ways in which the data for these indicators are collected. Table 11 in appendix 1 summarizes the 26 output indicators under pillar II and the source from which each of them uptakes data.

2.a.6. Target/Result indicators (Pillar II)

Table 12 in appendix 1 summarizes the 24 target indicators setting objectives at the beginning of the programing period. 19 of them are, at the same time, focused on measuring immediate effects of interventions which means that they are also results indicators for Pillar II. The main data source for these indicators is the MA operations database. Nevertheless, most of the indicators require support from other statistical sources such as Eurostat's database or some statistics carried out at national/regional level. Besides statistical sources, both the information stored in the IACS and the communicated by the LAG to the MA becomes relevant to compute these indicators.

2.a.7. Complementary Result indicators (Pillar II)

These complementary indicators are meant to support both evaluation and the ex post evaluation of the RDPs that are part of the biannually Enhanced Annual Implementation Report. MA operations database plays a key role to calculate these indicators. Evaluators will use some others data sources to ease the evaluation process. These sources span from

statistical at farm level as FADN, Eurostat's FSS or specific research projects to international sources such as the International Energy Agency or the Intergovernmental Panel on Climate Change (IPCC). Table 13 in appendix 1 summarizes the five complementary result indicators and the different data sources they use.

The EC makes all these indicators available in its interactive dashboard (https://agridata.ec.europa.eu/extensions/DataPortal/cmef_indicators.html)

2.b. Characteristics of the identified data sources

The previous review highlighted the great variety of data sources that CMEF's indicators need for their calculation. While administrative databases store all the information related to CAP beneficiaries and allow the direct quantification of the CAP results and outputs, statistical databases are meant to give a broader description on the EU agricultural sector including environmental domain. The previous section also showed that both types of sources need to be combined to carry out the monitoring and evaluation of the Policy.

In this section, we describe the most relevant data sources. We show the scope and the purpose of Eurostat's statistical datasets related to agriculture in social-economic and environmental domains. The Commission manages several services that provide with data to CMEF's indicators such as the statistics in the FAND, the data from the JRC's European Soil Data Centre (ESDAC) and the reports from the marketing and price monitoring dashboard. The Commission also centralized the Clearance Audit Trail System (CATS) information and the information in the IACS (and LPIS). Other European entities and organisations such as European Environment Agency (EEA) and Birdlife International provide valuable data to assess the environmental effect of the Policy. Apart from explaining the domains and the objectives each data source, this section presents two more characteristics where these data can be obtained from and the format they can be found. Table 15 (appendix 3) summarizes the latter features.

2.b.1. EUROSTAT

The statistical office of the European Union is Eurostat and provides with high quality statistics and data on Europe (https://ec.europa.eu/eurostat/web/main).

Eurostat collaborates with MS in the European Statistical System (ESS). MS collect data and compile statistics for national and EU purposes and Eurostat harmonizes these statistics in close cooperation with the national statistical authorities (National Statistical Institutes, NSIs). Statistics are concentrated mainly on EU policy but it has been extended and it covers nearly all statistical fields.

Eurostat is also in charge of the statistics dissemination. Eurostat's database is organized in datasets that are accessible in many ways. In this regard, and speaking in terms of interoperability, Eurostat has implemented a couple of Web services to retrieve the information easily. The access to the datasets is possible through *SDMX Web Services* and *Json* and *Unicode Web Services*. These two services enable the possibility of getting a complete list of publicly available datasets, getting the complete structure definition of a given dataset and downloading a subset of a given dataset or even the full dataset (https://ec.europa.eu/eurostat/web/main/data/web-services).

Individual datasets or the complete database can be automatically downloaded by using the bulk download facility (https://ec.europa.eu/eurostat/web/main/data/bulkdownload).

Access to microdata stored in Eurostat's database is possible under request for research organization recognized as a research entity. Microdata contains information on individual

persons, households or business entities dully anonymised (https://ec.europa.eu/eurostat/web/microdata/overview).

After this brief overview on Eurostat's database, we focus on the most relevant datasets used in the CMEF indicators.

2.b.1.a. Agri-environment indicator (AEIs)
The main purpose of these Agri-environmental indicators (AEIs) is to keep track of the integration of environmental concerns into the CAP at EU, national and regional levels (https://ec.europa.eu/eurostat/web/agriculture/agri-environmental-indicators).

There are 32 Agri-environmental indicators collecting information related to themes such as water, land use and soil, climate change and air quality, and biodiversity and landscape.

This set of AEIs were identified by means of DPSIR (Driving force — Pressure — State — Impact — Response) model. This model aims to capture the key 'factors' involved in the relationships between agriculture and the environment and to reflect the complex chain of causes and effects between these factors (European Environment Agency, 2005).

Since this set of AEIs requires a multi-perspective approach, several organisations, apart from Eurostat, have contributed to define them. The entities involved are Directorate-General for Agriculture and Rural Development (DG AGRI), Directorate-General for Environment (DG ENV), JRC, EEA, and Directorate-General for Health and Food Safety (DG SANTE).

In this case, Eurostat harmonizes, stores and disseminates some of the AEIs but is not responsible for its collection or maintenance. The AEIs available in Eurostat's database are: farmers' training level and use of environmental farm advisory services, area under organic farming, mineral fertiliser consumption, consumption of pesticides, irrigation, energy use, cropping patterns, livestock patterns, soil cover, tillage practices, manure storage, intensification/extensification, specialisation, gross nitrogen balance, risk of pollution by phosphorus, pesticide risk, (archive) ammonia emissions, greenhouse gas emissions, water abstraction, soil erosion, population trends of farmland birds.

2.b.1.b. Economic Accounts for Agriculture (EAA)
Economics Account for Agriculture comprises three interlinked datasets: EAA, Agricultural Labour input Statistics (ALIS) and Unit value statistics for agricultural products. These three statistics, jointly, analyse the production process and primary income generated by Agriculture.

2.b.1.b.1 Economic Accounts for Agriculture
The EAA is a satellite account of European System of Accounts (ESA) providing complementary information and concepts adapted to the particular nature of the agricultural industry (https://ec.europa.eu/eurostat/cache/metadata/en/aact_esms.htm) and becomes a basic tool for analysing the macroeconomic situation of a country's agricultural sector and changes in agricultural income (European Court of Auditors, 2016).

EAA describes both the income generated by the agricultural activity itself and the disposable income of agricultural households which includes the income coming from other Non-agricultural secondary activities. Each type of activity is focus on:

- Agricultural activity:
    - Growing of non-perennial crops.

    - Growing of perennial crops.
    - Plant propagation.
    - Animal production.
    - Mixed farming.
    - Support activities to agriculture and post-harvest crop activities.
    - Hunting, trapping and related service activities.
    - Specialised units providing machines, equipment and personnel for the performance of contract work at the agricultural production stage.
- Non-agricultural secondary activities:
    - Activities which represent a continuation of agricultural activity and which use agricultural products:
        - Processing of agricultural products.
        - Grading and packing.
    - Activities involving the agricultural holding and its means of agricultural production:
        - Agro-tourism.
        - Farm shops.
        - Sports and rural recreation.
        - Services for third parties.
        - Landscaping services.
        - Fish-farming.
        - Other activities involving the use of the land and means of agricultural production.

The EAA provide a wide range of indicators on the economic activities in the agricultural sector which include output, intermediate consumption, gross and net value added, gross fixed capital formation (GFCF), both in current prices and in constant prices, as well as compensation of employees, other taxes and subsidies on production, net operating surplus or net mixed income, property income and net entrepreneurial income in current prices (https://ec.europa.eu/eurostat/cache/metadata/en/aact_esms.htm). Regarding agricultural income, EAA defines three indicators (European Commission, 2000a):

- Indicator A: Index of the real income of factors in agricultural per Annual Work Unit (AWU) which corresponds to the real net value added at factor cost of agriculture per total AWU.
- Indicator B: Index of real net agricultural entrepreneurial income per unpaid AWU. This indicator presents the changes in net entrepreneurial income over time, per non-salaried AWU and provides information on trends rather than on income levels when converted into the form of an index for each MS.

- Indicator C: Net entrepreneurial income of agriculture. This income aggregate is presented as an absolute value (or in the form of an index in real terms). It allows comparability over time of the income of the agricultural industry between Member States.

Data collection and aggregation at national level is entirely financed by the Member States, and national statistical institutes or ministries of agriculture are responsible for data collection and the calculation of national EAAs. The Commission (Eurostat) is responsible for establishing the methodology and aggregating the data at EU level.

2.b.1.b.2 Agricultural Labour Input Statistics (ALIS)
ALIS is an inseparable and integrated part of the EAA and addresses one of its basic objectives that is to express trends in and levels of agricultural income in relation to the trends in agricultural labour input. The second objective is the general macroeconomic productivity analyses (European Commission, 2000b).

These statistics are meant to provide an overview of the volume of labour in the agricultural industry that is systematic, comparable and as complete as possible, to serve as a basis for analyses, forecasts and political measures within the EU (European Commission, 2000b).

The unit of measurement of agricultural labour input is AWU which is defined as the number of hours actually worked in a full-time job within agriculture. In this context, the definition of work includes all work actually performed in connection with the production of products from the agricultural activities and the inseparable non-agricultural activities. Agricultural labour input must correspond to the value of output, intermediate consumption and value added as recorded in the EAA in order to establish the correct measure of the income indicators, mainly indicator A and B (European Commission, 2000b).

2.b.1.b.3 Unit Value Statistics for Agricultural Products
Unit value is an instrument to provide further information on characteristics of the change in the value of agricultural products, other than the price components as such (European Commission, 2000a).

Unit values refer to the concept of the output of agricultural activity. They are obtained by dividing current values (in producer prices and in basic prices) by the corresponding physical quantities. They differ from prices in as much as the variation in unit values includes any variation in quality.

Two set of unit values are stablished:

- At basic prices that include subsidies and exclude taxes on products.
- At producer prices where subsidies on products are not added and taxes on products are not deducted.

2.b.1.d. Farm Structure Survey (FSS)
The purpose of FSS is to obtain reliable data, at regular intervals, on the structure of agricultural holdings in the EU (https://ec.europa.eu/eurostat/web/microdata/farm-structure-survey).

The FSS is conducted consistently throughout the EU with a common methodology on a regular basis and provides, therefore, comparable and representative statistics across

countries and time, at regional levels. Every 3 or 4 years a sample survey is performed and once in ten years data are collected as a census what means that all individual agricultural holdings, above pre-established thresholds, and farmers in a country are surveyed. This census is the only data collection instrument that produces statistical information on farms at the most detailed geographical level (European Commission, 2020c). During 2020, MS carried out this census and the results are expected to be published by 2022 (European Commission, 2021).

The information collected in the FSS covers land use, livestock numbers, rural development, management and farm labour input (including the age, gender and relationship to the holder of the agricultural holding). The survey data can then be aggregated by different geographic levels (countries, regions, and for basic surveys also district level). The data can also be arranged by size class, area status, legal status of the holding, objective zone and farm type.

EU Countries are responsible for selecting the sample, preparing the questionnaires, conducting the direct interviews or collecting the data from the corresponding administrative registers. Then, data are forwarded to Eurostat who centrally processes the information in accordance with the requirements of the regulation (EC) No 1200/2009.

FSS produces a variety of information on specific CAP targets, as well as providing a basis for extrapolating FADN data. Nevertheless, there is a need for farm statistics to evolve to respond to new policy requirements, which implies not only new data requirements but also their cross-linking to data in other domains, from environment to rural areas.

The Strategy for Agricultural Statistics 2020 and beyond aims at the rationalisation of the European Agricultural Statistics System (EASS) and at a more efficient data collection process. The new approach for Integrated Farm Statistics (IFS) is aimed at achieving this objective and entered into force on 27th August 2018 (European Commission, 2020c).

The main purpose of the Integrated Farm Statistics (IFS) is to provide comparable data on the agricultural holdings of the European Union. Its main element is the introduction of a flexible and modular framework of data collection based on a decennial agricultural census collecting core structural data from all EU farms, Farm Structure Surveys collecting core structural data from a large sample of farms in interim years, and 'Modules' collecting data on specific topics from sub-samples of the farms surveyed for the core data.

The core data are on:

- General variables.
- Variables of land.
- Variables of livestock.

and the modules' data are on

- Labour force and other gainful activities.
- Rural development measurements.
- Animal housing and manure management (European Commission, 2020c).

IFS requires for MS to provide data which cover 98 % of the total utilised agricultural area (UAA) (excluding kitchen gardens) and 98 % of the livestock units (LSUs) of the Member State. To be surveyed, agricultural holdings need to be above at least one of the physical

thresholds established in the Regulation (EU) 2018/1091. These thresholds regard the size of agricultural land or the number of livestock units and configure the so-called main frame. The holdings in the main frame represent the relevant population for surveying core variables as well as for the modules 'Labour force and other gainful activities' and 'Rural development' (although only a part of them might benefit from rural development measures). Only a subset of the holdings of the main frame —only those with at least one of the following: bovine animals, pigs, sheep, goats, poultry represents the relevant population for the module 'Animal housing and manure management module' (European Commission, 2020c).

2.b.1.d. Agricultural production

2.b.1.d.1. Crop production

Statistics on crop products are a tool for monitoring and managing the market of crop products (European Commission, 2020b). The main goal of crop production statistics is to determine the productive area, harvested production, yield and humidity of crops in the EU. The information concerns more than 100 crop products that are organized in different categories as follow:

- 17 categories and subcategories for cereals.
- 29 categories and subcategories for other main crops (mainly dry pulses and protein crops, root crops industrial crops and plants harvested green from arable land).
- 40 categories and subcategories for vegetables.
- 41 categories and subcategories for permanent crops.

Apart from this crop categorisation, the Utilised Agricultural Area (UAA) is broken down in 18 categories and subcategories.

Depending on the type of crop, different annual data are collected (https://ec.europa.eu/eurostat/cache/metadata/en/apro_cp_esms.htm):

- For cereals and for other main field crops such as dried pulses, root crops, fodder and industrial crops: area under cultivation, harvested production, yield, humidity and main area.
- For vegetables: harvested area, harvested production and main area.
- For permanent crop: production area, harvested production and main area.

A couple of remarks need to be considered to understand these variables. The first one is related to use of the term “area”, there are several ideas under this general term such as area under cultivation, harvested area, production area, main area. The definition of each one is described in (European Commission, 2020b). In this sense, an agronomically realistic area counting is done and therefore, ditches, embankments, hedges, paths separating lots, or groves of trees are excluded. This approach corresponds to the one used in the Farm Structure Survey, where non-productive area is supposed to be included under 'other land' —all those parts of the total area belonging to the agricultural holding which are not utilised agricultural area, unutilised agricultural area or wooded area (European Commission, 2020b).

The second remark refers to crop production and yield data. These data are available in both EU standard humidity and in national humidity.

The main data sources are administrative records, surveys and expert estimates. National Statistical Institutes or Ministries of Agriculture are responsible for the national data collection in accordance with the Regulations and agreements in force.

Eurostat is responsible for compiling the EU aggregates. Due to different revision policy for the EU aggregates and the Member States' data, there may be a difference between the EU aggregate and the sum of national data between updates.

2.b.1.d.2. Animal production

Animal production statistics provide with statistics on three main sub-domains (https://ec.europa.eu/eurostat/cache/metadata/en/apro_anip_esms.htm):

- Livestock and meat: these data cover meat production, as activity of slaughterhouses and as other slaughtering, meat production forecast and livestock statistics, including regional statistics.
- Milk and milk product: these statistics cover farm production and utilisation of milk, collection and production activity by dairies and statistics on the structure of dairies.
- Eggs for hatching and farmyard poultry chicks provides with statistics on the structure and the activity of hatcheries as well as reports on the external trade of chicks.

Going into details, the variables subject to study in each of the above-mentioned categories are

- For livestock statistics: the number of bovine animals, pigs, sheep and goats held on agricultural holdings within each MS's territory.
- For slaughtering statistics: number and carcass weight of bovine animals, pigs, sheep, goats and poultry slaughtered in slaughterhouses, whose meat is deemed fit for human consumption. An estimate of the extent of slaughtering carried out other than in slaughterhouses is also supplied, so that the statistics include all bovine animals, pigs, sheep and goats slaughtered on each MS's territory.
- For meat production forecasts: MS produce forecasts on gross indigenous production in relation to the number of bovine animals, pigs, sheep and goats slaughtered plus the balance of intra-Community and external trade in these live animals. This forecast is based on the information from the previous topics (livestock statistics and slaughtering statistics) plus any other available information on this regard.

MS are responsible for the collection of data and for the production of statistics on the previous three categories. The coverage, the period and transmission deadlines of these statistics are established in the following regulation for each topic:

- Livestock, slaughtering and meat forecast: (EC) No 1165/2008.
- Milk and milk products: COUNCIL DIRECTIVE 96/16/EC of 19 March 1996.
- Eggs for hatching and farmyard poultry chicks: (EC) No 617/2008, implementing Regulation (EC) No 1234/2007 (Single CMO Regulation).

2.b.1.e. Agricultural Prices and Agricultural Price Indices

2.b.1.e.1. Selling prices of agricultural products (absolute prices)

The main purpose of this dataset is to provide information on agricultural prices that enables the comparation between MS and allows carrying out economic analyses such as socio-economic models calculation, econometric modelling and the determination of price elasticities. Agricultural prices are key for decision-making in economic activities (https://ec.europa.eu/eurostat/cache/metadata/en/apri_ap_esms.htm).

The main variables in agricultural absolute prices dataset comprise:

- The "output" price: the average price received by farmers on the market for an agricultural commodity, produced within a specified 12-month period. This price is measured at the farm gate, i.e. at the point where the commodity leaves the farm and, therefore, does not cover the costs for transport or processing.
- The "input" price: the average price paid by a farmer for buying means of agricultural production within a specified 12-month period. This price is measured at the farm gate and, therefore, the input price covers the costs of transport and processing, but it can be calculated from the average of retail purchase price for the farmer.

The main sources of agricultural prices used to generate the absolute prices are:

- Samples of producers selling directly to the consumers.
- Records of transaction as part of an administrative process.
- Administered prices.
- Enquiries to bodies purchasing agricultural products or selling means of production.

The Member States provide Eurostat with monthly and annual price series. The data are transmitted to Eurostat using the Eurostat Single-Entry Point (EDAMIS).

2.b.1.e.2. Price indices of agricultural products

A price index illustrates how the price of a product or of a basket of products has changed since the base period. In line with this idea, the purpose of the Agricultural Prices Index (API) is to provide information on trends in producer prices of agricultural products and purchase prices of the means of agricultural production. They are intended

- to permit comparison of these trends both between the various MS and the EU as a whole and between the different products within a Member State or the European Union.
- to facilitate comparisons between trends in producer prices and trends in purchase prices of the means of agricultural production.

(https://ec.europa.eu/eurostat/cache/metadata/en/apri_pi_esms.htm)

APIs show how agricultural revenue and expenditure are influenced by their price component which have a decisive influence on farmers' incomes. Therefore, these indices are connected with Economic Accounts for Agriculture (EAA) (European Commission, 2020b).

Nevertheless, and based on its definition, APIs cannot express differences between the MS in terms of absolute agricultural price levels and furthermore, EU APIs can differ from the indices of agricultural prices published by the national official websites of Member States, as the latter may be computed in respect of different base, formula or field of observation.

The main variables in EU Agricultural Price Indices (output and input) (European Commission, 2020a):

- The index of producer prices of agricultural products (output) cover agricultural goods and services. They include crops, livestock and livestock products. The producer prices index of agricultural products (output) represents the measure of transaction prices reflecting revenue received by the producer for goods and services actually sold to customers over a period. Furthermore, the elementary indices of animal prices refer to animals leaving agriculture (slaughter or export) and the weight is calculated as the value of the corresponding sales. Imports of animals are regarded as negligible.
- The index of purchase prices of the means of agricultural production (input) covers agricultural inputs including intermediate consumption of goods and services (fertilisers, pesticides, feed, seed, energy and lubricants, maintenance and repairs, etc.) and gross fixed capital formation related to investments goods (machinery and equipment, farms, buildings, etc.) over a given period.

The main sources of agricultural prices used to elaborate the indices are:

- Samples of producers which make direct sales.
- Records of transaction as part of an administrative process.
- Administered prices.
- Enquiries to bodies purchasing or selling the agricultural products or means of production.

Data are collected by EU Member States and transmitted to Eurostat that calculates and publishes the indices.

2.b.2. Commission Services

2.b.2.a. Joint Research Centre - European Soil Data Centre (ESDAC)

The European Soil Data Centre (ESDAC) (https://esdac.jrc.ec.europa.eu/) is the thematic centre for soil related data in Europe. Its ambition is to be the single reference point and to host all relevant soil data and information at European level. It contains a number of resources that are organized and presented in various ways: datasets, services/applications, maps, documents, events, projects and external links.

The main dataset is the European Soil Database (ESDB) but ESDAC also distribute information on themes such as erosion by water, soil organic carbon, wind erosion, harvest erosion, desertification, hydraulic properties, landslides, soil compaction, salinization, biodiversity, sealing, contamination, nutrients and pH. ESDB data allow expert users to run soil, water and air related models.

The most detailed maps (1kmx1km grid) is distributed under request but can also be visualized via a Web Map Viewer (http://esdac.jrc.ec.europa.eu/viewer). In terms of

interoperability, the information is also available through services that follow the Open Geospatial Consortium (OGC) interoperability standards, in this case WMS.

2.b.2.b. Farm Accountancy Data Network (FADN)
The European FADN provides detailed financial, economic and structural information at farm level on more than 80,000 farms in Europe. FADN has been established in 1965 (Council Regulation EEC/79/65) and all those years FADN has been an important tool in creating and evaluating the CAP.

The information collected for each sample farm has evolved over time in accordance with the CAP development and currently contains more than 1,000 variables. The data are collected in a systematic way on an annual basis. FADN contains harmonized farm level data across Europe. The data elements to be provided to the EC and bookkeeping principles are the same in all countries. The data to be uploaded and the exact definition of each data element is defined in the FADN Farm Return, examples are:

- Physical and structural data, such as location, crop areas, livestock numbers, labour force, etc.
- Economic and financial data, such as the value of production of the different crops, stocks, sales and purchases, production costs, assets, liabilities, production quotas and subsidies, including those connected with the application of CAP measures.

Farms are selected in the sample according to a selection plan that guarantees its representativity. The field of observation is stratified according to 3 criteria: region, economic size and type of farming. The survey does not cover all agricultural holdings in the Union but only those which due to their size could be considered commercial so that farms with lowest production capacity (utilize agriculture area and livestock) are excluded. However, farms that constitute FADN field of observation cumulate (with exception of Cyprus and Malta) more than 80% of UAA and as a consequence receives majority of CAP area payments.

Every year a set of standard results are calculated. The standard results are a set of aggregated statistics, calculated from the Farm Returns that is publicly available in three dimensions: time (year), geography (Country, Region) and typology (Type of Farming, and economic) (https://agridata.ec.europa.eu/extensions/FarmEconomyFocus/FarmEconomyFocus.html).

They describe in considerable detail the economic situation of farmers by different groups:

- 9 general types of farming.
- 22 principal types of farming.
- 62 particular types of farming.

Similarly, farms can be grouped into 14 or 6 size classes.

Besides these standard results, the data are used for:

Policy making and evaluation

The FADN plays a vital role in European policy making. It is an important tool to monitor the income situation in agriculture and it provides information for the development and evaluation of agricultural policies. Subsidy systems and other policies are designed to

achieve certain goals. FADN provides a tool to evaluate the effect and impact of subsidies on the profitability and viability of farms. FADN gives objective information on the agricultural sector. The FADN data are used as well to simulate potential impact of planed policies on different groups of farms. Examples of analyses using FADN data conducted by EC includes cereal and beef costs of production analysis and simulation of subsidy changes on farm results (European Commission, 2019).

Research

Research based on FADN increases the understanding of the productivity of the agricultural sector and of individual farms. Examples are productivity analyses, the optimal use of inputs, cost of production analyses and regional differences in the profitability of crops. FADN data is used as empirical background for testing different theoretical hypothesis.

Farmers

FADN provides valuable information for farmers for benchmarking and improving their profitability. The detailed feedback and benchmarking allow farmers to evaluate his farm management.

2.b.2.c. Marketing and price monitoring dashboard

The EC publishes throughout the year information on the price situation, markets developments for agricultural commodities and food. Several reports are issued with two temporal perspectives —short-term and medium-term. The short-term outlook is based on DG AGRI expert's reflections on the arable crop, meat and dairy markets in the EU. The medium-term outlook is issued once a year and it is "*a set of market and sector income prospects elaborated on the basis of specific assumptions regarding macroeconomic conditions, the agricultural and trade policy environment, weather conditions and international market developments*" (https://ec.europa.eu/info/food-farming-fisheries/trade/agriculture-markets-and-prices_en)

The evolution of the world and EU agricultural markets is examined with a series of reports covering global food supply and demand, organic imports, and global food security, amongst others (https://ec.europa.eu/info/food-farming-fisheries/farming/facts-and-figures/performance-agricultural-policy/studies-and-reports/market-analyses-and-briefs_en).

The evolution prices for the most representative products are monthly published in excel format and are available since January 1991. Nevertheless, since August 2020 all this information is accessible in an interactive way through the Agri-food data portal (https://agridata.ec.europa.eu/extensions/DataPortal/agricultural_markets.html)

The Agri-food data portal enables the accessibility to the data. The portal allows users to filter and compose interactive visualizations of the result. Apart from this visualization capability, it implements a tool for the user to download the bulk or filtered data in csv format.

2.b.2.d. Integrated Administration and Control System - Land Parcel Identification System (IACS - LPIS)

This system allows MS to control and manage, in a standardized way, the CAP income support to farmers. More precisely IACS ensures that transactions financed under the area and animal-based aid schemes are carried out correctly, prevents, discovers and follows up on irregularities, recovers unduly paid amounts and supports farmers in making correct

applications (https://ec.europa.eu/info/food-farming-fisheries/key-policies/common-agricultural-policy/financing-cap/financial-assurance/managing-payments_en).

IACS is based in four interconnected databases:

- Land Parcel Information System (LPIS): the identification system of agricultural parcels established on the basis of maps or land registry documents or other cartographic references. It makes use of Geographical Information System techniques (GIS of IACS).
- Geospatial aid Application (GSA): system that allows farmers to graphically indicate the agricultural areas for which they apply for support.
- Database for animals: for those countries where animal-based aid schemes apply.
- Integrated Control System: system which ensures systematic checks of aid applications. It is based on cross checks and physical on-farm controls (on-the spot checks).

Each MS operates and manages the IACS/LPIS through accredited Paying Agencies (PA).

IACS stores and manages all the information related to the payments of CAP aids at individual farm level which makes the system a valuable source of data for the CMEF. Moreover, LPIS links the payments to the territory and support the control of the area-based aid schemes.

2.b.2.e. Clearance Audit Trail System (CATS)

CATS is a very detailed database aimed at assisting the Commission services in carrying out audits of agricultural expenditure, and in particular the clearance of accounts. It stores data on the level of aid received, the areas and the number of animals concerned at beneficiary level. It also includes comprehensive annual data on products, inspections, export refunds and public storage.

CATS became operational in 2000 for audit and control of agriculture expenditure purposes but a legal amendment in 2002 (Commission Regulation (CE) No 419/2002) enabled CATS to be used for monitoring developments and providing forecasts in the agricultural sector.

The required information is collected by the responsible authorities in MS, PA, and then transmitted to the Commission services. The Commission gathers, processes and validates all data and make available a set of tables showing, for each Member State, the distribution of payments per size-class of aid received (European Commission, 2002).

2.b.3. Independent organizations

2.b.3.a. Birdlife International, European Bird Census Council and Scheme (EBCC) and the Pan-European Common Bird Monitoring Scheme (PECBMS)

BirdLife International is a global partnership of conservation organisations (NGOs) that strives to conserve birds, their habitats and global biodiversity, working with people towards sustainability in the use of natural resources(http://www.birdlife.org/).

The EBCC is an association under Dutch Law of like-minded expert ornithologists co-operating in a range of ways to improve bird monitoring and atlas work and thereby inform and improve the management and conservation of bird populations in Europe (https://www.ebcc.info/).

The Indices, trends and indicators computed by PECBMS can be interactively consulted in its Web site (https://pecbms.info/trends-and-indicators/indicators/). The set of main indicators for Europe and EU are freely available for download in its web site (https://pecbms.info/use-of-the-results/data-access-policy/). They can be download in Excel sheets format. These indices and indicators are also transmitted to Eurostat and published in the statistics database under Environment/Biodiversity dataset so that they are accessible in the same way as explained for Eurostat.

The information derived by PECBMS address one of the indexes on biodiversity under sustainable management of natural resources and climate action objective.

2.b.4. Related to EU

2.b.4.a. European Environment Agency (EEA) and European Environment Information and Observation Network (EIONET)

The EEA is an agency of the EU whose task is to provide sound, independent information on the environment. The EEA aims to support sustainable development by helping to achieve significant and measurable improvement in Europe's environment, through the provision of timely, targeted, relevant and reliable information to policymaking agents and the public (https://www.eea.europa.eu/about-us).

The environmental information provided by the EEA is organized in four main groups (https://www.eea.europa.eu/themes):

- Air and Climate: air pollution, climate change adaptation, climate change mitigation.
- Nature: biodiversity – ecosystems, land use, soil, water and marine environment.
- Sustainability and well-being: environment and health, policy instruments, resources efficiency and waste, sustainability transitions.
- Economic sectors: agriculture, energy, industry, transport.

Some of the data provided by the EEA are also stored in Eurostat's database. This is the case of some agri-environmental indicators such as ammonia emissions, greenhouse gas emissions, water abstraction in agriculture, biodiversity statistics or Common farmland birds in the EU (coming from PECBMS). Other agri-environmental indicators available through the EEA are: NATURA 2000 areas, land use change, genetic diversity and water quality nitrate pollution and pesticide pollution.

The EEA develops and coordinates the activities of The European environment information and observation network (Eionet). Eionet is a partnership network of the EEA and its member and cooperating countries providing high-quality trusted data, information and assessments for Europe (https://www.eea.europa.eu/about-us/countries-and-eionet).

The datasets that the EEA stored is accessible by two main means:

- EEA Dataservice with which the user can search and retrieve environmental datasets, maps, charts and applications (https://www.eea.europa.eu/data-and-maps).

- EEA geospatial catalogue which facilitates the discovery of the public geospatial datasets produced and/or published by the EEA (https://www.eea.europa.eu/data-and-maps).

Moreover, The EEA manages the Webmap services Discomap that allows developers to merge and join EEA services into other products (https://discomap.eea.europa.eu/Index/). Nevertheless, to have access to restricted and internal datasets an Eionet account is required.

2.c. Initiatives enhancing data sources for CAP Monitoring and Evaluation

Increasing concerns on agriculture sustainability brings forward the need of enhancing the scope of the variables collected by agriculture statistical surveys as FAND for evaluation purposes. Farm Level Indicators for New Topics in policy evaluation (FLINT) project, for instance, has showed the feasibility of collecting sustainability data at farm level. This project is called to ease the shift towards the Farm Sustainability Data Network (FSDN) promoted by the European Commission.

On the other hand, some initiatives as Copernicus services and LUCAS project have been delivering valuable data for CAP monitoring and evaluation purposes. Nevertheless, they offer now new and updated information that ease the measurement of the CAP performance in some relevant domains such as environment and climate. These initiatives will be cover in detail on other WP of this project.

2.c.1. Farm Level Indicators for New Topics in policy evaluation (FLINT)

FLINT addressed the need for data on the sustainability of agriculture, not only within the industry but especially among researchers and policy makers to monitor and evaluate the CAP with its cross-compliance, greening and rural development measures. (https://www.flint-fp7.eu/)

The project was created to test the feasibility of collecting sustainability data at farm level and to illustrate the value of this type of data to improve policy making (Poppe, Vrolijk, Dolman, & Silvis, 2016). In this sense, FLINT defined a list of relevant sustainability themes based on emerging policy needs, a literature review and a review of national initiatives to measure sustainability. The themes have been discussed with different stakeholder to evaluate the feasibility and usefulness of collecting farm level data on these themes. Finally, 31 themes were selected (see Figure 3), which have been translated into a list of data items to be collected at farm level.

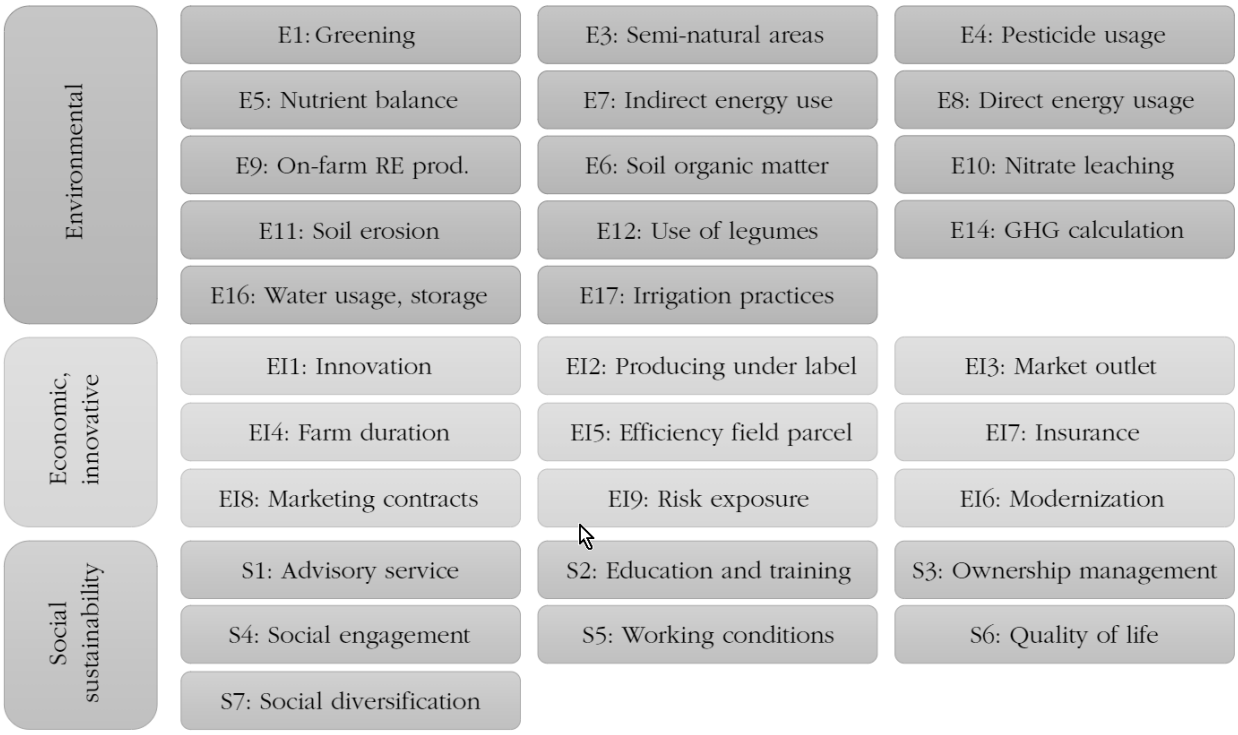

Figure 3: Sustainability themes as included in the FLINT data collection

The feasibility of collecting these data was tested by collecting the defined data items in 9 MS (Ireland, Netherlands, Germany, Poland, Finland, Hungary, Greece, Spain and France) on 1,100 farms of different farm types (Vrolijk, Poppe, & Keszthelyi, 2016). The results show that data collection is possible in the different administrative environments that MS face or have chosen to organize the national FADN. In general, the FLINT project showed positive experiences of collecting sustainability data, furthermore the project showed that farmers are willing to make the data available (Vrolijk, Poppe, & Keszthelyi, 2016).

The project has shown how policy analysis benefit from additional data with indicators on the sustainability performance of farms (profit, planet and people aspects). A number of cases was selected to illustrate different aspects of these new opportunities (i.e. comparison of sustainability performance between countries, trade-off between different sustainability indicators and the link between specific policy measures and the broader sustainability performance of farms).

FLINT has provided a significant contribution to the field of policy assessment relevant to the CAP by showing the feasibility of collecting farm level sustainability data and illustrating the added value of these data in a number of cases. This becomes even more relevant with the establishment of the Green Deal and Farm to Fork strategy aim to make food systems fair, healthy and environmentally-friendly. In this sense, the Farm to Fork strategy sets clear ambitions with respect to the increase in organic farming, and a reduction in pesticides, fertilizers and antibiotics. It also proposes the development of the Farm sustainability network in which the lessons learned from FLINT will be used. The future CAP will therefore show a higher level of ambition to mitigate environmental and climate impacts.

2.c.2. Copernicus

Copernicus is the EU's Earth observation programme and offers information services that draw from satellite Earth Observations (EO) and in-situ (non-space) data (https://land.copernicus.eu/). In the online workshop "Copernicus and the Common Agricultural Policy", held from 09/03/2021 to 10/03/2021, the following main contribution areas to the Common Agricultural Policy have been identified:

- Area Monitoring & Control System.
- Environment-Climate change.
- Farmers level support.

Especially relevant for the CAP Area Monitoring & Control System is the Copernicus Land Monitoring Service (CLMS) (https://land.copernicus.eu/). Products include the following datasets:

- Global: including products with moderate resolution (10-50 m) such as land cover, to medium resolution (250-500m) such as vegetation indices (FAPAR, VCI, DVI) and Leaf Area Index, or coarser (soil water index, surface soil moisture).
- Pan-European: includes CORINE Land Cover datasets, High Resolution Layers, CLC+.
- Local: e.g. Natura 2000.
- Imagery and reference data, including LUCAS (see next section).

New Copernicus Land Monitoring products are planned, including a new generation of Corine (CLC +), the High Resolution Layer Crop Types (HRL-Crop Types) and biophysical parameters, more specifically the High Resolution Vegetation Phenology and Productivity

Also relevant are the data provided through the Climate Change services, (https:/climate.copernicus.eu/) including climate historical data such as ERA-Interim, new seasonal forecasts, and the rich set of agroclimatic indicators: (https://cds.climate.copernicus.eu/cdsapp#!/dataset/sis-agroclimatic-indicators?tab=overview).

2.c.3. LUCAS

The Land Use and Coverage Area frame Survey (LUCAS) is an in-situ survey carried-out on a three-yearly basis since 2006. It aims at gathering harmonised information and assess changes in land use, land cover, landscape elements and environmental parameters, i.e.:

- For land use for instance, agriculture, forestry, recreation or residential use
- For land cover for instance crops, grass, broad-leaved forest, or built-up area

Surveyors also collect data on irrigation management and structural elements in the landscape. A topsoil (0–20 cm) sample is taken (not collected in every survey) at one out of 10 points and physical and chemical properties are analysed. Analyses are used to:

- assess environmental factors.
- update European soil maps.
- validate soil models.

- measure the quantity of organic carbon in the soil.

The latest published survey dates from 2018. It provides observations at more than 330.000 points surveyed in the 27 EU MS. Two level of information are obtained from LUCAS surveys:

- Micro-data (see data items above) with associated point and landscape photos in the 4 cardinal directions and soil data.
- Statistical tables with aggregated results by land cover and land use at geographical level. Estimates are based on weighted point data.

Aggregated data are available through the EUROSTAT data Portal (https://ec.europa.eu/eurostat/web/lucas/data) in Excel format.

Primary data are also available, including the micro-data above, soil data and point and landscape photos. In this case an ad-hoc request needs to be placed from the portal.

3. Conclusions and recommendations

This deliverable reviewed the elements that set up the CMEF for the CAP 2014-2020. The main data sources involved have been identified and described briefly. Additionally, the deliverable has extracted the findings from the EC's report assessing the CMEF performance as well as the conclusions from three ECA's reports on the efficiency of the data sources used to quantify the effects of CAP on farmer's income, on the effectiveness of Basic Payments Schemes and Greening measurements and, finally, on the use of new imaging technologies to monitor and control the area-based direct payment aids.

The CMEF stablishes a set of indicators whose value or its variation enables the CAP monitoring and evaluation process. The indicators are grouped by the level of the policy they aim to measure. Thus, context indicators give the necessary background to understand the signals derived from the impact indicators which are meant to inform on the accomplishment of CAP general objectives. The data required for these indicators are typically collected at national and/or regional level, following statistical methods and then aggregated at European and/or world level. The number of data sources involved in their calculation varies and those aimed at measuring the environmental effects of the Policy usually require a broader range of sources than those focused on the social-economic aspects.

Other indicators are meant to give information on direct outputs and results of the Policy. Therefore, as CAP is split into two Pillars, output indicators give information on both Pillar I instruments and Pillar II measures, while results indicators inform on Pillar I specific objectives and Pillar II priorities. Due to the nature of output indicators, they mainly collect the required information from administrative databases which keep records of the individual beneficiaries information applying for CAP support. Result indicators, in addition to administrative databases, also make use of statistical data sources.

Given de above, the output indicators to monitor and evaluate Pillar I measurements make use of the information stored in the Clearance Audit Trail System (CATS) and in the Information System for Agriculture Refund Expenditure (AGREX) while Pillar I result indicators use, among others, the information from FADN and Eurostat's EAA. In this regard, the European Court of Auditors (2016) report remarks that both FADN and EAA do not measure disposable income of farm households, "*which would facilitate assessing the achievement of the treaty objective of ensuring a fair standard of living for farmers*".

As for Pillar II output indicators, on the one hand, they use the information stored in the administrative databases such as the PA database of payments, the IACS and the records at operational level. On the other hand, result/target indicators need to combine both administrative databases such as PA/MA operation databases and IACS and statistical data such as Eurostat's FSS and FADN. Nevertheless, the evaluation of priorities' achievement under Pillar II, that is to say RDP, sometimes requires additional information that is not embedded in any of the CMEF indicators. Apart from these data gaps, the European Commission (2018b) highlights the impact on the timing and frequency of data (indicators) availability for monitoring and evaluation.

The European Commission (2018b) also gives some insights on what the new Performance Monitoring and Evaluation Framework will require in terms of data acquisition. The future indicators set is expected to be better focused "*to reflect as closely as possible whether the supported interventions contribute to achieving the objectives*", therefore it should prioritize the use of more accurate data to assess the contribution of CAP interventions going beyond available data.

The Commission also expects that data sharing between existing sources and new technologies will enhance future data availability. Regarding the use of new technologies for data acquisition the European Court of Auditors (2020) remarks the potential benefits they could bring, not only to administration (in the scope of the report, PA) by reducing administrative burden but also to farmers who, additionally to this burden reduction, could benefit from obtaining up-to-date information on their holdings. Nevertheless, this report also concludes that there is a "*Slower progress in meeting the challenge of using new technologies to monitor environmental and climate requirements*".

Based on the review in this deliverable, we gather the following conclusions that could settle the baselines for the potential data sources:

- Data sources and data acquisition technologies must provide with the adequate information for indicators to capture well the effects of the Policy they try to quantify, otherwise the indicator value could lead to a wrong conclusion.
- To be useful for evaluation and monitoring purpose, data sources must provide not only adequate information but also provide it timely for indicator requirements.
- Statistical data sources, even when delivering valuable information for monitoring and evaluation, need to enhance their scope and methodologies to better address the new data needs in the PMEF.
- Administrative databases need to be ready to store new data coming from different data acquisition technologies spanning different domains (economics or environment, for instances).
- Improving the interoperability and, to the extent possible, the harmonization of administrative and statistical databases would exploit the synergies between them for monitoring and evaluation purposes while reducing the collection burden in terms of time (for farmers and surveyors) and costs.

References

Andersson, A., Höjgård, S., & Rabinowicz, E. (2017). Evaluation of results and adaptation of EU Rural Development Programmes. *Land Use Policy, 67*, 298-314. doi:https://doi.org/10.1016/j.landusepol.2017.05.002

Castaño, J., Blanco , M., & Martinez, P. (2019). Reviewing Counterfactual Analyses to Assess Impacts of EU Rural Development Programmes: What Lessons Can Be Learned from the 2007–2013 Ex-Post Evaluations. *Sustainability, 11*(4), 1105. doi:https://doi.org/10.3390/su11041105

Courtney, P., & Powell, J. (2020). Evaluating Innovation in European Rural Development Programmes: Application of the Social Return on Investment (SROI) Method. *Sustainability 2020, 12*(7), 2657. doi:https://doi.org/10.3390/su12072657

European Commission. (2000a). *Manual on the Economic Accounts for Agriculture and Forestry EAA/EAF 97 (Rev. 1.1).* Luxembourg: Office for Official Publications of the European Communities. Retrieved from https://ec.europa.eu/eurostat/web/products-manuals-and-guidelines/-/ks-27-00-782

European Commission. (2000b). *Target methodology for agricultural labour input (ALI) statistics (Rev. 1).* Luxembourg:: Offece for Official Publications of the European Communities. doi:ISBN:92-894-0108-7

European Commission. (2002). REPORT FROM THE COMMISSION TO THE COUNCIL AND THE EUROPEAN PARLIAMENT PARLIAMENT on the establishment of a database on payments under the Guarantee Section of the European Agricultural Guidance and Guarantee Fund. *Brussels, 25.06.2002 COM(2002) 339 final*. Retrieved from https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52002DC0339&from=EN

European Commission. (2013). Overview of CAP Reform 2014-2020. Agricultural Policy Perspectives Brief, No.5. *Agricultural Policy Perspectives Brief*(5).

European Commission. (2015b). COMMISSION STAFF WORKING DOCUMENT final Better Regulation Guidelines. *Brussels, COM (2015) 215 final*. Retrieved from http://edz.bib.uni-mannheim.de/edz/pdf/swd/2015/swd-2015-0111-en.pdf

European Commission. (2015c). *Common evaluation questions for rural development programmes 2014-2020.* Retrieved from European Network for Rural Development: https://enrd.ec.europa.eu/sites/default/files/uploaded-files/wp_evaluation_questions_2015.pdf

European Commission. (2017). *Technical handbook on the monitoring and evaluation framework of the common agricultural policy 2014 – 2020.* Retrieved from Common monitoring and evaluation framework: https://ec.europa.eu/info/sites/info/files/food-farming-fisheries/key_policies/documents/technical-handbook-monitoring-evaluation-framework_june17_en.pdf

European Commission. (2018a). REGULATION OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL establishing rules on support for strategic plans to be drawn up by Member States under the Common agricultural policy (CAP Strategic Plans) and financed by the European Agricultural Guarantee Fund. *Brussels, 1.6.2018*

COM(2018) 392 final. Retrieved from https://ec.europa.eu/transparency/regdoc/rep/1/2018/EN/COM-2018-392-F1-EN-MAIN-PART-1.PDF

European Commission. (2018b). REPORT FROM THE COMMISSION TO THE EUROPEAN PARLIAMENT AND THE COUNCIL on the implementation of the Common Monitoring and Evaluation Framework and first results on the performance of the Common Agricultural Policy. *Brussels, 5.12.2018 COM(2018) 790 final*. Retrieved from https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52018DC0790&from=EN

European Commission. (2019). Ongoing analyses using FADN data. *Committee for the Farm Accountancy Data Network (FADN), Brussels, 02 October 2019*.

European Commission. (2020a). *Agricultural product and input price statistics. Handbook 2020 Edition*. Retrieved from https://ec.europa.eu/eurostat/cache/metadata/Annexes/apri_ap_esms_an1.pdf

European Commission. (2020b). *Annual crop statistics Handbook. 2020 Edition.* Retrieved from https://ec.europa.eu/eurostat/cache/metadata/Annexes/apro_cp_esms_an1.pdf

European Commission. (2020c). *Integrated farm statistics manual. 2020 edition.* Luxembourg: Publications Office of the European Union. doi:10.2785/03054

European Commission. (2020d). REPORT FROM THE COMMISSION TO THE EUROPEAN PARLIAMENT AND THE COUNCIL 13th FINANCIAL REPORT FROM THE COMMISSION TO THE EUROPEAN PARLIAMENT AND THE COUNCIL on the EUROPEAN AGRICULTURAL GUARANTEE FUND 2019 FINANCIAL YEAR. *Brussels, 2.9.2020 COM(2020) 475 final {SWD(2020) 168 final}*. Retrieved from https://eur-lex.europa.eu/resource.html?uri=cellar:0738293a-ee8a-11ea-991b-01aa75ed71a1.0013.02/DOC_1&format=PDF

European Commission. (2021, March). *Glossary:Farm structure survey (FSS) - Statistics Explained*. Retrieved from https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Glossary:Farm_structure_survey_(FSS)

European Court of Auditors. (2016). *Is the Commission's system for performance measurement in relation to farmers' incomes well designed and based on sound data?* Luxembourg: Publications Office of the European Union. doi:10.2865/06260

European Court of Auditors. (2017). *Greening: a more complex income support scheme, not yet environmentally effective.* Luxembourg: Publications Office of the European Union. Retrieved from https://www.eca.europa.eu/Lists/ECADocuments/SR17_21/SR_GREENING_EN.pdf

European Court of Auditors. (2018). *Basic Payment Scheme for farmers – operationally on track, but limited impact on simplification, targeting and the convergence of aid levels.* Luxembourg: Publications Office of the European Union. Retrieved from https://www.eca.europa.eu/Lists/ECADocuments/SR18_10/SR_BPS_EN.pdf

European Court of Auditors. (2020). *Using new imaging technologies to monitor the Common Agricultural Policy: steady progress overall, but slower for climate and*

environment monitoring. Spectial Report 04. Luxembourg: Publications Office of the European Union. doi:10.2865/46869

European Environment Agency. (2005). Agriculture and environment in EU-15 — the IRENA indicator report. *EEA Report, Luxembourg: Office for Official Publications of the European Communities, 2005*(No 6/2005). doi:ISBN 92-9167-779-5

Katalin, T., & Andrius, K. (2016). Spatial information in European agricultural data management. Requirements and interoperability supported by a domain model. *Land Use Policy, 57*, 64-79. doi:https://doi.org/10.1016/j.landusepol.2016.05.023

Meixner, O., Schlögl, F., & Pichlbauer, M. (2020). Evaluation of the Economic Impacts of the European Rural Development Program in Austria. *International Journal on Food System Dynamics 11 (2)*, 88-100. doi:http://dx.doi.org/10.18461/ijfsd.v11i2.42

OECD-DAC. (2002). *GLOSSARY OF KEY TERMS IN EVALUATION AND RESULTS BASED MANAGEMENT.* Retrieved from Evaluation of development programmes: https://www.oecd.org/dac/evaluation/2754804.pdf

Poppe, K., Vrolijk, H., Dolman, M., & Silvis, H. (2016). FLINT Farm-level Indicators for New Topics in policy evaluation: an introduction. *Studies in Agricultural Economics 118 (3)*, 116-122.

Vrolijk, H., Poppe, K., & Keszthelyi, S. (2016). Collecting sustainability data in different organisational settings of FADN in Europe. *Studies in Agricultural Economics 118 (3)*, 138-144.

Wieliczko, B. (2020). Suitability Of Complexity Economics For Long-Term Agricultural Policy-Making. *Problems of Agricultural Economics, 3(364) 2020* , 18-30.

Appendices

Appendix 1: Summary of the data sources used for CMEF indicator

Table 7: Context indicators and data sources

INDICATORS				ENTITY-DATA SOURCE														
TYPE	CONTEXT ID	IMPACT ID	NAME	Eurostat	Commission	Forest Europe	UNECE	FAO	European Environment Agency (EEA)	Copernicus	European Bird Census Council (EBCC)	national/ regional data	IACS/LPIS	Joint Research Centre	EurObserv'ER	European Biodiesel Board	Stratégie grains	UNFCCC
Socio-economic	C01		Population	Demography and migration Demography statistics by other typologies														
	C02		Age structure	Demography and migration Demography statistics by other typologies														
	C03		Territory	Demography and migration Demography statistics by other typologies														
	C04		Population density	Demography and migration Demography statistics by other typologies														
	C05	I14	Employment rate	Labour Force Survey														
	C06		Self-employment rate	Labour Force Survey														
	C07		Unemployment rate	Labour Force Survey														
	C08	I16	GDP per capita	National and Regional Economic Accounts Regional statistics by typology Mid-Predominantly-rural typology														
	C09		Poverty rate	Survey on income and living conditions Degree of urbanisation														
	C10		Structure of the economy	National and Regional Economic Accounts														
	C11		Structure of employment	Labour Force Survey Regional Economic Accounts Mid-Predominantly-rural typology														
	C12		Labour productivity by economic sector	National and Regional Economic Accounts Mid-Predominantly-rural typology														
Sectorial	C13		Employment by economic activity	Labour Force Survey														
	C14		Labour productivity in agriculture	Economic Accounts for Agriculture Agricultural Labour Input Statistics														
	C15		Labour productivity in forestry	Economic accounts for forestry and logging Annual work units in forestry and logging														
	C16		Labour productivity in the food industry	National Accounts Labour Force Survey														
	C17		Agricultural holdings (farms)	Farm Structure Survey														
	C18		Agricultural area	Crop production														
	C19		Agricultural area under organic farming	Organic farming Farm Structure Survey														
	C20		Irrigated land	Farm Structure Survey														
	C21		Livestock units	Farm Structure Survey														
	C22		Farm labour force	Farm Structure Survey														
	C23		Age structure of farm managers	Farm Structure Survey														
	C24		Agricultural training of farm managers	Farm Structure Survey														
	C25	I02	Agricultural factor income	Economic Accounts for Agriculture Agricultural Labour Input Statistics														
	C26	I01	Agricultural entrepreneurial income	Economic Accounts for Agriculture Agricultural Labour Input Statistics National Accounts														
	C27	I03	Total factor productivity in agriculture	Economic Accounts for Agriculture Agricultural Production Data Farm Structure Survey	FADN[1]													
	C28		Gross fixed capital formation in agriculture	Economic Accounts for Agriculture National Accounts														
	C29		Forest and other wooded land (FOWL)	Forestry statistics		State of Europe's Forests Report													
	C30		Tourism infrastructure	Tourism statistics														
Environment	C31		Land Cover						https://www.eea.europa.eu/data-and-maps/dataviewers/land-monitoring-service-score	CORINE Land Cover 2018								
	C32		Areas facing natural and other specific constraints - ANCs	Total UAA	Data reported by Member States (programming period 2014-2020)													
	C33		Farming intensity	Agriculture prices and price indices Farm Structure Survey	FADN[1]													
	C34		Natura 2000 areas						Natura 2000 Barometer statistics Natura 2000 data	CORINE Land Cover 2018								
	C35	I08	Farmland birds index (FBI)	Environment statistics, Biodiversity							Pan-European Common Bird Monitoring Scheme (PECBMS)							
	C36		Conservation status of agricultural habitats (grassland)							CORINE Land Cover 2018	Conservation status of habitat types and species European Environment Information and Observation Network							
	C37	I09	HNV (high nature value) farming	Farm Structure Survey						CORINE Land Cover 2018		Agricultural census data species and habitat distribution specific sampling surveys RDP monitoring data designations (ie.- NATURA.)	[2]IACS/[3]LPIS					
	C38		Protected forest			State of Europe's Forests Report													
	C39	I10	Water abstraction in agriculture	Environment and energy – Water statistics on national level Agro-environmental indicator (AEI) 20														
	C40	I11	Water quality	Agri-environmental indicators, Pressure and Risks					Nutrients in freshwater									
	C41	I12	Soil organic matter in arable land											LUCAS dataset map of the topsoil organic carbon of Europe European Soil Data Centre (ESDAC)				
	C42	I13	Soil erosion by water	Agri-environmental indicators								studies, surveys, reports						
	C43		Production of renewable energy from agriculture and forestry	Energy Statistics											Data on biogas	Data on biodiesel	Data on bioethanol	
	C44		Energy use in agriculture, forestry and food industry	Energy balances Crop Production Land Use, Land Use Change and forestry				Land Use, Land Use Change and forestry - Area of wooded land										
	C45		Emissions from agriculture	Environment					Annual EU GHG inventory Ammonia emissions from agriculture									National Inventory Submissions 2018

[1]**FADN**: Farm Accountacy Data Network [2]**IACS**: Integrated Administration and Control System [3]**LPIS**: Land Parcel Identification System

Table 8: Impact Indicators and data sources

INDICATORS			ENTITY-DATA SOURCE										
OBJECTIVE	INDICATOR	NAME	Eurostat	Commission	FAO	international sources	UNFCCC	European Environment Agency	European Bird Census Council (EBCC)	Copernicus	IACS/ LPIS	National/ Regional data	Joint Reseach Centre
Viable food production	I01	Agricultural entrepreneurial income	Economic Accounts for Agriculture Agricultural Labour Input Statistics National Accounts										
	I02	Agricultural factor income	Economic Accounts for Agriculture Agricultural Labour Input Statistics										
	I03	Total factor productivity in agriculture	Economic Accounts for Agriculture Agricultural Production Data Farm Structure Survey	[1]FADN									
	I04	EU commodity price variability		EU prices from AMIS through AGRIVIEW	FAOSTAT	dairy.ahdb.org.uk www.pecuaria.com.br www.feedstuffs.com London International Financial Futures and Options Exchange							
	I05	Consumer price evolution of food products	Harmonised Indices of Consumer Prices (HICP)										
	I06	Agricultural trade balance	External Trade database (COMEXT)										
Sustainable management of natural resources and climate action	I07	Emissions from agriculture					National Inventory Submissions 2019	Annual EU GHG inventory Ammonia emissions from agriculture					
	I08	Farmland bird index	Environment statistics, Biodiversity						Pan-European Common Bird Monitoring Scheme (PECBMS)				
	I09	High nature value (HNV) farming	Farm Structure Survey							CORINE and land cover data	[2]IACS/ [3]LPIS	Agricultural census data Species and habitat databases Specific sampling surveys RDP monitoring data designations	
	I10	Water abstraction in agriculture	Environment and energy Agri-environmental indicator										
	I11	Water quality	Agri-environmental indicators, Pressure and Risks Gross nutrient balance					Nutrients in freshwater					
	I12	Soil organic matter in arable land											LUCAS map of the topsoil organic carbon content of Europe
	I13	Soil erosion by water	Agri-environmental indicators									studies, surveys, reports	European Soil Data Centre (ESDAC)
Balanced territorial development	I14	Rural employment rate	Labour Force Survey										
	I15	Degree of rural poverty	Income and living conditions										
	I16	Rural GDP per capita	National and Regional Economic Accounts Regional statistics by typology										

[1]**FADN**: Farm Accountacy Data Network [2]**IACS**: Integrated Administration and Control System [3]**LPIS**: Land Parcel Identification System

Table 9: Result indicators Pillar I

	INDICATORS		ENTITY-DATA SOURCE						
OBJECTIVE	RESULT ID	NAME	Eurostat	Global Trade Atlas	FAO	USDA	European Central Bank	Commission	European Environmental Agency
Enhance farm income	R.01_PI	Share of direct support in agricultural income	Economic Accounts for Agriculture					EU budget data on financial years (DG AGRI)	
	R.02_PI	Variability of farm income						[1]FADN	
Improve agricultural competitiveness	R.03_PI	Value added for primary producers in the food-chain	Economic accounts for agriculture Structural business						
	R.04_PI	EU agricultural trade	Comext database economic accounts for agriculture prodcom	Export -> EU28 / world Import -> EU28, Canada, China, Japan, Russia, United States					
Maintain market stability	R.05_PI	Public intervention: % volume of products bought in intervention storage out of total EU production	Agricultural production					Member to DG AGRI [2]ISAMM database (volumes of public storage)	
	R.06_PI	Private storage: % volume of products exported in private storage out of total EU production	EU production for respective products					Member to DG AGRI [2]ISAMM database (volumes of public storage)	
	R.07_PI	Export refunds: % volume of products exported with export refunds out of total EU production	final production for respective products					Member to DG AGRI [2]ISAMM database (volumes of public storage)	
	R.08_PI	EU commodity prices compared to world prices			Food Price Monitoring and Analysis Tool (FPMA)	http://www.usda.gov/wps/portal/usda/usdahome	Exchange Rates Monthly EUR/USD	Member to DG AGRI EU prices	
Meet consumer expectations	R.09_PI	Value of production under EU quality schemes compared to total value of agricultural and food production						External study commissioned by the Commission	
	R.10_PI	Importance of organic farming	Share of organic area in total UAA Share of organic livestock in total livestock						
Provide environmental public goods (climate change mitigation and adaptation)	R.11_PI	Crop diversity	Farm Structure Survey						
	R.12_PI	Share of grassland in total UAA	Crop statistics						
	R.13_PI	Share of EFA in agricultural land	total arable land					Member States notifications [2]ISAMM database or Agriview (the number of hectares of EFA)	
	R.14_PI	Share of area under greening practices	Crop statistics for UAA					Member States notifications [2]ISAMM database or Agriview (Output indicators for greening and greening exemptions)	
	R.15_PI	Net greenhouse gas (GHG) emissions from agricultural soils							Annual EU GHG inventory CO2 emissions from agricultural soils
Maintain diverse agriculture	R.16_PI	Structural diversity	Farm Structure Survey						

[1]**FADN:** Farm Accountacy Data Network [2]**ISAMM:** Information System for Agricultural Market Management and Monitoring

Table 10: Output indicators Pillar I

	INDICATORS			ENTITY-DATA SOURCE				
	INSTRUMENTS	INDICATOR ID	INDICATOR NAME	[1]CATS	Member State notifications	Output indicators	Internal calculation DG AGRI	Eurostat
Direct payments	Basic payment scheme	O.01_PI	Number of farmers	✓				
		O.02_PI	Number of hectares	✓				
	Single area payment scheme	O.03_PI	Number of farmers	✓				
		O.04_PI	Number of hectares		Regulation (EU) No 639/2014			
	Transitional national aid (TNA)	O.05_PI	Number of farmers					
		O.06_PI	Number of units for which TNA is granted (hectares / animals / other)					
	Redistributive payment	O.07_PI	Number of farmers	✓				
		O.08_PI	Number of hectares	✓				
	Greening	O.09_PI	Total number of farmers who have to apply at least one greening obligation		Regulation (EU) No 639/2014			
		O.10_PI	Total number of hectares declared by those farmers					
	Greening exemptions	O.11_PI	Number of farmers exempted by: organic farmers / exempted from crop diversification / exempted from EFA obligation					
		O.12_PI	Number of hectares declared by these farmers (organic farmers, exempted from crop diversification, exempted from EFA obligation)					
	Crop diversification	O.13_PI	Number of farmers subject to crop diversification (with 2 crops; with 3 crops)					
		O.14_PI	Number of hectares of arable land declared by farmers subject to crop diversification (with 2 crops; with 3 crops)					
	Permanent grassland	O.15_PI	Number of farmers with permanent grassland counting for the ratio					
		O.16_PI	Number of hectares covered by permanent grassland declared by the farmers counting for the ratio					
		O.17_PI	Number of farmers with permanent grassland in designated environmentally sensitive areas					
		O.18_PI	Number of hectares covered by environmentally sensitive permanent grassland declared by these farmers					
		O.19_PI	Number of hectares of designated as environmentally sensitive permanent grassland (total)					
	Environmental Focus Area	O.20_PI	Number of farmers subject to EFA requirements					
		O.21_PI	Number of hectares of arable land declared by farmers subject to EFA					
		O.22_PI	Number of hectares declared by farmers as EFA, broken down by EFA type					
	Equivalence	O.23_PI	Number of farmers applying equivalent measures (certification schemes or agri-environment-climate measures)					
		O.24_PI	Number of hectares declared by farmers implementing equivalent measures (certification schemes or agri-environment-climate measures)					
	Payment for young farmers	O.25_PI	Number of farmers	✓				
		O.26_PI	Number of hectares	✓				
	Small farmers' scheme	O.27_PI	Number of farmers	✓				
		O.28_PI	Number of hectares	✓				
	Voluntary coupled support	O.29_PI	Number of beneficiaries of voluntary coupled support (broken down by sector)	✓				
		O.30_PI	Quantities eligible (number of hectares/ number of animals broken down by sector)	✓				
		O.31_PI	Number of hectares	✓				
		O.32_PI	Number of animals	✓				
	Payment for areas with natural constraints	O.33_PI	Number of farmers	✓				
		O.34_PI	Number of hectares	✓				
	National programmes for the cotton sector	O.35_PI	Number of farmers	✓				
		O.36_PI	Number of hectares	✓				
Market measures Indicator	Public intervention	O.37_PI	Volume put in intervention in Year N		Regulation (EU) No 2016/1240			
		O.38_PI	Duration					
	Private storage	O.39_PI	Volume		Regulation (EU) No 2016/1240			
		O.40_PI	Duration					
	Export refunds	O.41_PI	Volume of products exported with export refunds		Regulation (EU) No 612/2009			
	Exceptional measure	O.42_PI						
	Producer organisations	O.43_PI	% of production marketed by producer organisations and associations of producer organisations					
	School schemes	O.44_PI	Number of final beneficiaries of school milk scheme		Regulation (EU) No 657/2008			
		O.45_PI	Number of final beneficiaries of school fruit scheme					
	Wine sector	O.47_PI	Number of hectares of new vine plantings		Regulation (EU) No 2015/561			
		O.48_PI	Number of hectares of restructured vineyards					
		O.49_PI	Number of promotion projects in the wine sector		Regulation (EU) No 2016/1150			
		O.50_PI	Number of projects of investment and innovation measures					
Horizontal aspects Indicator	Cross compliance	O.51_PI	Number of hectares subject to cross-compliance			✓		
		O.52_PI	Share of CAP payments subject to cross-compliance				✓	
	Quality policy	O.53_PI	Total number of new GI - wine				✓	
		O.54_PI	Total number of new GI - food				✓	
			Total number of new GI – spirit drinks					
	Organic farming	O.54_PI	Number of hectares (total and under conversion)					organic farming statistics
		O.55_PI	Number of certified registered organic operators					organic farming statistics
	Promotion policy	O.56_PI	Number of programmes (in and outside the EU)					
		O.57_PI	Number of new proposing organisations					
	Farm Advisory system	O.58_PI	Number of farmers advised		Regulation EU (No) 1308/2013			

[2]**CATS**: Clearance Audit Trail System

Table 11: Output indicators Pilar II and data sources

INDICATORS				ENTITY-DATA SOURCE						
ID	NAME	TITLE	[1]MEASURES	Application form	Payment claims	[3]PA database of payments	[4]IACS	[2]MA, Annual reporting from risk management tool manager	[2]MA, reporting from [5]LAG	[2]MA, reporting from [6]NRN
O.1	Total public expenditure	Total amount of expenditure (EAFRD + other public)	All measures	For commitments	✓	✓				
O.2	Total investment	Sum of all public and private expenditure (eligible expenditure only) of all the tangible and/or intangible investments made for operations supported under a particular investment measure/sub-measure.	4, 5, 6.4, 7.2 to 7.8, 8.5 and 8.6	✓						
O.3	Number of actions/operations supported	Number of operations supported	1, 2, 4, 6, 7, 8.5 and 8.6, 9, 17.2 and 17.3	✓						
O.4	Number of holdings/beneficiaries supported	Number of holdings/beneficiaries supported	3.1, 4.1, 5, 6, 8.1 to 8.4, 11, 12, 13, 14, 17.1	✓						
O.5	Total area (ha)	Area (ha) : area supported	4, 8.1 to 8.5, 10.1, 11, 12, 13, 15.1	✓	✓		✓			
O.6	Physical area supported (ha)	Physical area supported (ha)	10.1	✓			✓			
O.7	Number of contracts supported (ha)	Number of contracts supported	10, 15	✓						
O.8	Number of Livestock Units supported (LU)	Number of LU supported	14, 4	✓						
O.9	Number of holdings participating in supported schemes	Number of holdings participating in supported schemes	9, 16.4, 17.2 and 17.3	Plus confirmation amendment on completion of the operation						
O.10	Number of farmers benefiting from pay-outs	Number of farmers benefiting from pay-outs/compensation	17.2 and 17.3					✓		
O.11	Number of training days given	Number of training days given	1.1	Plus confirmation amendment on completion of the operation						
O.12	Number of participants in trainings	Number of participants in trainings	1.1	Plus confirmation amendment on completion of the operation						
O.13	Number of beneficiaries advised	Number of beneficiaries advised	2.1	Plus confirmation amendment on completion of the operation						
O.14	Number of advisors trained	Number of advisors trained	2.3	Plus confirmation amendment on completion of the operation						
O.15	Population benefiting from improved services/infrastructures (IT or others)	Total population benefiting from improved services/infrastructures (broadband, other ICT or others)	7	Plus confirmation amendment on completion of the operation						
O.16	Number of EIP groups supported, number of EIP operations supported and number and type of partners in EIP groups	Number of EIP operations and type of partners in EIP groups	16	✓						
O.17	Number of cooperation operations supported (other than EIP)	Number of cooperation operations supported (other than EIP)	16	✓						
O.18	Population covered by LAG	Population covered by LAG	19						✓	
O.19	Identification number of LAG	Identification number of LAG	19						✓	
O.20	Number of LEADER projects suported	Number of LEADER projects supported	19						✓	
O.21	Number of cooperation projects supported	Number of cooperation projects supported	19						✓	
O.22	Number and type of project promoters	Number and type of project promoters	19						✓	
O.23	Unique identification number of LAG involved in cooperation projects	Unique number of LAG involved in cooperation projects	19						✓	
O.24	Number of thematic and analytical exchanges set up with the support of NRN	Number of thematic and analytical exchanges set up with the support of NRN, by type	Networking							✓
O.25	Number of NRN communication tools	Number of NRN communication tools, by type	Networking							✓
O.26	Number of ENRD activities in which the NRN has participated	Number of ENRD activities in which the NRN has participated	Networking							✓

[1]The **measures** in this column refer to COMMISSION IMPLEMENTING REGULATION (EU) No 808/2014 of 17 July 2014 **[2]MA:** Managing Aothority **[3]PA:** Paying Agency **[4]IACS:** Integrated Administration and Control System
[5]LAG: Local Acción Group **[6]NRN:** NationalRural Network

Table 12: Result/Target indicators and data sources

INDICATORS				ENTITY-DATA SOURCE				
PRIORITY	RESULT ID	TARGET ID	NAME	Eurostat	[5]MA/[6]PA operations database	[1]IACS	regional/national statistics	Application forms of LEADER projects transferred from [2]LAGs to MA
Fostering knowledge transfer and innovation in agriculture, forestry and rural areas		T1	Percentage of expenditure under Articles 14, 15 and 35 of Regulation (EU) No 1305/2013 in relation to the total expenditure for the RDP		✓			
		T2	Total number of co-operation operations supported under the co-operation measure (Article 35 of Regulation (EU) No 1305/2013) (groups, networks/clusters, pilot projects…)		✓			
		T3	Total number of participants trained under Article 14 of Regulation (EU) No 1305/2013		✓			
Enhancing farm viability and competitiveness of all types of agriculture in all regions and promoting innovative farm technologies and the sustainable management of forests	R1	T4	Percentage of agriculture holdings with RDP support for investment in restructuring or modernisation	Farm Structure Survey	✓			
	R3	T5	Percentage of agriculture holdings with RDP supported business development plan/investments for young farmers	Farm Structure Survey	✓			
Promoting food chain organisation, including processing and marketing of agricultural products, animal welfare and risk management in agriculture	R4	T6	Percentage of agricultural holdings receiving support for participating in quality schemes, local markets and short supply circuits, and producer groups/organisations	Farm Structure Survey	✓			
	R5	T7	Percentage of farms participating in risk management schemes	Farm Structure Survey	✓			
Restoring, preserving and enhancing ecosystems related to agriculture and forestry	R7	T9	Percentage of agricultural land under management contracts supporting biodiversity and/or landscapes	Total agricultural land area In base year for the RDP area	✓	✓		
	R8	T10	Percentage of agricultural land under management contracts to improve water management		✓			
	R10	T12	Percentage of Agricultural land under management contracts to improve soil management and/or prevent soil erosion		✓			
	R6	T8	Percentage of forest or other wooded areas under management contracts supporting biodiversity	Total forestry and wooded land area In 2013 for the RDP area	✓	✓		
	R9	T11	Percentage of forestry land under management contracts to improve water management		✓			
	R11	T13	Percentage of forestry land under management contracts to improve soil management and/or prevent soil erosion		✓			
Promoting resource efficiency and supporting the shift towards a low carbon and climate resilient economy in agriculture, food and forestry sectors	R12	T14	Percentage of irrigated land switching to more efficient irrigation systems	Total irrigated land in a base year	✓	✓		
		T15	Total investment in energy efficiency		✓			
		T16	Total investment in renewable energy production		✓			
	R16	T17	Percentage of Livestock Units (LU) concerned by investments in livestock management in view of reducing GHG and/or ammonia emissions		✓		✓	
	R17	T18	Percentage of agricultural land under management contracts targeting reduction of GHG and/or ammonia emissions	Total agricultural land	✓	✓		
	R20	T19	Percentage of agricultural and forest land under management contracts contributing to carbon sequestration and conservation	Total agricultural and forest land area	✓	✓		
Promoting social inclusion, poverty reduction and economic development in rural areas	R21	T20	Jobs created in supported projects					✓
	R22	T21	Percentage of rural population covered by local development strategies				✓	✓
	R24	T23	Jobs created in supported projects					✓
	R23	T22	Percentage of rural population benefiting from improved services / infrastructures		✓		✓	
	R25	T24	Percentage of rural population benefiting from new or improved services / infrastructures (ICT)		✓		✓	

[1]**IACS**: Integrated Administration and Control System [2]**LAG**: Local Acción Group [3]**NRN**: NationalRural Network [4]**RDP**: Rural Development Program [5]**MA**: Managing Authorities [6]**PA**: Paying Agencies

Table 13: Complementary result indicators and data sources

INDICATOR			ENTITY-DATA SOURCE				
PRIORITY	RESULT ID	NAME	Eurostat	Commision DG AGRI	[4]MA/[5]PA	Others	TRANSMISION
Enhancing farm viability and competitiveness of all types of agriculture in all regions and promoting innovative farm technologies and the sustainable management of forest	R2	Change in agricultural output on supported farms/ AWU	Farm Structure Survey	[2]FADN	Operations database	National census	Enhanced [1]AIR 2017 Enhanced AIR 2019 Ex-post evaluation report
Promoting resource efficiency and supporting the shift towards a low carbon and climate resilient economy in agriculture, food and forestry sectors	R13	Increase in efficiency of water use in agriculture in RDP supported projects			Operations database	Collected from beneficiaries by evaluators	Enhanced [1]AIR 2017 Enhanced AIR 2019 Ex-post evaluation report
Promoting resource efficiency and supporting the shift towards a low carbon and climate resilient economy in agriculture, food and forestry sectors	R14	Increase in efficiency of energy use in agriculture and food processing in Rural Development Program supported projects		[2]FADN	Operations database, information from the completed project	International Energy Agency	Enhanced [1]AIR 2017 Enhanced AIR 2019 Ex-post evaluation report
Promoting resource efficiency and supporting the shift towards a low carbon and climate resilient economy in agriculture, food and forestry sectors	R15	Renewable energy production from supported projects			Operations database, information from the completed project	International Energy Agency	Enhanced [1]AIR 2017 Enhanced AIR 2019 Ex-post evaluation report
Promoting resource efficiency and supporting the shift towards a low carbon and climate resilient economy in agriculture, food and forestry sectors	R18	Reduced emissions of methane and nitrous oxide			Operations database, information from the completed project	Nationalemission inventories Specific research projects [3]IPCC	Enhanced [1]AIR 2017 Enhanced AIR 2019 Ex-post evaluation report

[1]**AIR**: Annual Implementation Report [2]**FADN**: Farm Accountancy Data Network [3]**IPCC**: Intergovernmental Panel on Climate Change [4]**MA**: Managing Authorit [5]**PA**: Paying Agency

Appendix 2: Indicators involved in Common Evaluation Questions for Rural Development Evaluation

Table 14: Indicators involved in evaluation questions.

				Pillar II Target and Result indicators																																			Pillar II Output indicators								Impact indicators															
				T1	T2	T3	T4		T5	T6	T7	T8	T9	T10	T12	T8	T11	T13	T14			T15	T16		T17	T18		T19	T20	T21		T23	T22	T24	O.9	O.16	O.28	O.21	O.23	O.24	O.25	O.26	I01	I02	I03	I07	I08	I09	I10	I11	I12	I13	I14	I15	I16
							R1	R2	R3	R4	R5	R6	R7	R8	R10	R6	R9	R11	R12	R13	R14			R15	R16	R17	R18	R20	R21	R22	R23	R24	R23	R25																												
Focus area-related evaluation questions	Priority 1 Fostering knowledge transfer and innovation in agriculture, forestry and rural areas	Focus area P1A: Fostering innovation, cooperation, and the development of the knowledge base in rural areas		x																																																			
		Focus area P1B: Strengthening the links between agriculture, food production and forestry and research and innovation, including for the purpose of improved environmental management and performance			x																													x	x	x	x	x																		
		Focus area P1C: Fostering lifelong learning and vocational training in the agricultural and forestry sectors				x																																																
	Priority 2 Enhancing farm viability and competitiveness of all types of agriculture in all regions and promoting innovative farm technologies and the sustainable management of forests	Focus area P2A: Improving the economic performance of all farms and facilitating farm restructuring and modernisation, notably with a view to increasing market participation and orientation as well as agricultural diversification					x	x																																															
		Focus area P2B: Facilitating the entry of adequately skilled farmers into the agricultural sector and, in particular, generational renewal							x																																													
	Priority 3 Promoting food chain organisation, including processing and marketing of agricultural products, animal welfare and risk management in agriculture	Focus area P3A: Improving competitiveness of primary producers by better integrating them into the agri-food chain through quality schemes, adding value to agricultural products, promotion in local markets and short supply circuits, producer groups and organisations and inter-branch organisations								x																																												
		Focus area P3B: Supporting farm risk prevention and management									x																																											
	Priority 4 Restoring, preserving and enhancing ecosystems related to agriculture and forestry	Focus area P4A: Restoring, preserving and enhancing biodiversity, including in Natura 2000 areas, and in areas facing natural or other specific constraints, and high nature value farming, as well as the state of European landscapes										x	x																																									
		Focus area P4B: Improving water management, including fertiliser and pesticide management												x			x																																					
		Focus area P4C: Preventing soil erosion and improving soil management													x			x																																				
	Priority 5 Promoting resource efficiency and supporting the shift towards a low carbon and climate resilient economy in agriculture, food and forestry sectors	Focus area P5A: Increasing efficiency in water use by agriculture																	x	x																																			
		Focus area P5B: Increasing efficiency in energy use in agriculture and food processing																			x	x																																	
		Focus area P5C: Facilitating the supply and use of renewable sources of energy, of by-products, wastes and residues and of other non food raw material, for the purposes of the bio- economy																					x	x																															
		Focus area P5D: Reducing green house gas and ammonia emissions from agriculture																							x	x	x																										
		Focus area P5E: Fostering carbon conservation and sequestration in agriculture and forestry																										x																									
	Priority 6 Promoting social inclusion, poverty reduction and economic development in rural areas	Focus area P6A: Facilitating diversification, creation and development of small enterprises, as well as job creation																											x																									
		Focus area P6B: Fostering local development in rural areas																												x	x	x																					
		Focus area P6C: Enhancing the accessibility, use and quality of information and communication technologies (ICT) in rural areas																															x																			
Evaluation questions related to other aspects of the RDP	Operational performance	Synergies among priorities and focus areas enhanced the effectiveness of the RDP		x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x																						
	Technical assistance	Technical assistance contributed to achieving the objectives laid down in Article 59 of Regulation (EU) No 1303/2013 and Article 51(2) of Regulation (EU) No 1305/2013																																																				
	National rural networks (NRN)	Contribution of the NRN to achieving the objectives laid down in Article 54(2) of Regulation (EU) No 1305/2013?																																																			
Evaluation questions related to Union level objectives	EU 2020 headline targets	Contribution of the RDP to achieving the EU 2020 headline target of raising the employment rate of the population aged 20 to 64 to at least 75 %																																																			
		Contribution of the RDP to achieving the EU 2020 headline target of investing 3% of EU's GDP in research and development and innovation		x	x																																																
		Contribution of the RDP to climate change mitigation and adaptation and to achieving the EU 2020 headline target of reducing greenhouse gas emissions by at least 20% compared to 1990 levels, or by 30% if the conditions are right, to increasing the share of renewable energy in final energy consumption to 20%, and achieving 20% increase in energy efficiency																			x			x																													
		Contribution of the RDP to achieving the EU 2020 headline target of reducing the number of Europeans living below the national poverty line																																																		
		Contribution of the RDP to improving the environment and to achieving the EU Biodiversity strategy target of halting the loss of biodiversity and the degradation of ecosystem services, and to restore them																																																		
	CAP objectives	Contribution of the RDP to the CAP objective of fostering the competitiveness of agriculture																																																		
		Contribution of the RDP contributed to the CAP objective of ensuring sustainable management of natural resources and climate action																																																		
		Contribution of the RDP to the CAP objective of achieving a balanced territorial development of rural economies and communities including the creation and maintenance of employment																																																		
		Contribution of the RDP to fostering innovation		x																																																	

Appendix 3: Summary of the characteristics of data sources

Table 15: Summary of the characteristics of the main data sources employed in the CMEF

DATA SOURCE	CAP OBJETIVE THEMES	DATA AGREGATION	ACCES	INTEROPERABILITY	FORM/FORMAT	PORTAL
EUROSTAT	- Economic - Environmenta - Social	- EU level - National level	- Free access	Through: - SDMX Web Services - Unicode Web Services.	- Json	https://ec.europa.eu/eurostat/web/main/data/web-services https://ec.europa.eu/eurostat/web/microdata/overview
		- Microdata at person, household or business level	- Accesible under request for research organisations			
European Soil Data Centre (ESDAC)	- Environmental	- EU Maps (1x1 km grid)	- Free access (Map viewer) - Dowload under request	- WMS	- Raster images - Geodatabases (vector and 63ttribute data) - PDF (reports)	http://esdac.jrc.ec.europa.eu/viewer
Farm Accountancy Data Network (FADN)	- Economic	- Farm level - Regional level - National level	- Free access	- Download - Interactive dashboard	- Excel format (Since 1991) - CSV (from dashboard 2020 onwards)	https://agridata.ec.europa.eu/extensions/FarmEconomyFocus/FarmEconomyFocus.html).
Integrated Administration and Control System – Land Parcel Identification System (IACS – LPIS)	- Economic - Environmental	- Parcel level	NA[1]	NA[1]	NA[1]	https://ec.europa.eu/info/food-farming-fisheries/key-policies/common-agricultural-policy/financing-cap/financial-assurance/managing-payments_en.
Clearance Audit Trail System (CATS)	- Economic	- EU level - National level	NA[2]	NA[2]	NA[2]	
<u>Independent organizations:</u> Birdlife International, European Bird Census Council and Scheme (EBCC) and the Pan-European Common Bird Monitoring Scheme (PECBMS)	- Environmental	- EU level	- Free Access	- Download - Interactive dashboard	- Excel format	https://pecbms.info/use-of-the-results/data-access-policy/
European Environment Agency (EEA) and European Environment Information and Observation Network (EIONET)	- Environmental	- EU level - National level	- Free access	- Download - Interactive dashboard	- Maps - Charts	https://www.eea.europa.eu/data-and-maps
			- Download under register	- Webmap services (Discomap)		https://discomap.eea.europa.eu/Index/
Farm Level Indicators for New Topics in policy evaluation (FLINT)	- Economic - Environmental - Social	- Research project	- Research project	- Research project	- Research project	(https://www.flint-fp7.eu/
Copernicus	- Environmental	- European level	- Free acces (Map viewer) - Dowload require register	- Interactive viewer - Download	- SQLite database	https://land.copernicus.eu/
Land Use and Coverage Area frame Survey (LUCAS)	- Environmental	- Microdata: 2X2 Km points grid	- Photos acces Under request	NA*	- CSV	https://ec.europa.eu/eurostat/web/lucas/data https://esdac.jrc.ec.europa.eu/projects/lucas
		- European level	- Free acces	- Interactive dashboard - Download	- Excel format - TSV	

[1] LPIS data accessibility is PA dependant. [2] The EC aggregates the data to report on MSs' payments distribution.