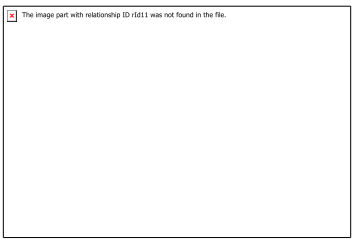
Monitoring and Evaluation Frameworks for the Common Agricultural Policy

Deliverable D4.4

Report and evaluation of demonstration cases



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Contents

Executive Summary

This document aims at providing a synthesis based on all demonstration cases and the lessons learned. Specifically, the purpose of this deliverable is to showcase whether the demonstration cases increase the adaptation of the technologies or whether there are some further problems identified which need to be addressed by further research and innovation projects.

Since the demonstration cases are still in the implementation phase, this document considers to be the first version of the respective deliverable and an updated version will be submitted at the end of the project.

The sections of this deliverable are:

Section 1 – Introduction

Section 2 – Description of Demonstration Cases

This section includes a description of all demonstration cases.

Section 3 – Evaluation criteria of the demonstration cases (KPIs)

This section includes a description of the identified and defined evaluation criteria (KPIs) of each demonstration case and indicates their connection with each case's objectives.

Section 4 – Problems/ risks identified

This section includes the identified problems/ risks of each demonstration case along with the impact they might had and the mitigation measures that will be followed to reduce this impact.

1. Introduction

Evaluation is a systematic determination of a subject's merit, worth and significance, using criteria governed by a set of standards. It can assist an organisation, program, project or any other initiative to assess any aim, concept/ proposal, or any alternative, to help in decision-making; or to ascertain the degree of achievement or value in regards to the aim, objectives and results of any such action that has been completed. The primary purpose of evaluation, in addition to gaining insight into prior or existing initiatives, is to enable reflection and assist in the identification of future change[1].

Despite the fact that during the evaluation process of the demonstration cases all the relevant requirements have been taken into consideration (i.e. business, stakeholder, solution, etc.), a special focus has been placed in the transition one. In the framework of MEF4CAP, this requirement is of great importance since it monitors and describes temporary capabilities, such as data conversion and training requirements, as well as operational changes needed to transition from the current state to the future one.

Thus, through the transition phase that each case has been going through, demonstrate new approaches on how the adaptation of the technologies can support operations in the future agri-food monitoring and evaluation objectives.

[1] https://en.wikipedia.org/wiki/Evaluation

2. Description of Demonstration Cases

The D4.1 Definition of demonstration cases presented the demonstration cases and their framework illustrating how the new approach "checks by monitoring" and the combination of technologies could be integrated in different cases and assess/ address specific indicators for the better monitoring and evaluation of CAP and future policies. This deliverable, along with the D4.3 Description of design and results of demonstration cases, aims to present further details/ information on the demonstration cases and provide more concrete descriptions on the scope of each of them.

2.1. Demonstration Case #1: Ireland

Currently, farm data in Ireland is generally obtained from the farmer, with a few exceptions. For instance, in terms of Farm Accountancy Data Network (FADN) data collection, some farm specific administrative data held by the Department of Agriculture, Food and the Marine can be accessed directly with the farmer's permission.

The Irish demonstration case aims to expand this capacity, in particular by developing linkages with dairy processors to directly access data such as milk sales and input purchases for participating dairy farms. The common practice for collecting and inputted these data is by hand by data recorders that visit these farms. However, this is a time consuming and expensive process and places an unnecessary burden on the farmer.

Therefore, the Irish demonstration case engaged a group of 5 conventional dairy farms in Ireland that were willing to allow access to their data flow between processor and the FADN system in order to collect various data and make this process more efficient and economical.

This demonstration case aims to deliver a prototype that will be used in the future for the collection of data from a wider array of farms and data holders and would demonstrate how it is possible to build the technology that allows data to be assembled and presented in a more accessible and easier to interpret format for the farmer and advisor. This would then lead to a better likelihood of the achievement of performance improvements and enhancement of the automation of processing data for policy evaluation monitoring.

2.2. Demonstration Case #1: Poland

One of the major problems regarding agriculture is related to overuse of fertilisers which has negative impact in farm income and environment. Optimal usage of fertiliser requires very specific information regarding from one side amount of direct application of nutrients and use of organic manures and from the other side uptake and unavoidable losses to preserve soil production capacity. Therefore, the optimal fertiliser management on farm level should base on information of input and output of nutrients collected on plot level.

The current FADN system in Poland does not collect such detailed information. Collection of additional information with the use of administrative data of plots would support farmer management decisions and provide additional information for policy makers. Therefore, farms involved in FADN were chosen and asked to collect additional information. It is expected that these farms will receive expended farm report providing them detailed information of nutrient balance and if necessary, adjust future fertiliser application.

2.3. Demonstration Case #1: The Netherlands

This demonstration case addresses the potential of ICT developments at farm and sector level, with control of data flows originating at the farm. Farmers increasingly operate within a network of commercial and governmental organisations. The information exchange between farmers and these organisations increasingly occurs via digital means. These digital information flows could provide a wealth of information for policy evaluation and monitoring and have the potential to reduce transaction costs (e-declarations, etc.). This case takes some best practices as a starting point and explores the potential to widen this development to other Member States with different organisations of data flows.

Specifically, through the Dutch demonstration case, information requirements will be delivered, i.e. the specific data standards and requirements that must either met or developed in order to produce and provide to the farmers the required information. Furthermore, the information transfer protocols that are considered important for the communication of the required information to the relevant third-parties are presented, identifying and defining the existing or the tailored made Application Programming Interfaces (APIs). Governance and business model aspects are also explored to better depict the needs and requirements that should be met so as to support the sustainability of the solution and to address possible reluctance to data sharing.

2.4. Demonstration Case #2: Greece

The Greek demonstration case focuses on the uses of digital tools in support of future Common Agricultural Policy (CAP) monitoring and evaluation. An agro-environmental data management platform has been demonstrated capable to collect, share and visualise farm level cultivation related data (i.e. farm calendar data including parcel geometry, crop type, harvest, use of pesticide/ irrigation/ fertilisers, geo-tagged photos) along with data from relevant external sources referring to CAP indicators (e.g. soil quality, biodiversity index, water bodies, GHGs emissions). The collected farm level data allow the extraction of farm/ regional aggregates/ statistics relevant with future CAP performance monitoring. Selected outcomes will be shared with individual farmers acting as rewards/ incentives for further data sharing of farm level data.

The agro-environmental data management platform has also been integrated with EO based decision support tools (e.g. crop type classification algorithms) further supporting the operations of the Integrated Administration and Control System (IACS).

This approach is tested with a selection of approximately 60 Greek farms, members of Neuropublic's network, that are located in the region of Northern Greece, allowing to experiments with the extraction of regional aggregated outcomes from the farm logs.

2.5. Demonstration Case #2: Spain

EU Farm to Fork strategy will ensure that farmers keep more detailed tracking of al the tasks they carry out in their holdings. Special concerns are on the use of fertilisers, pesticides and water consumption. In Spain there is not currently a system for obtaining information of inputs at parcel scale (though every five years there is a survey on farmers' performance).

The compulsory farm book is the tool for farmers to keep record of all these issues. Up to now, it was only mandatory for phytosanitary. SIEX and Sustainable nutrition in agricultural soils

Royal Decrees in Spain (2022) will enforce to provide this information on a monthly basis (after each treatment/ application) from July 2023, onwards.

This demonstration case has developed a digital farm book connected via API with the administration to provide the mandatory information requested. The information feeds a Geographic Information System (GIS) enriched with satellite information (weather and EO) that allow cooperative members (farmers) and their advisors to follow-up their performance and ensure their alignment with policy demands. The demonstration case showcases that a mandatory request for farmers can also become in useful information for improving their production patterns, especially in the use of phytosanitary, fertilisers and water.

The code of conduct on agricultural data sharing has been used as framework, releasing a contract for sharing data that fulfils with its provisions. The expected outcomes of this demonstration case are the evaluation of innovative agricultural data sharing approaches and the several potential benefits for farmers.

To support this approach five farmers from a cooperative wine cellar (Cuatro Rayas) located in Valladolid province have been collaborated in the development of the digital farm book and the GIS.

2.6. Demonstration Case #3: the Netherlands

Privacy preserving infrastructures can play an important role in addressing the issue of data sharing in the agricultural and food system. The federated learning method aims to facilitate such a privacy preserving infrastructure and support data sharing for agricultural and food data spaces that consists of interactions between stakeholders that aim for sustainability and economic objectives. These interactions could concern data owners, data gateways, algorithmic models and data users, such as policy analysts.

In this demonstration cases, as a privacy preserving federated learning infrastructure, vantage6 is used for secure information exchange. This infrastructure was hosted at proximity of three stations, respectively, STATION-1 the Netherlands, STATION-2 Poland and STATION-3 Ireland. Simple statistical analysis was used to demonstrate the federated set-up within the agricultural accounting domain. Main results of this demonstration case contribute to pathways for semantically interoperable data sharing within the agri-food system and insights to a privacy-by-design transition to of the FADN by monitoring and evaluating off-farm income and education. These insights are to some extent generalisable for other farm business activities to understand the impact of the measures taken under the CAP.

2.7. Demonstration Case #4: Spain

The new CAP brings with it several novelties such as the eco-schemes, which reward climate and environmentally beneficial agricultural or livestock practices through voluntary commitments.

In order to test the monitoring of Spanish Strategic Plan eco-scheme (CAP) “Low Carbon Agriculture – (P1) Increasing the carbon sink capacity of pastures by promoting extensive grazing eco-scheme” payments, the Spanish demonstration case supports sheep breeders in cooperatives to easily demonstrate to payment agencies that their herds comply with the requirements to receive this aid, through the development of an innovative methodology.

The demonstration case defines the workflow to translate the herd position collected from Global Positioning System (GPS) devices attached to some sheep into geo-referenced information ready to be incorporated in GIS. Once the position is processed and ingested within the GIS environment. Indexes derived from satellite imagery support the identification of those most-intensive grazing areas within the LPIS parcel and the information derived from the positioning system shows the actual movements of the herd in the field.

To carry out this demonstration case, three farms of sheep breeders' members of the EA Group cooperative have been engaged. The holdings are located in the Extremadura Region, at the Alburguergue, Villanueva de la Serena and Torrejón el Rubio municipalities.

3. Evaluation criteria of the demonstration cases (KPIs)

A criterion is a standard or principle used in the evaluation as the basis for evaluative judgement[2]. Thus, criteria should apply to the following two principles:

- The criteria should be used thoughtfully supporting high-quality evaluation.
- The criteria should be aligned with the purpose of the evaluation and be covered according to the relevant stakeholders' needs.

Based on the Organisation for Economic Co-operation and Development (OECD), there are six standard criteria that are broadly used for evaluation.

- **Relevance:** The extent to which the objectives of project are consistent with recipients' requirements, country needs, global priorities and partners' policies.

  It provides answer to the question: Is the project doing the right things?

- **Effectiveness:** The extent to which the objectives of project were achieved or are expected to be achieved, considering their relative importance.

  It provides answer to the question: Is the project achieving its objectives?

- **Coherence:** The compatibility of the project with other projects in a country, sector or institution.

  It provides answer to the question: How well does the project fit?

- **Efficiency:** A measure of how economically resources/ inputs (funds, expertise, time, equipment, etc.) are converted into results.

  It provides answer to the question: How well are resources being used?

- **Impact:** Positive and negative primary and secondary long-term effects the project produces, whether directly or indirectly, intended or unintended.

  It provides answer to the question: What difference does the intervention make?

- **Sustainability:** The continuation of benefits from the project after major development assistance has ceased.

  It provides answer to the question: Will the benefits last?

  One of the key activities of the project is the evaluation of the proposed approaches. Within the evaluation process, key performance indicators (KPIs) are the conditions that need to be met before we conclude that these approaches increase the adaptation of technologies or not. KPIs form the basis of evaluating how successful was a demonstration case and if the initial goals have been satisfied.

[2] OECD 2021

Most of the demonstration cases managed to set the KPIs and indicate their connection with the pilot's objectives. In the following updated version of this deliverable the outcomes of each demonstration case will be presented.

3.1. Demonstration Case #1

In the Irish demonstration case, the following KPIs were defined and the main objective that aim to address is the data collection to calculate and report economic and environmental KPIs for Irish dairy farms. This objective is connected with the MEF4CAP's fourth and fifth objectives which refer to the improved adoption of pathways and harmonised frameworks.

Table 1: KPIs for the Irish Demonstration Case

KPI	Objective
KPI_1: Economic return per hectare (gross output)	Economic and environmental KPIs for Irish dairy farms
KPI_2: Profitability per hectare (gross margin)	
KPI_3: Family Farm Income per hectare	
KPI_4: Productivity of labour	
KPI_5: Market orientation	
KPI_6: Viability	
KPI_7: Household vulnerability	
KPI_8: Isolation	
KPI_9: Age profile	
KPI_10: Hours worked on farm	
KPI_11: Agricultural education	
KPI_12: Total farm average NH_3 emissions	
KPI_13: NH_3 emissions per hectare	
KPI_14: NH_3 emissions per unit of output	
KPI_15: N Balance per hectare	
KPI_16: P Balance per hectare	
KPI_17: N use efficiency	
KPI_18: P use efficiency	

The main purpose of the Dutch demonstration case is not to create additional data but to collect data in a reliable and cost-efficient way. In that sense, the proof of the usefulness is not the improvement of statistics but if the methods developed results in data that can be audited and cross-checked. The following table summarises the KPIs that have been defined for the Dutch demonstration case.

Table 2: KPIs for the Dutch Demonstration Case

KPI	Objective
KPI_1: Potential benefits of robotic accounting in combining financial accounting and farm management information systems demonstrated	Accounting approach in agricultural monitoring
KPI_2: Ability to compute the relevant Farm2Form indicators and mass balances (organic farming) demonstrated	
KPI_3: 4-week moving average of miniral balance N	
KPI_4: Experiences and challenges reported (document)	

KPI_5: Dashboard developed	Visualisation of combined data
KPI_6: Data access established (governance)	
KPI_7: Data access established (technical)	
KPI_8: Dashboard design evaluated with (and contributed to by) users	
KPI_9: Dashboard and data governance discussed and evaluated	
KPI_10: Experiences and challenges reported (document)	
KPI_11: Sensor and digital invoice data gathered and combined (Ireland)	Collaboration with Ireland and Poland, synthesis
KPI_12: N and P balances gathered (Poland)	
KPI_13: Workshop in the Netherlands, … and Europe presenting results	
KPI_14: Synthesis document with results of DC1 ("Integration of economic and sensor data for farm monitoring")	

3.2. Demonstration Case #2

In the Greek demonstration case, among the core objectives that have been defined early in the project, is to successfully address the needs for monitoring new information items that are relevant to policies monitoring (e.g. Green Deal, new CAP). The following table provides a list matching the information needs, the policy indicator and the rational of the approach to be followed.

Table 3: KPIs for the Greek Demonstration Case

KPI	Objective
KPI_1: Crop type identification based on truth hard evidence *Farm/Regional level crop type identification* *Fails of EO methods with small parcels or parcels with irregular shapes will be addressed through the use of farmers calendars and photos*	Monitoring new standards relevant to Green Deal and the new CAP
KPI_2: Applied farming practices (e.g. Crop rotation, Mowing, Ploughing) *Farm/Regional level identification of practices connected with GAEC and CAP monitoring.* *Fails of EO methods with small parcels or parcels with irregular shapes will be addressed through the use of farmers' calendars (field book) and photos.*	
KPI_3: Applied quantity/ type of fertilisers *Farm/Regional level fertilisers applications (kg/ha).* *Process farmers' calendars to extract statistics on fertilisers use on a farm/regional level. Close to real time calculation of indicators and comparison with targets.*	
KPI_4: Applied quantity/ type of pesticides	

Farm/Regional level pesticides applications (kg or Lt /ha). *Process farmers' calendars in order to extract statistics on pesticides use on a farm/regional level. Close to real time calculation of indicators and comparison with targets.*	
KPI_5: Applied quantity of irrigation *Farm/Regional level irrigation use (Lt /ha).* *Process farmers' calendars in order to extract statistics on irrigation use on a farm/regional level. Close to real time calculation of indicators and comparison with targets.*	

In the Spanish demonstration case, the following KPIs have been set along with the initial calculated values for Spain and these KPIs aim to address the objectives of monitoring and evaluation of fertilisers and pesticides usage as well as water consumption.

Table 4: KPIs for the Spanish Demonstration Case

KPI		Objective
KPI_1: N Balance per Hectare	71.1 kg N/ha	*Monitoring and evaluation of nitrogen inputs towards Farm to Fork 2030 reduction objectives + Efficient Soil Management*
KPI_2: P Balance per Hectare	32.6 kg P2O5/ha	*Monitoring and evaluation of phosphorus inputs towards Farm to Fork 2030 reduction objectives + Efficient Soil Management*
KPI_3: K Balance per Hectare	26.8 kg K2O/ha	*Monitoring and evaluation of potassium inputs towards Farm to Fork 2030 reduction objectives + Efficient Soil Management*
KPI_4: Crop Rotation	Monoculture (vineyard)	*CAP monitoring and evaluation purposes + Efficient Soil Management*
KPI_5: Ammonia Emissions per Farm	501,22 kg NH3/farm	*Monitoring and evaluation of ammonia emissions towards Farm to Fork 2030 reduction objectives+ Efficient Soil Management*
KPI_6: Ammonia Emissions per Hectare	20 kg NH3/ha	*Monitoring and evaluation of ammonia emissions towards Farm to Fork 2030 reduction objectives + Efficient Soil Management*
KPI_7: Adoption of (Natural) Biocontrols on Farm	NA	*Monitoring and evaluation of biocontrol's systems towards Farm to Fork 2023 phytosanitary use reduction + Efficient Soil Management*
KPI_8: Pesticide Use on Farms	1,86 kg pesticides/ha	*Monitoring and evaluation of pesticide inputs towards Farm to Fork 2030 reduction objectives + Efficient Soil Management*

KPI_9: Carbon Sequestration per ha	≅25 t SOC/ha (La Seca Municipality)	*Monitoring and evaluation of carbon sequestration to achieve EU goals on GHG emissions reduction + Efficient Soil Management*
KPI_10: Water consumption	4,044 m3/ha (2020)	*Monitoring and evaluation of water inputs towards reduction objectives + Efficient Soil Management*
KPI_11: Pesticide risk on Farms	Indicator value of 90 in 2019 (from an initial baseline of 110 in 2011)	*Monitoring and evaluation of pesticide risk inputs towards Farm to Fork 2030 reduction objectives + Efficient Soil Management*

3.3. Demonstration Case #3

For this demonstration case, the main KPI in order for the case to be considered as successful is if the federated set-up that is ready is able to perform an algorithm with, preferably, non-fictive data.

3.4. Demonstration Case #4

The main outcome of the Spanish demonstration case is the development of a replicable methodology for herd monitoring for extensive livestock production cooperatives. The KPIs that have been set for this case are represented in the table below along with the initial values for Spain and the respective objectives that aims to address.

Table 5: KPIs for the Spanish Demonstration Case

KPI		Objective
KPI_1: Carbon Sequestration per Hectare	*≅25 t SOC/ha (Villanueva de la Serena Municipality)*	Monitoring and evaluation of carbon sequestration to achieve EU goals on GHG emissions reduction + Efficient Soil Management
KPI_2: Cattle load per hectare	NA	Monitor and evaluation of eco-scheme requirements & intensification or abandonment of grazing areas.
KPI_3: Days/hours of outdoor grazing	NA	Monitor and evaluation of eco-scheme requirements

4. Problems and risks identified

In the table below are presented the risks that have identified from the early stages of the implementation of the demonstration cases along with the probability of occurrence and the impact that might have as well as the mitigation measures. In the following updated deliverable, it will be stated if any of these risks has occurred and what was the impact on the outcomes of the demonstration cases.

Table 6: Risks identified

Risks	Description	Probability	Impact	Mitigation measures
Demonstration Case #1: Ireland				
Non-delivery of data	Non-co-operation of some processors/farmers	High	High	Have targeted two processor/farmer groups
GDPR compliance	Data sharing agreement issues with farmers	Low	High	Discussions with Institutional GDPR officer ongoing
Technical issues	Technical challenges in data sharing across organisations	Medium	High	Discussions between Soops and stakeholders (Teagasc and Processors)
Non-delivery of data	Non-co-operation of some processors/farmers	High	High	Have targeted two processor/farmer groups
Demonstration Case #1: Poland				
Farmer unwillingness to share values of new indicators	In case of values of calculated indicators that proves improper use of fertilisers there will be incentives not to share results	Medium	Medium	In phase of farm selection, it was explained that the effectiveness of procedure is above the indicators results
Demonstration Case#1: the Netherlands				
Participation of farmers	Farmers might not consent to providing and sharing data.	Medium	High	Clear explanations of expectations and what will happen to the sensor and personal data, as well as providing formalized WR consent forms for the legal basis of GDPR and registration of the purpose of sharing the data.
Data access and availability	Availability of and access to FADN / Signpost data is considered a precondition to success, but might be delayed	Medium	Medium	Early verification of procedures for data access. Either consortium agreement or a separate NDA for developer(s) will

	(e.g. due to governance, or confidentiality concerns).			provide the legal framework for data access. If delays occur, management team WR should be alerted to speed up the procedure.
Technology readiness level of dashboard	TRL and quality of dashboard may be impacted by resource restrictions or time pressure.	Medium	Medium	Transparent communication about processes and organise several demonstrations, both internally and with end users.
Technological data connections	Exports of open source and FADN data need to be available to establish technical data connections.	Medium	Medium	Be clear about technological requirements for data sets as soon as possible and involve the right people at WR, propagate prototype with data exports that are made available or using dummy data are second best options (not preferred).
User adoption of prototype	For this dashboard prototype the objective is to demonstrate possibilities of data sharing and creating insights for decision making to stakeholders and end users. The prototype does need to indicate usability to end users do reach this objective.	Medium	Low	Document user requirements (in user stories). Organise several demonstrations, both internally and with end users.
Demonstration Case #2: Greece				
GDPR issues	Extraction of aggregated data products from farmers' calendars	Low	Medium	Contracts signed with farmers. Part of the datasets will be utilised – In case of objections no visualisation/rendering of individual farm/ farmer data.
Quality of data	Quality of data is low. Empty values, incorrect	High	Medium	Data curation mechanisms. Exclude

	entries, and data entries in heterogeneous form			farms with no or incorrect datasets.
Demonstration Case #2: Spain				
National policy framework development	Several regulations affecting this DC are in development and the final releases may be delayed	Medium	Medium	Constant contact with policy makers to support them in the process
Demonstration Case #3: the Netherlands				
Data availability	There is no real-world data at the right time with the right circumstances.	Medium	Medium	Use fictive data
Resource availability	Participating partners does not have the right capacity and resources for the federated set-up	Low	High	Use a simulated environment to report results
Demonstration Case #4: Spain				
Lack of network coverage	Little sets of data received	High	Low	Some GPS trackers have SD cards to retrieve the data
Problems with the devices	Devices not properly fitted to the neck of the animals	Low	Low	The data is constantly monitored to detect these issues and correct them
National policy framework development	Several regulations affecting this DC are in development and the final releases may be delayed	Medium	Medium	Constant contact with policy makers to support them in the process

5. Conclusions

All four demonstration cases have different approaches and test various technologies but the goal is one; to explore and determine whether the adaptation of those technologies could be facilitated through these cases.

Despite the fact that the demonstration cases are still in progress, some first lessons learned could be presented below:

- The identification of the appropriate technology is very crucial for the monitoring and evaluation framework and should be applicable to the context and the capacity of the stakeholders (from farmers to policy-makers). Simple, user-friendly technology should be chosen that is easy to learn and use for the stakeholders.
- The stakeholders should be trained in using the technology in order to ensure that they have the qualifications not only to collect data accurately but also process and analyse them effectively. The training should be conducted in a participatory manner and should be tailored to the needs of the stakeholders and based on the standards and rules posted by the regulations/ framework.
- Participatory monitoring and evaluation should be considered as the new approach and be used in order to bring in the same table all the relevant stakeholders. This could help to ensure that the data collected is relevant and accurate, and that the stakeholders feel part of the process.
- While technology can be a useful tool for data collection, it has limitations. For instance, it might not be able to capture certain types of data, such as qualitative information, fertilise/ pesticide applications or the perceptions of the stakeholders.
- The data collected through technology should be used to inform decision-making about future pathways. The data should be analysed and shared among the community to ensure that all the decision that will or have been taken are based on proofs and valid information.
- The use of technology in monitoring and evaluation should be continuously evaluated and adapted to secure and ensure that all the stakeholders' and community's needs are met. Continuously feedback should be sought from the stakeholders and adjustments should be made as necessary.

