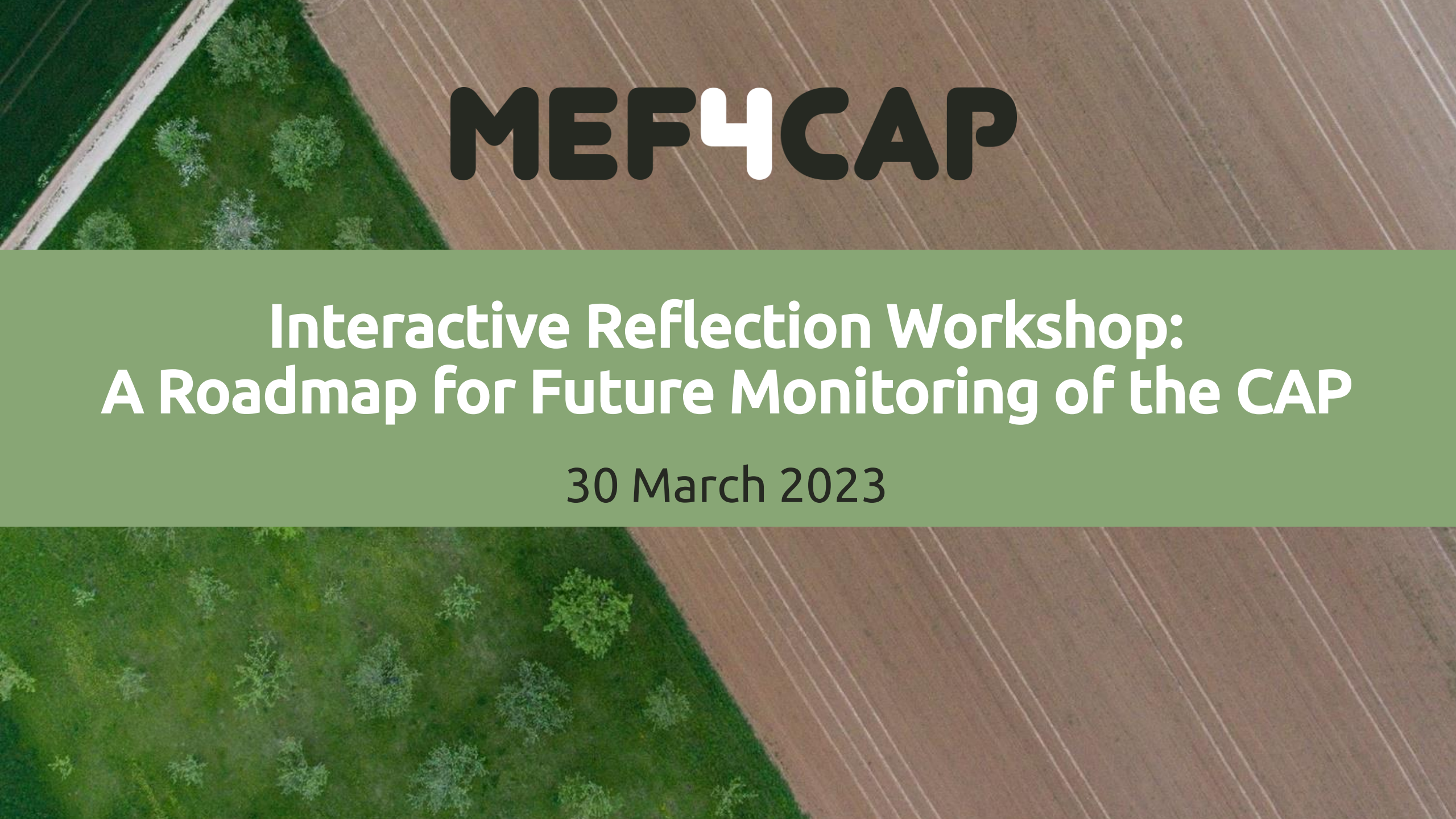


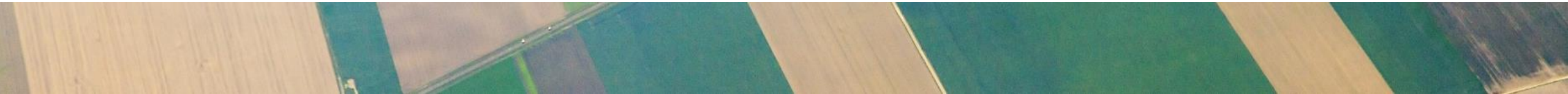
MEF4CAP

Interactive Reflection Workshop: A Roadmap for Future Monitoring of the CAP

30 March 2023

Agenda

- 9h30 Welcome & overview of MEF4CAP project
- 9h40 Demo Case 1: Use of digital information flows in the agri-food sector
- 10h10 Demo Case 2: Integrating open-source satellite data with farm level data
- 10h30 Demo Case 3: Linking national datasets for a broader use in policy evaluation
- 10h40 Demo Case 4: New ways for monitoring agri-environmental measures
- 10h50 Break
- 11h05 Generic framework for EU roadmap(s)
- 11h15 Interactive session on the framework presented, gaps and steps ahead
- 12h15 Wrap-up and closing remarks
- 12h30 End and networking lunch



Consortium

Background

Agricultural statistics

Advisory services

ICT

Earth observation

Farm economics

Monitoring

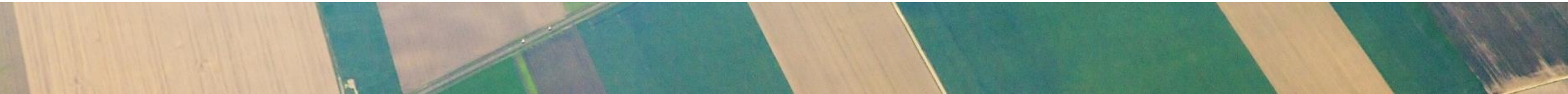
Policy evaluation

Farm cooperatives

Citizen organisations

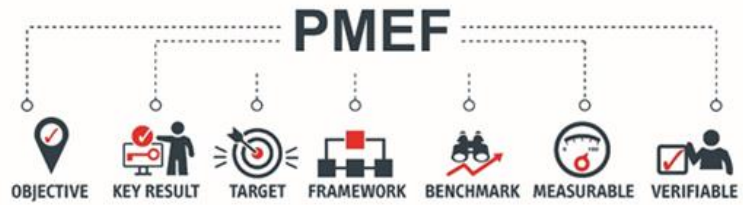
Direction of the new CAP

- CAP direction influenced by **emerging sustainability agenda**
  - Global, EU, national policy drivers & various stakeholder perspectives
  - EU Farm to Fork, EU Biodiversity Strategy, UN SDGs & Paris Climate Agreement
- **Transformative change required** – changing societal expectations
  - Civil society seeking the promotion of environmental sustainability in EU policy
  - Agri-food sector seeking a slower pace for change – time to adjust
- These factors have **motivated the revision of CAP objectives**
  - **Environmental and Societal goals in particular**



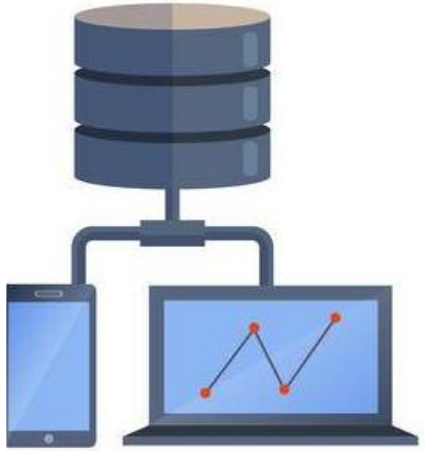
Implications for monitoring & evaluation

- Shift from **compliance to performance**
  - Compliance with actions or regulations (original approach)
  - Performance, or achievement of specific objectives (new delivery model)
- MS CAP **Strategic Plans -** greater autonomy at MS level
  - **But commonality with overarching EU indicator set**
- Existing indicators - considerable, but…
  - Not always fit for purpose – in need of update (also granularity)
- **Additional environmental and social data a particular priority**
  - GHGs, biodiversity, water, organics, pesticides, fertiliser usage etc.
  - Quality of life, gender issues and animal welfare etc.
- **Economic data** – some gaps remain
  - e.g. little information on use of risk management tools



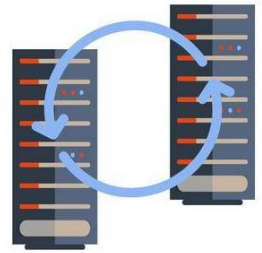
Impacts for administrators & data providers

- **Costs and benefits**
  - For administrators and data providers (farmers)
  - Obstacles, but also opportunities.
  - These will differ across Member States.
- **Increased opportunity** to produce relevant indicators
  - Multiple sources of agricultural data
- **Evolving technology**
  - For data collection, processing, management, analysis
- Potential for **improved integration** of data sources
  - e.g. IACS, FADN/FSDN, FMIS, LPIS, farm machinery/sensors.



Data utilisation

- Strong case for the **benefits of data sharing**
  - Make better use of existing data
  - Reduce collection cost and burden
  - Richer data analysis possible



- But **obstacles to data integration**
  - Issues around interoperability, trust, sensitivity and potential legal impediments

- Policy has/should influence decision making at the farm level
  - Indicators should reveal farm specific differences
- **Farmer buy-in is crucial** - uptake of sustainable practices
  - Data must be used in a way that returns benefits to farmers too
  - Role for farm advisory in the demonstration of such benefits, but heterogeneous in MSs

MEF4CAP objective

Wide **range of needs** and **increasing amount of data** in agri-food sector

MEF4CAP will deliver a roadmap for future monitoring and evaluation

- where the needs of different stakeholders are identified
- and the potential of different technologies is (fully) exploited
- while minimizing the associated cost and administrative burden

Project logic

2 Identify technological developments

WP 2
ICT developments / sources
Farm administration Chain initiatives Satellites Sensors

1 Identify future needs

WP 1
Wish list of indicators
Categorised in:
Policy evaluation, monitoring and control, farmer needs
And/Or
Planet People Profit

4 Demonstration cases

WP 3
Evaluating potential of ict development to meet needs

WP 4
Demonstration cases

ICT developments

Needs

X V V? V? V? V? X

Potential pathways

3 Assess potential of technological developments to meet future needs

needed to exploit potential

Demonstration cases

- Develop demonstration cases to illustrate, communicate potential of technological developments to meet monitoring and evaluation needs
  - Use of digital Information flows in the agri-food sector (entry point FADN)
  - Integrating open-source satellite data with farm level data (entry point FMIS/farm books, IACS)
  - Federated learning across multiple data stations (entry point FADN)
  - New ways for monitoring agri-environmental measures

Objectives reflection workshop

- Present lessons learned
  - From the project in general but especially from the demo cases and the national workshops
- Critically reflect on the lessons learned, especially regarding to
  - Identified pathways
  - Roadmaps
  - Demonstration cases

MEF4CAP

Thank you for your attention

Presentation by:

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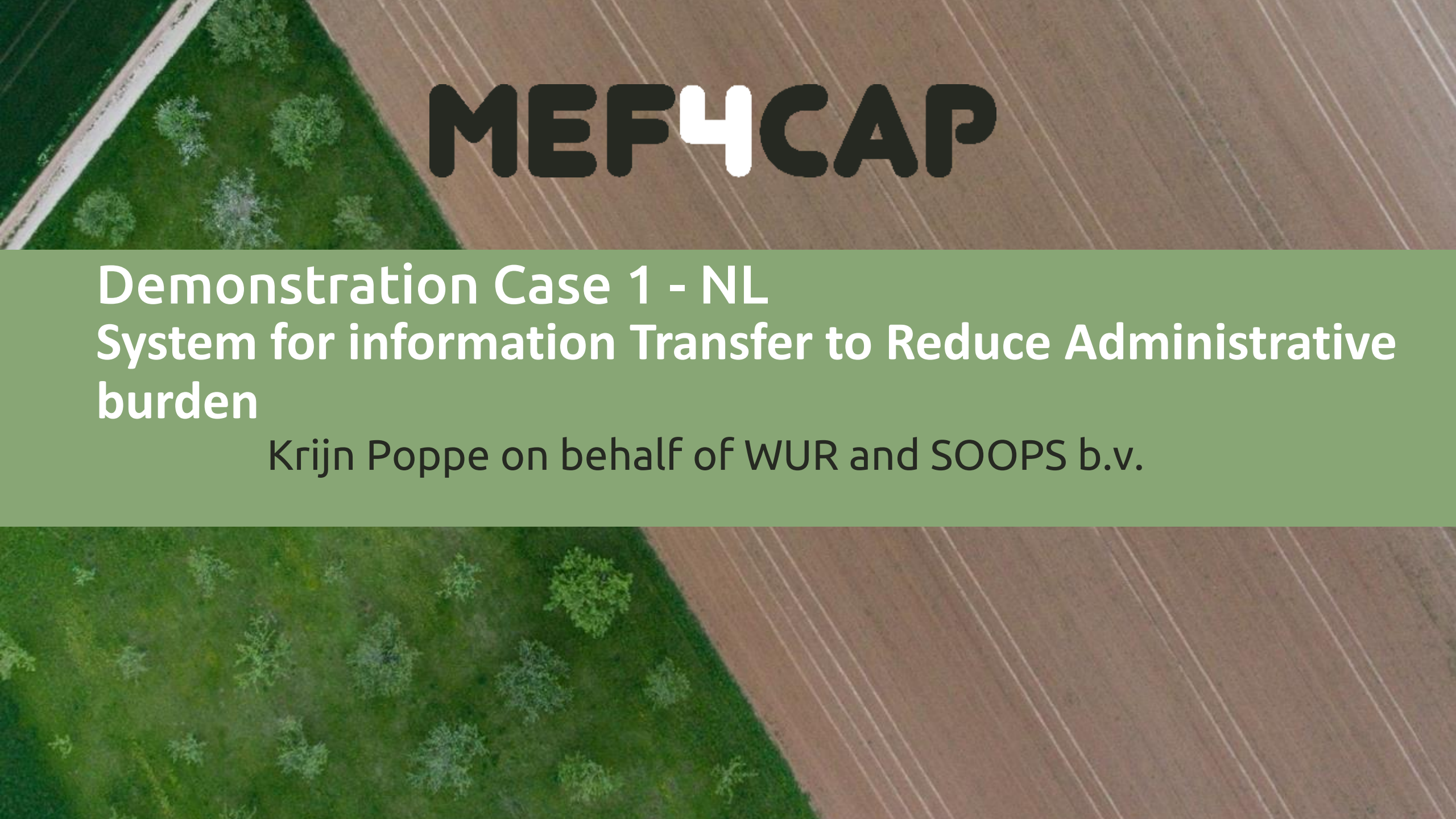


Demonstration Case 1 - NL

System for information Transfer to Reduce Administrative burden

Krijn Poppe on behalf of WUR and SOOPS b.v.

Short description of the DC: the need for innovation in the farm office

- Context, rationale and objectives
  - Food production is becoming more data-intensive: industry schemes on sustainable food, CSRD-scope 3, Organic farming and certification of mass-balances, Eco-schemes in CAP, FSDN as follow up of FADN.
  - Family farms do not collect a lot of data for internal management, external demand for data leads to administrative burdens
  - External stakeholders often choose their own solution (paper, web site to be filled in, authorisations of farmers to build large central databases etc).
- Innovation in farm office is needed.
- Our stakeholders: farmers, farm trading partners as data providers

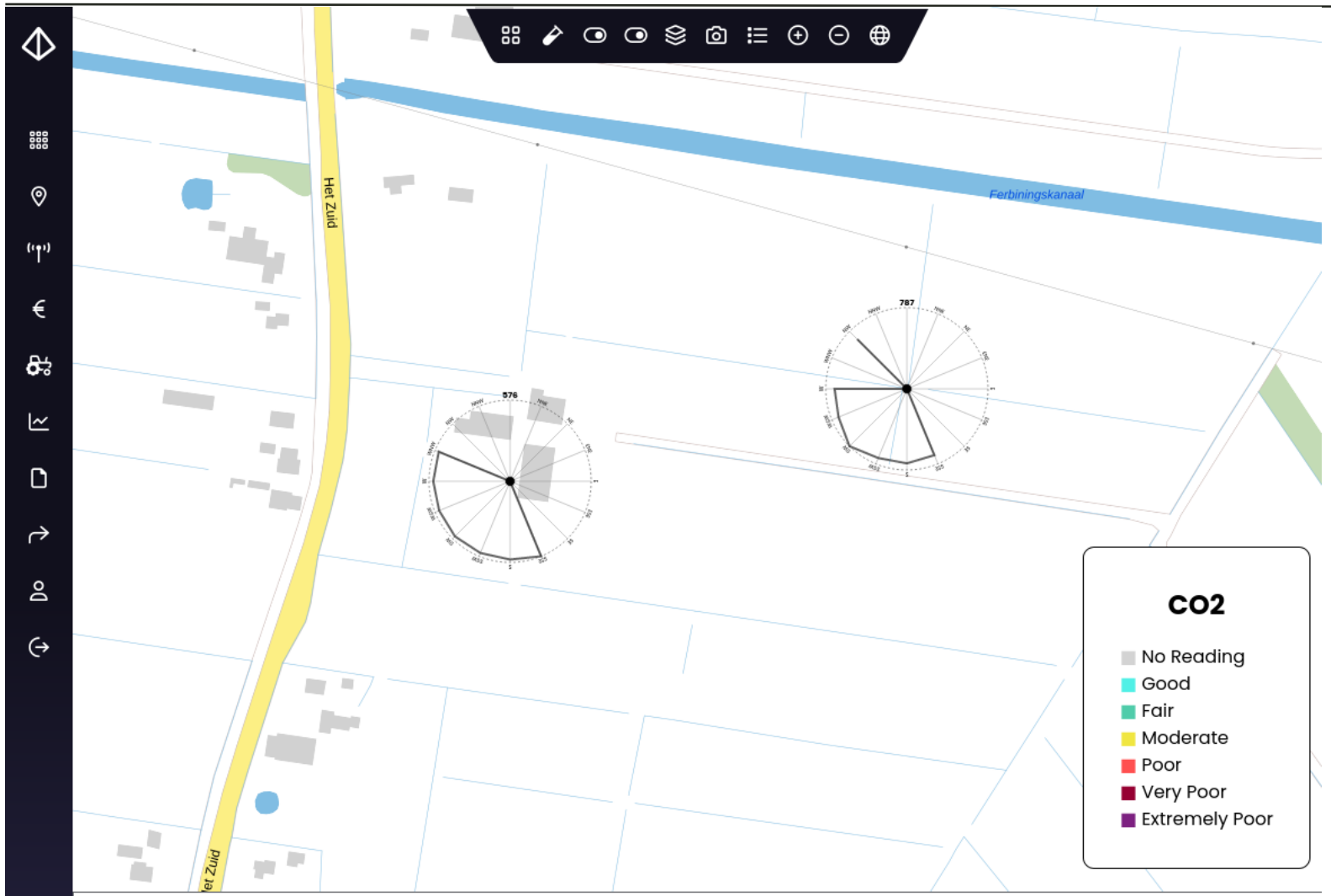
The digital technologies

- Collect farm relevant sensor- and satellite-data and integrate this with farm accounting data in a farm friendly dashboard
- Robotic accounting based on digital invoices (UBL, XML, UNCEFACT)

Design criteria for the farm dashboard:

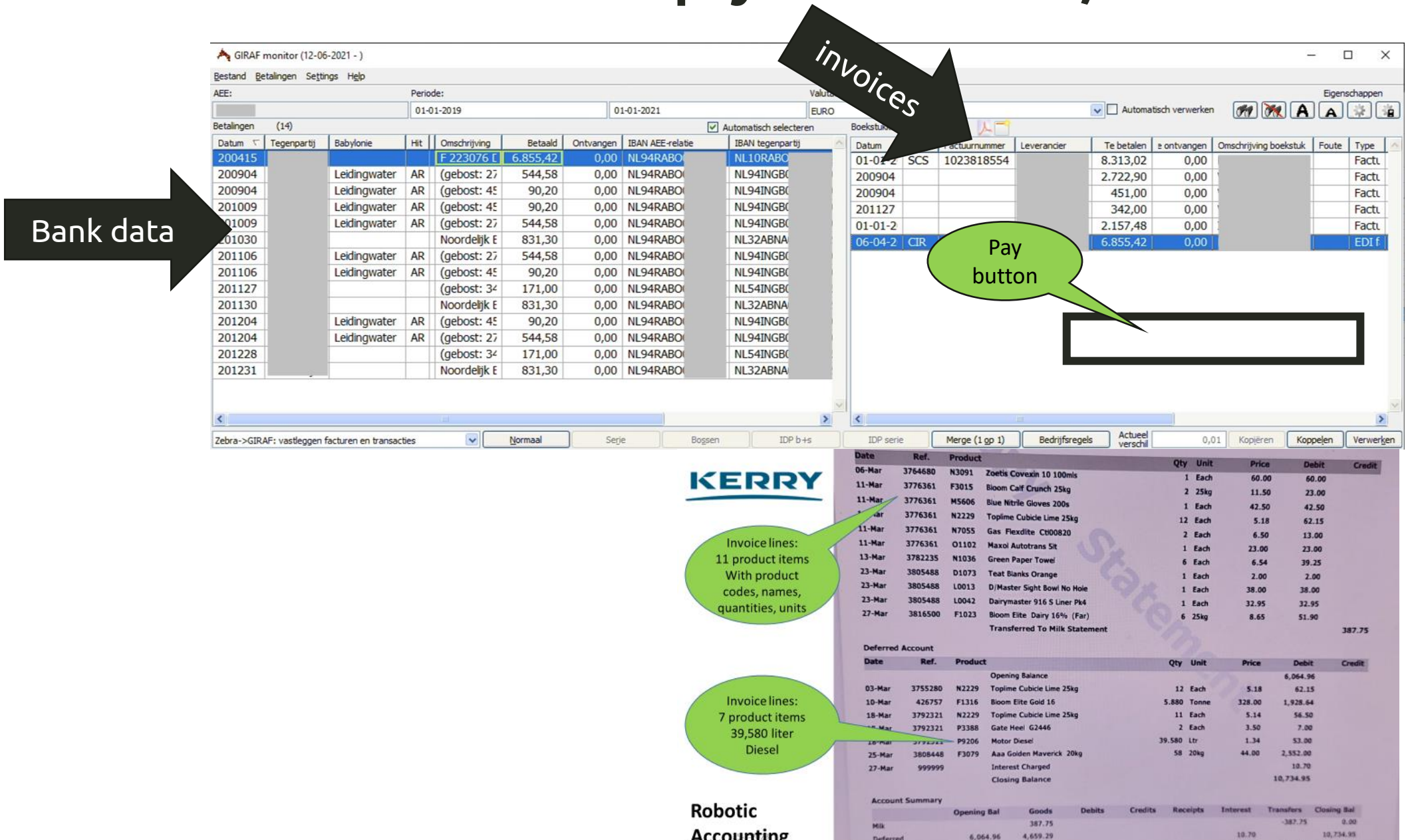
- Deliver useful sustainability data with pathway to new data types
- Reduce manual input by farmers as much as possible
- Integrate administrative work in management (paying, programming machines)
- Farmer is the owner of his own data and has full control over options to share
- Auditable in certification process of the farm (integration Financial accounts and Management information systems)

Screen: Map Farmer B CO2 Pollution rose



Location	Value	2022-11-05																							
		0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	
Farmer B Barn	CO2	592	592	572	589	570	575	581	575	560	556	560	554	547	558	560	560	564	562	558	557	555	554	550	
Farmer B Field	CO2	837	859	807	832	793	796	804	789	759	737	725	724	724	728	738	745	749	752	750	751	749	749	748	

Screen on Finance: farmer pays EDI-invoices, checks bank account



The technology “readiness”

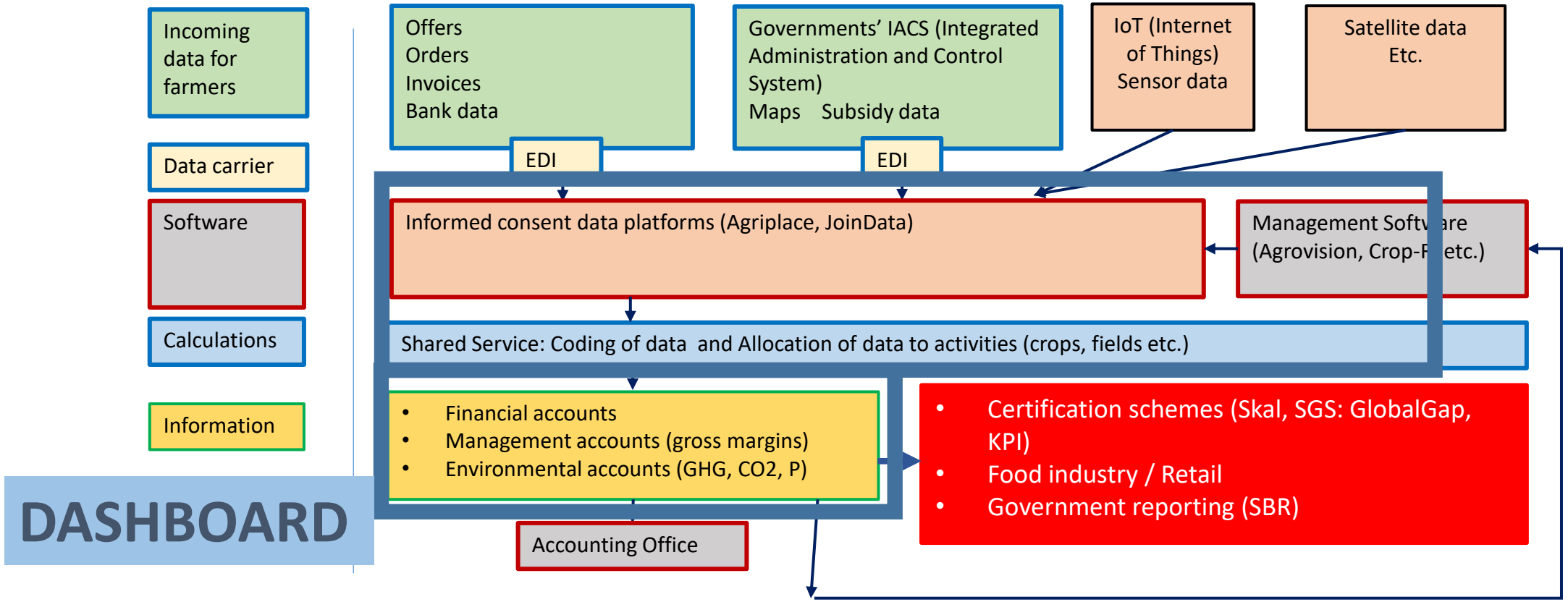
Technology component	Technical readiness	Socio-economic readiness
Sensor - technology	medium. Good for monitoring in research and advisory projects. Not for evaluation and regulation of individual farmers.	High (at least in the NL, given debates on ammonia policy)
Mix sensor and accounting data	high	High (at least in the NL)
Digital invoices	high	Lack of incentives
Robotic accounting	high	Depends on digital invoices
Farm dashboard with robotic accounting	high	Depends on willingness to invest by software providers / collective action
Sharing data, under control of the farmer	high	high

The indicators

- Sensor data on air pollutants: AQI (Air Quality Index), NH3, CO, CO2, PM10, PM2.5,
- Environmental accounting data: use of pesticides, use of antibiotics, N-surplus/ha, P-surplus/ha, energy use (and implicit GHG emissions). At farm level and crop/field level (if financial accounts and farm management systems are integrated)
- Certification data: mass balances for organic farms
- Economic / financial accounting data (as in FADN; non-farm income)

Data flows to/from farms via dashboard: potential future situation

Problem frame: Realise a “future-proof”, international and scalable plaform where structured and non-structured data for farmers can be combined. The created data can be used as a base for reporting, compliance and –monitoring, AI, Machine Learning, etc Based on Data Space concept for data governance.



Drivers for adoption

- Farmers want less administrative burdens
- Many farmers are interested in their emissions (if not yet punished on it)
- Farmers want control over their data
- Accountants want digital invoices in tight labour market
- Software companies might be interested in new features
- Food companies and banks are interested in the farm data for several reasons

Barriers to adoption

- Sensors are not yet advanced enough to base environmental regulation on the data
- Some farmers are afraid of more transparency
- It is easier for strong trading partners in the food chain to create their own websites and apps, and force farmers to type in the data
- Not clear if current software companies want to invest in dashboard (small market, FMIS are now international, Accounting software is non-agro)
- Governments are afraid to intervene in the data and software market

Possible actions to favour adoption

BARRIER	ACTION	WHO SHOULD TAKE ACTION?
Sensors and protocols for sensor data to be improved	Align with stakeholders and develop new projects in practice	SOOPS b.v., Wageningen UR, some regional stakeholders
Some farmers afraid of transparency	Develop governance solutions and business models to mitigate	MEF4CAP 4th paper Farmers' organisations
Find incentives for trading partners to provide digital data	Create a joint mission	MEF4CAP policy brief ?? accounting offices, FMIS suppliers, branch organisations
Not clear if current software companies want to invest in dashboard	Develop alternative collective solutions	MEF4CAP 4th paper Farmers' organisations
Government is non-interventionist	Create a joint mission	MEF4CAP policy brief ??

Comments and insights from the national workshops

- Several follow-up projects of regions, farmers organisations and agri-business on sensor data are interested in the dashboard with sensor and accounting data
- It is important to find an incentive for trading partners of the farm to digitize invoices; concentrate on the 20% companies that provide 80% of data necessary.
- A shared service to support the algorithms for indicators in robotic accounting might be an interesting option to investigate
- Current negotiations between Dutch government and the farm sector on the future of farming might support digital solutions as proposed

Reflections on the applicability of the DC results to other contexts

other users, member states, indicators

- Digital invoices: can be applied EU-wide. Also tested in DC 1 in Ireland
- Robotic accounting: can be applied EU-wide.
- Sensor and satellite technology: also relevant for water (pollution, use in irrigation), integration with machinery data. Can be applied EU-wide
- Farm Dashboard: can be applied EU wide. Useful to kick-off FSDN based on FADN.
  - In larger markets a market solution could be possible, in smaller markets a collaborative action could be desirable

ANY QUESTION?

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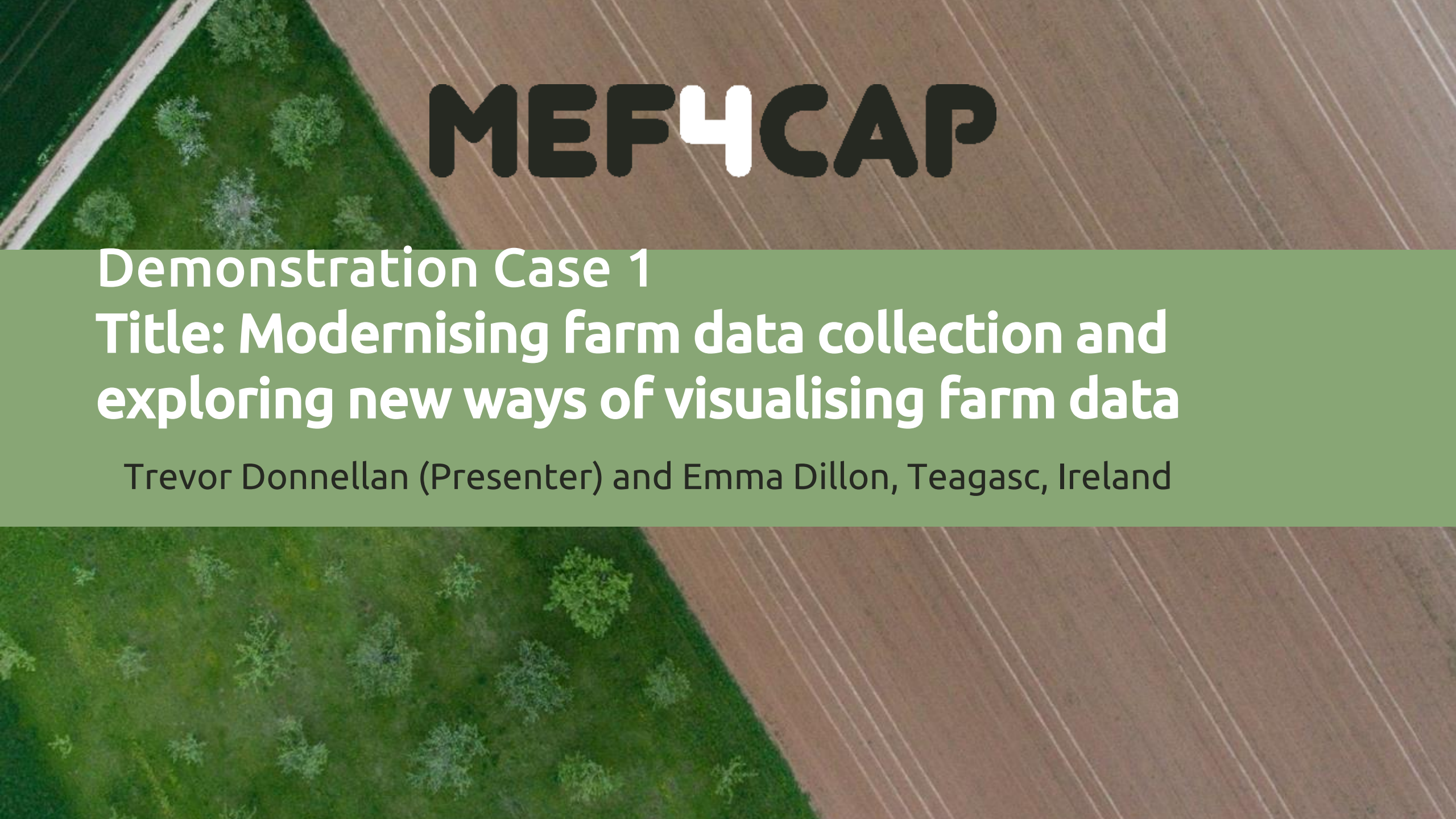

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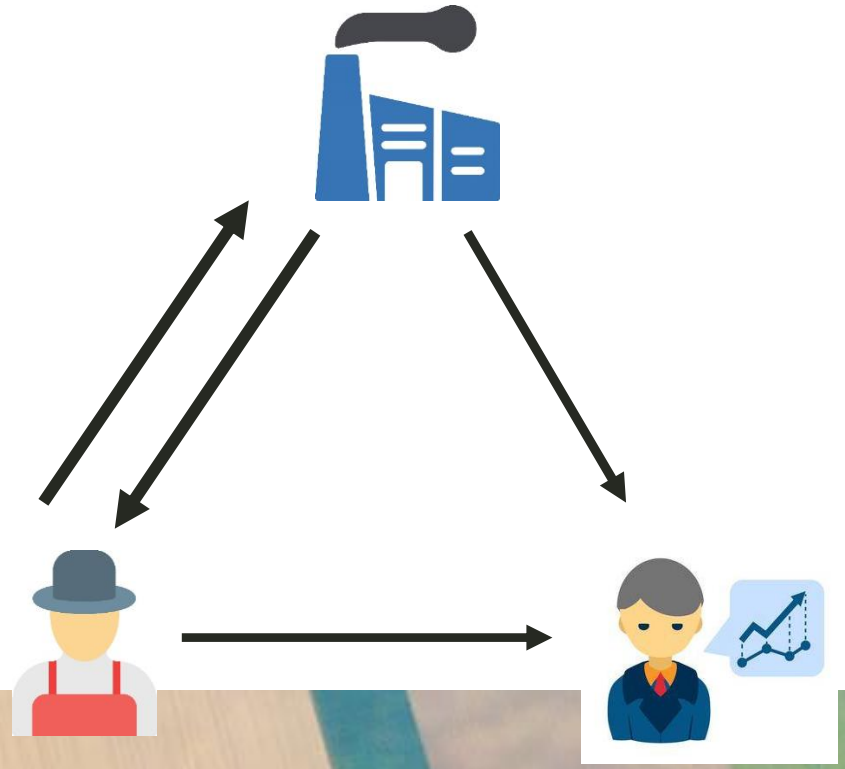
Demonstration Case 1
Title: Modernising farm data collection and exploring new ways of visualising farm data

Trevor Donnellan (Presenter) and Emma Dillon, Teagasc, Ireland

Digital Technology No 1

Digital Data Flows



To benefit the Farm Accountancy Data Network (FADN) **data collection agency (Teagasc) in Ireland**

Current manual data collection process could be **digitalised** by **automating data flows** from existing **databases.**

Investigating the feasibility of this by developing a digital **data flow from dairy processors** is one objective of this demonstration case.

Digitalisation of **other data flows** (such as from administrative data) **could also be explored**

Digital Technology No 2

Dairy Farm Sustainability Data Dashboard

Prototype farm sustainability dashboard for Key Performance Indicators (KPI) visualisation.

For use by **farmers, advisors**, **and researchers**.

In creating the dashboard, the objective was to make possible the interrogation of **farm level economic and environmental indicators**, and **to support learning** in the achievement of **improved farm sustainability.**

Discussions are ongoing with stakeholders on a final list of relevant indicators for dairy farms.

These would include metrics across the following themes: **Greenhouse gas emissions**, **ammonia emissions**, **water quality**, **biodiversity**, innovation, **soils**, **weather**, farm structure, **farm technical performance**, **production costs**, **profit** and **balance sheet data**.

Drivers for adoption of Digital Data Flows

- **What motivates Dairy Processor/Data Collection Agency to adopt Digital Data Flows?**

- **Reduced** data **collection burden** for data collection agency
- **Less time spent** by the **farmer** in providing data to the data collection agency
- Together the above would provide **potential for cost savings** and **time efficiencies** in the **data collection process**
- **Improved** data collection **efficiency and accuracy**
- **Fewer transcription errors**, reduced risk of disagreement with other data sources
- **Speedier reporting** of farm data for use by stakeholders and policy makers
- Scope to **collect a broader range of sustainability data** from farmers such as **social sustainability indicators** or evidence of environmentally sustainable changes in farm practices

Drivers for adoption of the Dairy Farm Sustainability Dashboards

- **What motivates Dairy farmers to adopt a Sustainability Dashboard?**

- **Efficient use of data** to facilitate **farm-level analysis** and **decision making** by farmers
- Provides more comprehensive data presented in a **user-friendly format**
- **Informs farmers** in terms of appropriate/identified **KPIs** for their farm
- Allows for more **tailored/bespoke farm advice** based on the (summarised) data
- **Provides data (and proof)** on the **sustainability status** of the farm, and trends over time
- Allows for the **benchmarking of farms** relative to other farms or relative to a target level of performance (with a range of performance metrics (KPIs) possible)
- Aids in **improved** (and informed) **farm management**
- A more digitally confident farmer in an ICT era

Possible actions to favour adoption of Digital Data Flows

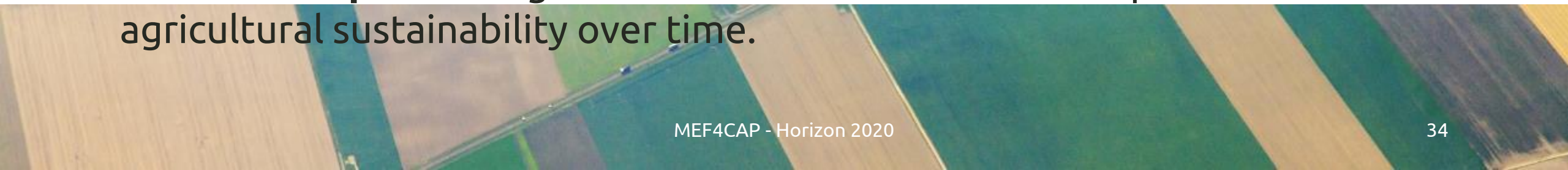
BARRIER	ACTION	WHO SHOULD TAKE THIS ACTION?
Requires **stakeholder** (in this **case dairy processor**) **buy-in** to facilitate digital data flows to data collectors	A clear **demonstration of benefits** such as **more timely, and detailed farm data** and the capacity to **better demonstrate** (prove) the **sustainability credentials** of dairy suppliers (farmers).	Data collectors/ Liaison agency/ Advisory services
Needs **farmer agreement**	**Engage and liaise with farmers** on the process involved and **benefits** of same.	Data collectors/ Liaison agency/ Advisory service
GDPR and **data sharing agreements**	Prepare a **clear briefing note** and agreement on data sharing for farmers. Undertake training for staff on their obligations.	Liaison agency
ICT and **human resources**	**ICT training** may be required for relevant staff. Likewise, **investment** will be needed to **refine the data sharing process**, and the logistics of same.	Liaison agency/ ICT colleagues

Possible actions to favour adoption of Dairy Farm Sustainability Dashboard

BARRIER	ACTION	WHO SHOULD TAKE THIS ACTION?
Concern around how the data will be used e.g. compliance	Involve farmers in the discussion at an early stage to **improve awareness and buy-in**.	Data collectors/ Liaison agency/ Advisory services / Processors
Concern about **data privacy**	Prepare a **clear briefing note** and **agreement on data sharing.**	Data collectors/ Liaison agency/ Advisory service
Skillset lacking for some	**Training** rollout	Liaison agency/ Advisory services
Reluctance to try something new – inertia/fear	**Engagement and education** to understand and reassure	Liaison agency/ Advisory services / Processors
Time constraints	**Engagement and education** to demonstrate benefits	Liaison agency/ Advisory services / Processors

Comments and insights from the national workshop on Digital Data Flows

1. There was broad agreement that **stakeholder buy-in is required** to ensure the smooth integration of data from disparate sources.
2. There needs to be **agreement and engagement with ICT colleagues** to facilitate the changes required so as to **ensure that ICT people are aware of the required data** for the digital data flow and in what **file format.**
3. **Relationship building and trust** in the **use and control of farmers' data** are crucial to ensure **continued farmer authorisation of the digital data flow** process.
4. The use of the **data to facilitate the calculation of sustainability metrics** is **of crucial importance** given the need to demonstrate improvements in agricultural sustainability over time.



Comments and insights from the national workshop on Dairy Farm Sustainability Data

1. Broad **community of stakeholders** in the agri-food sector need to **promote its use by farmers**, therefore enabling them to take actions to improve farm sustainability.

2. **Capacity to demonstrate farm improvement in sustainability over time**. The **dashboard** that has been developed should **not be considered as a finished product**. **Ongoing refinement** of the dashboard is likely to be necessary given the **evolving monitoring and evaluation framework** in the new CAP, and **commercial pressures coming from industry and consumers** to improve sustainability across a wide **range of topic areas.**

3. **Dashboards are a powerful tool**, bringing the capacity to analyse data in many different ways. **However**, some **concerns** were voiced by **dairy processors and farm extension experts** in knowledge transfer that the **farmer may be overwhelmed with data** and may **struggle to draw key inferences** to identify the actions necessary.

Reflections on the applicability of the DC results to other contexts

Digital data flows:

1. **Piloted with dairy farms** but could be **generalised to other farm types** and could be **adopted in other Member States**.
2. **Other sources of data could be utilised** e.g., administrative data or other commercial data for agriculture (from e.g. banking institutions or other input suppliers, other types of farm data or datasets relating to e.g., weather, soil and grass growth).

Sustainability dashboard:

1. **Piloted for dairy farms** but could be **adapted to cover other farm types**.
2. **Other sources of data could be utilised** and indicator sets could be widened as appropriate.
3. The dashboard could also **allow for the benchmarking of individual farm performance** against the average farm in the population or against the better performing farms.
4. Although the **prototype dashboard** has been **developed for Ireland**, there is **potential for this format** to be **used across other Member States**.

ANY QUESTION?

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Demonstration Case 1 - PL
Integrating and digitalizing administrative data in FADN to support efficient and sustainable fertilization

Zbigniew Floriańczyk, Institute of Agriculture and Food Economics - NRI

Short description of the DC: support for fertiliser management

- Context, rationale and objectives:
  - Growing interest in environmental aspects of agriculture production requires more specific and detailed information on farm level.
  - Small farms have limited capacity to collect additional information and to analyze new indicators.
  - Part of the information needed for calculation new indicators is collected by administration.
  - In order to decrease additional burden on farmers and advisors connected with new indicators direct transfer of digital administrative data was proposed.
- The stakeholder(s) considered:
  - farmers, advisory, agricultural policy stakeholders.

The digital technologies

- **The flow of digitalized information:**

  Currently data on fertilizer use, collected for FADN purpose, is aggregated at farm level and reported to farmers as an element of total costs of production.

  Direct transfer of data from Paying Agency regarding parcels and crops to FADN is a base for simplification of new indicators generation.

  Finally linking administrative plot data with additionally collected data on mineral and organic fertilizer applications and catch crops would allow for new indicators calculation – balance of NPK on plot level.

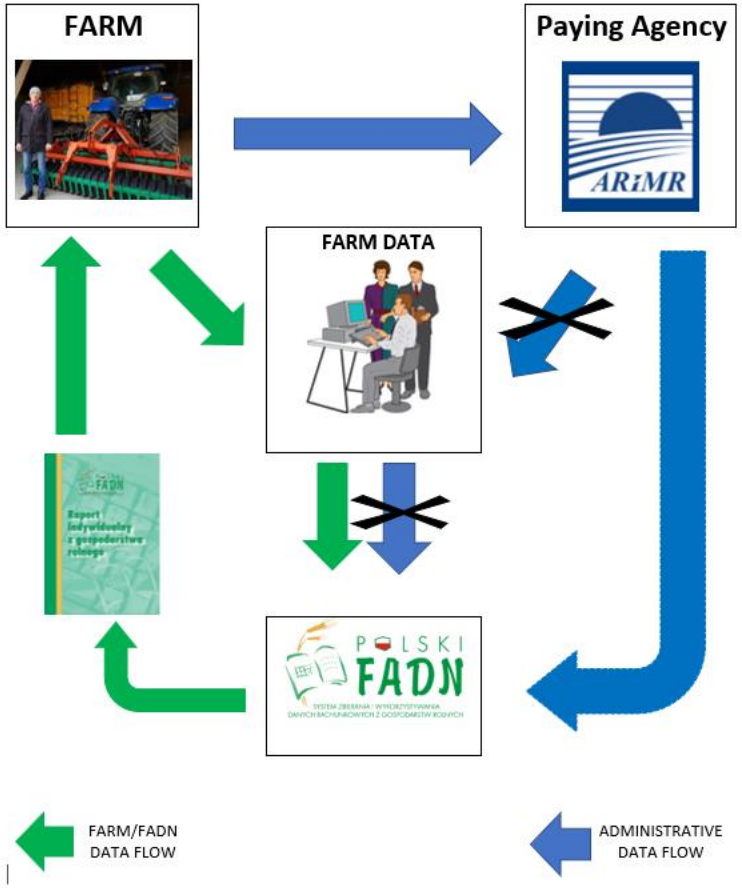
- **Ambitions**:

  Provide information that support fertilizer management on farm level.

  Reduce farmers effort in obtaining new indicators as much as possible.

  Integrate administrative data with FADN.

  Provide solutions with upscaling application potential.



The technology “readiness”

- The flow of digitalized information between administrative body and FADN sounds ready to implement but:
  - inconsistency of data definitions collected for administrative purposes and FADN require additional manual work to combine them: names of crop products and administrative databases are not matching names of products reported in FADN system.
  - real data collected by FADN not necessary corresponds with administrative data. Transfer of digitalized information require manual assistance to adjust administrative data to real situation. This however creates uncomfortable situation for farmer – revelation of farmers „wrongdoing”.

- Flow of digitalized information from administration to FADN requires changes in data protection regulations. Despite farmers agree to transfer administrative data to FADN internal procedures of administration bodies do not allow for this.

The indicators

Indicators selected for DC 1:

- Nitrogen Balance per Hectare
- Phosphorous Balance per Hectare
- Nitrogen Use Efficiency per Farm
- Phosphorous Use Efficiency per Farm

Due to the sensitivity of the indicators to other factors, e.g. rainfall, soil moisture, experts suggest periodical application of soil tests to cross check accuracy of the calculated indicators.

Comparison of new indicators values between farms is complicated while adjustment to local uncontrolled conditions such as weather, must be taken into account.

Drivers for adoption

- Farmers want to increase farm income and growing costs of fertiliser motivate them to look for alternatives (catch crops, natural fertilizer).
- Protection of scare water resources results in growing interest in monitoring farm fertiliser practises.
- Consumers and policy makers recognise problem of food security dependency on imported components of fertiliser.
- Researchers and agriculture policy analytics desire more detailed data.
- There is a need to reduce burdens of farm data collection.

Barriers to adoption

FARM/SOCIAL:

- collection of additional, more accurate data on fertilizers application at plot level is a significant problem for farmers - requires additional effort.
- problem of potential disclosure of administrative data inaccuracy.

METHODOLOGICAL:

- inconsistency of definitions applied in FADN and administrative databases.
- accuracy of new indicators.

ORGANIZATIONAL:

- legal solutions allowing for data flow between organizations.

Possible actions to favour adoption

- Given these barriers, which actions or measures do you think should be in place to overcome them? By whom?

BARRIER	ACTION	WHO SHOULD TAKE THIS ACTION?
FARM/SOCIAL	Insure, that there is a value for farmers of new indicators and secure protection of information.	ADVISORY, FADN.
METHODOLOGICAL	Unification of definitions used in administrative data that are collected for CAP purposes.	MARD, PA, FADN, EU COMMISSION.
ORGANIZATIONAL	Change in regulations allowing for direct data transfer form administration for research purposes.	MARD, EU COMMISSION.

Comments and insights from the national workshops

- Advisors that participated in national workshop expressed the need for training to support farmers with new indicators interpretation.
- Majority of the small farmers are rather disinterested in undertaking heavy investments to increase farm activity while there is also a problem of succession in their farms.
- On the other hand, in some large farms advanced technologies supporting fertilization management (e.g. machinery equipped with technologies automatically recording and transferring data on fertilizer application at plot level for farm management purposes) are already in use.
- Researchers are interested to obtain new indicators and consider them essential for future CAP analysis.

Reflections on the applicability of the DC results to other contexts

other users, member states, indicators

Despite the declarations of policy makers, the future of small family farms is rather murky. The cost of new technologies makes them affordable only for bigger farms, which deepens the technological gap between the two. One can expect some dramatic structural changes in the near future followed, only then, by a broader adoption of new technologies.

Application of solutions elaborated in Poland are rather country specific but barriers can be observed in other Member States.

ANY QUESTION?

Presentation by:

Zbigniew Floriańczyk

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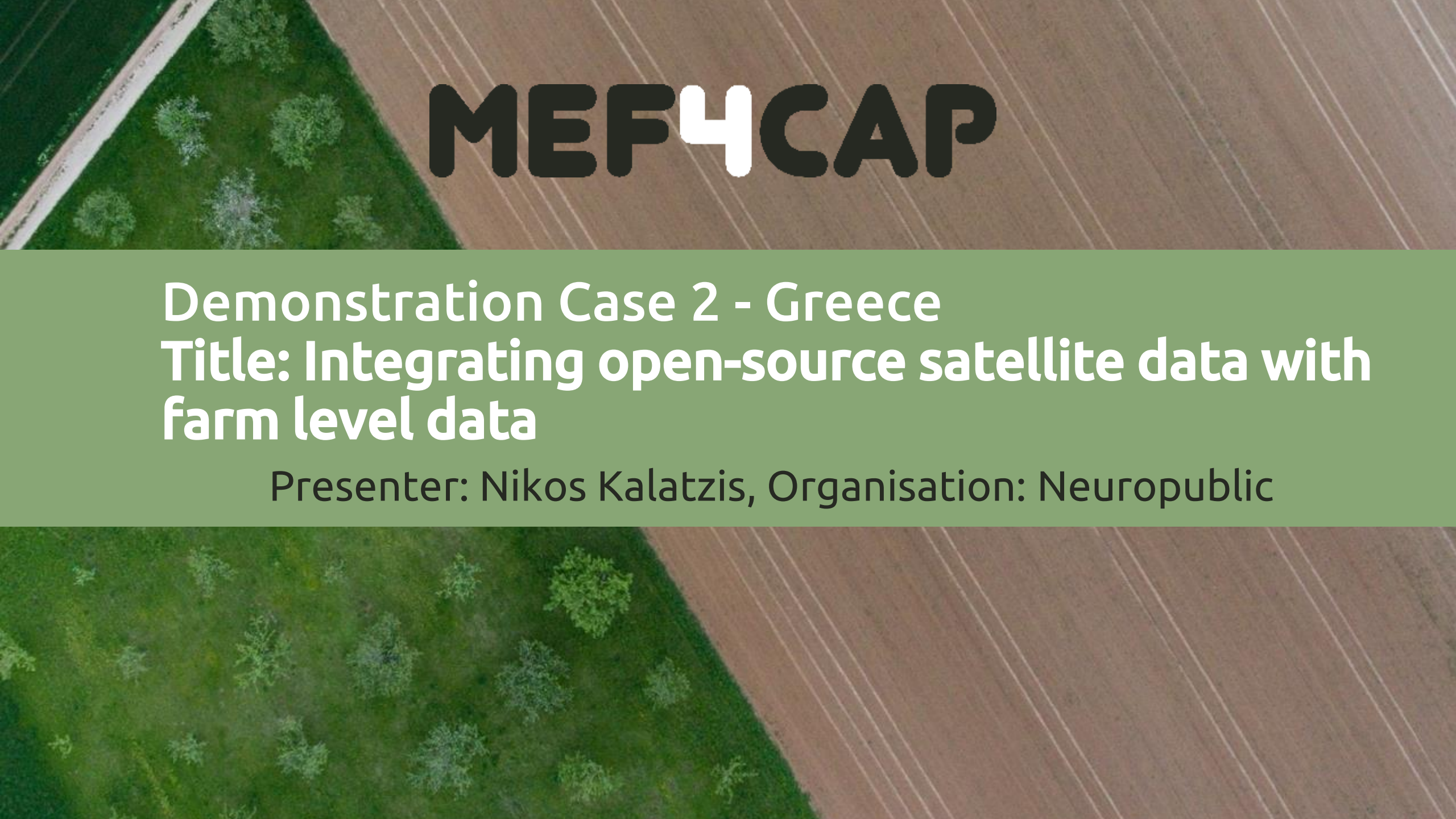


Demonstration Case 2 - Greece

Title: Integrating open-source satellite data with farm level data

Presenter: Nikos Kalatzis, Organisation: Neuropublic

Short description of the DC

- **Digital farm calendars** and **agricultural decision support systems** (FMIS) are already in use and contain data needed for policy monitoring.
  - ✓ FMIS offer data-driven advice for optimised use of inputs (e.g. pesticides, fertilises, irrigation)
  - *Can we use FMIS as farm-level data repositories (DB) and gateways (API) for calculating and sharing farm level aggregates?*
  - *Can Farmers and Advisors be an integral part of the policy monitoring process? Incentives and benefits?*

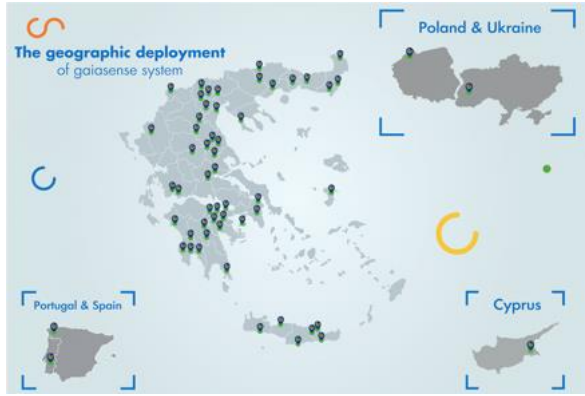
- Design, implementation and testing of an **"Agri-data aggregation platform"**
  - Mechanisms for **close-to-real-time calculation of performance indicators and aggregates** at parcel and/or group of parcels level (e.g. farmers association).
  - Controlled sharing of calculated outcomes with Advisors, Farmers, Policy makers - Ensure Role-based Access Control on data outcomes/aggregates.

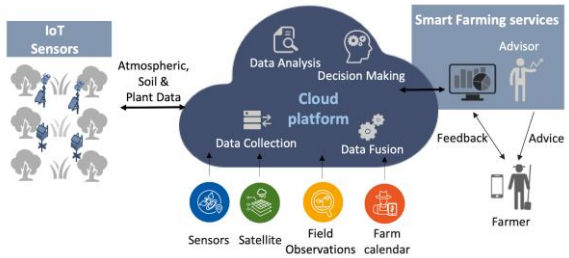
The digital technologies

- Tested with the use of “gaiasense” Smart Farming Solution
- ~400 IoT stations, ~70.000 ha, ~26 different crops
- A tool for advisors and farmers
  - Advice on irrigation, fertilization, crop protection
  - Supports certification audits (e.g., GlobalGAP, organic, subsidies)
  - Traceability

“Agri-data aggregation platform”

- Create/update/remove a group of parcels
- Calculate aggregates and **performance indicators** for parcels basd on user defined time-frames
- Share calculated aggregates with farmers

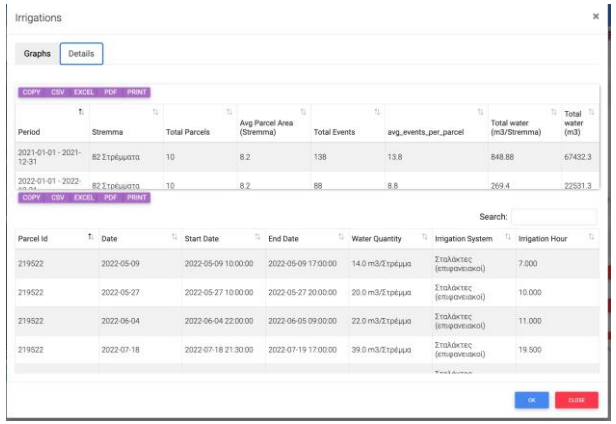


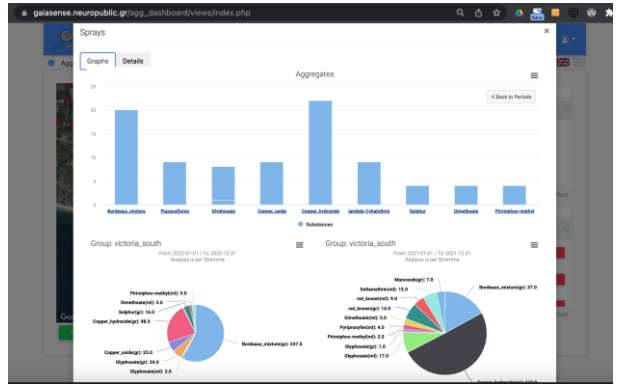


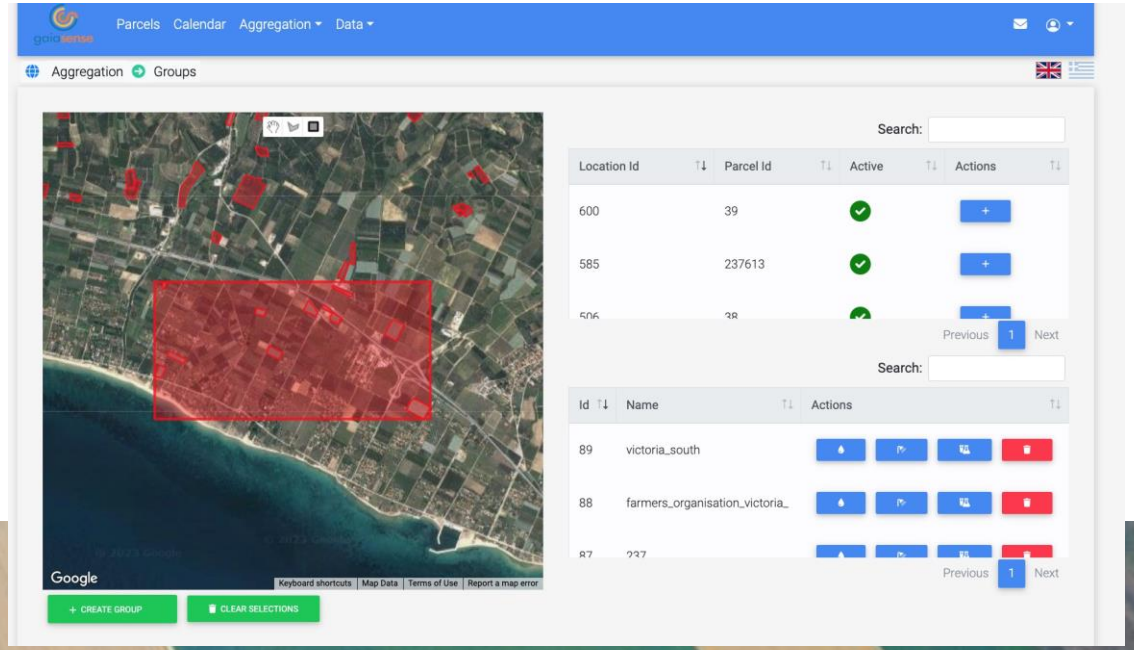
Technology	Properties
Digital Farmers Calendar	Data on Applied Farming practices
Agro-environmental sensors	Supportive evidence on practices
Satellite based EO	Calculated Indices relevant with agricultural activity
Information systems	Calculation of aggregates/ indicators, Controlled sharing of data (API), Export to file (pdf, xls, csv

The technology “readiness”

- FMIS are available in the market as operational/commerial solutions.
- There is a need for better **alignment and interoperability** among systems for more accurate data recordings
  - Common EU wide semantics for pesticides and fertilisers
  - Common data models and APIs for calculated indicators
    Directions on measurement units – methods for calculation
    (DIVINE project extending AIM data model for CAP indicators)





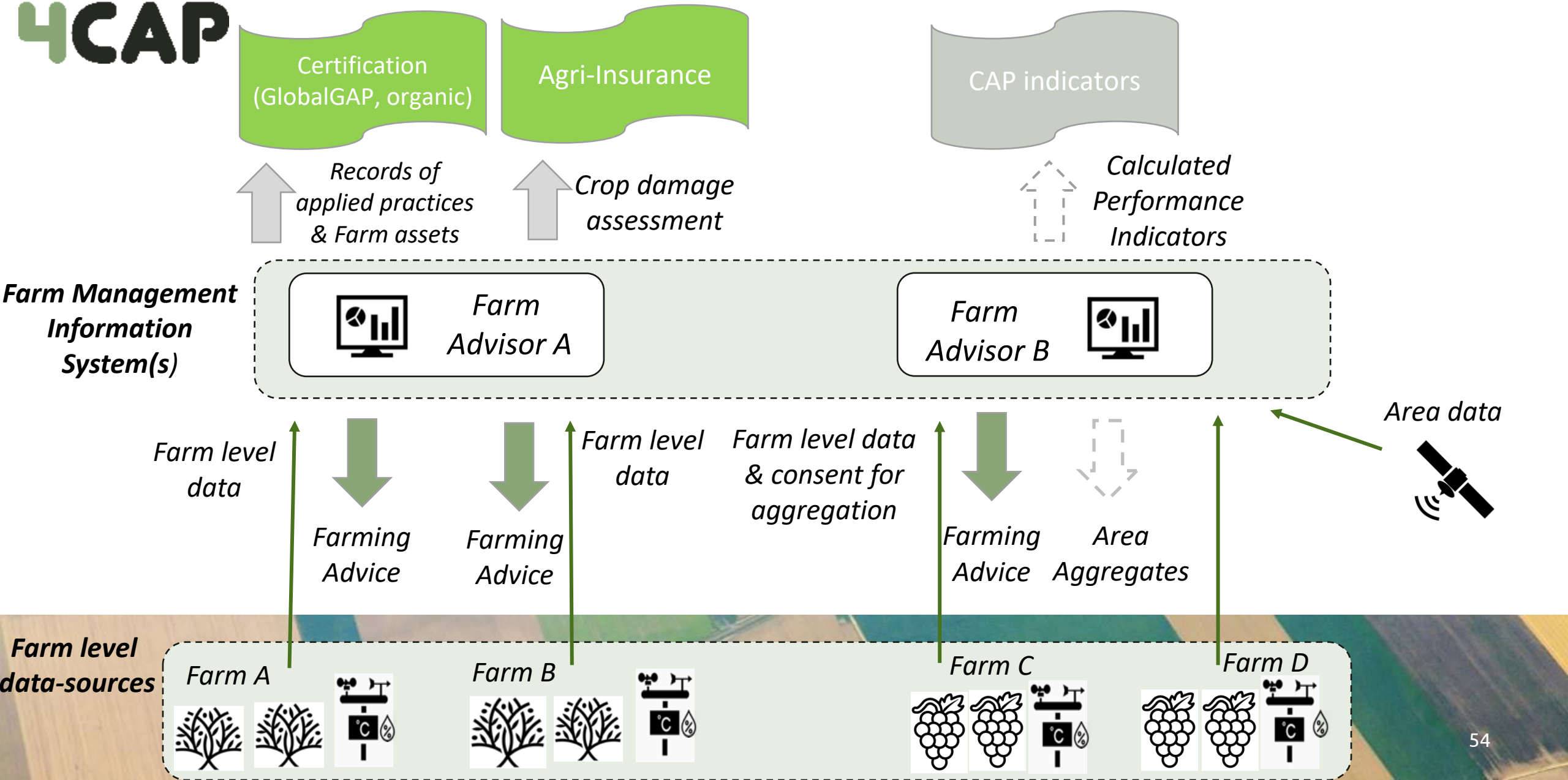


The indicators

Indicators	Description
Fertilisations application	Date-time, type of chemical, dose and their aggregates.
Pesticides application	Date-time, type of chemical, dose and their aggregates.
Irrigation	Date-time, volume and their aggregates.
Land management	Date-time-frequency of Ploughing
Harvests	Date-time, quantity, quality

Time period and (group of) parcels defined by the user (advisor)

Data flows


Certification (GlobalGAP, organic)
Agri-Insurance
CAP indicators
Records of applied practices & Farm assets
Crop damage assessment
Calculated Performance Indicators
Farm Management Information System(s)
Farm Advisor A
Farm Advisor B
Area data
Farm level data
Farming Advice
Farming Advice
Farm level data
Farm level data & consent for aggregation
Farming Advice
Area Aggregates
Farm level data-sources
Farm A
Farm B
Farm C
Farm D

Drivers for adoption - Farmer

- **Automate reporting obligations** (e.g., subsidies, pesticides use, certifications for Organic, GlobalGAP, traceability for selling fruit/vegetables, etc.)
- Provide criteria-based **benchmarking of farm's performance** – compare with last year and/or other farms in the area.
- Allow **cross-farm information sharing** in a protected manner (farmer has access on applied practices and conditions in other farms in the area in pseudonymized manner).
- Save time – User friendly visualization of farm's status.

Drivers for adoption - Advisor

- **Reduce advisors' burden on reporting needs.**
  The presented dashboard automates the extraction of reports (e.g., subsidies, pesticides use, certifications for Organic, GlobalGAP, traceability for selling fruit/vegetables, etc.).

- **Provision of more informed advice**.
  The advisor uses a single dashboard to view evidence from a group of farms, but also on individual farm bases. For example, identify anomalies in the use of inputs (e.g., when a parcel is overirrigated) and to react in a direct manner.

- The advisor can **demonstrate the performance and quality for a group of farms** (e.g., farmers association) to new potential customers (e.g., fruit processing factory). Support the faster building of trust even between organizations and people who didn't know each other.

Possible actions to favour adoption

Farmer

BARRIER	MEASURE	WHO SHOULD TAKE THIS MEASURE?
Farmers' age and lack of training	Generational handover + training	Advisory services / Government / regional administration
Lack of experience in digital techs	Training and real cases	Advisory services / Government
Administrative burden/workload especially on manual data input.	Technical means to make data entry easier. Provide incentives to farmers that provide rich and accurate data.	Advisory services / Government / regional administration
Reluctance to share data	Provide incentives for data sharing (e.g., access to regional data outcomes) Reassure farmers that sharing of their data will not cause penalties.	Government / regional administration
Investment Cost	Market competition/forces will lower the cost eventually	Government should provide incentives
Low connection in rural areas	Infraestracture investment	Government / Private companies
Farmer's data used for control vs policy improvements	Strategy	Government

Possible actions to favour adoption

Advisor

BARRIER	MEASURE	WHO SHOULD TAKE THIS MEASURE?
Data sharing issues	Give incentives/reward for sharing/build trust	Advisory services / Government / regional administration
Administrative burden/workload	Support end users	Advisory services
Lack of training	Training and real cases	Advisory services / Government / regional administration

Comments and insights from the national workshops

On line workshop 28/2/2023 - 1.5 hours, 50 participants - mostly farmer advisors, farmers, farmer organizations. Feedback through questionnaires.

Key outcomes:

- Farmers are willing to share part of their farm-book data with other producers in the area (e.g. members of the same cooperative). Incentives for data sharing:
  a) 45% get similar data from other parties
  b) 15% financial benefits

- Advisors where more responsive and more willing to test the “Agri-data aggregation platform”.
- In many cases, farmers are still not well familiar with the use of such systems – Advisor help is necessary.

Reflections on the applicability of the DC results to other contexts

- Great and yet unexplored potential in the **use and sharing** of agricultural **aggregates** especially for **area based -** group of farms
- Use of FMISs a mandatory prerequisite for the applicability of the results
- Easy to be applied for farms using the same FMIS.
  - Access control and GDPR issues
- More challenging to be applied for farms using different FMISs.
  - Data interoperability, Access control and GDPR issues

ANY QUESTION?

Presentation by:

Nikos Kalatzis

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Demonstration Case 2
Integrating open-source satellite data with farmer level data

Pablo Fernández Álvarez de Buergo

Cooperativas Agro-alimentarias de España (Spanish Co-ops)

cooperativas agro-alimentarias España

INSTITUTO TECNOLÓGICO AGRARIO
Junta de Castilla y León
Consejería de Agricultura y Ganadería

Short description of the DC

Case-country context:

EU Farm to Fork strategy will ensure that farmers keep more detailed tracking of all the tasks they carry out in their holdings. **Special concerns are on the use of fertilisers, pesticides and water**.

SIEX and related regulations enforce to provide this information (mainly fertilisers and pesticides treatments) **on a monthly basis** (after each treatment/application) **through digital means** from September 2023 onwards (one of the main novelties for the new CAP period in Spain).

Expected outcomes:

- An easy-to-use digital farm book which integrates into a GIS both in-farm and out-farm data for a better decision making.
- Farm book API development to communicate the required information to the administration and download the farms holdings available information. The adequate aggregation of farmers' data will result in indicators for CAP monitoring and evaluation purposes.
- A friendly system for tracking data at farm level in cooperative frameworks and available to be replicated beyond grapevines sector.

The stakeholder(s) considered:

Farmers and advisory services in cooperatives

The digital technologies

Digital farm book & GIS integration:

- ✓ In-farm data: crop, area (LPIS), yield, inputs consumption (water, fertiliser, pesticides), application dates.
- ✓ Out-farm data: earth observation (Sentinel 2), meteorological (AEMET & SiAR) and soil information (LUCAS and regional databases when available).

The technology "readiness"

- ✓ Commercial technology already in place and well tested (digital farm book & GIS).
- ✓ High average age of the Spanish farmers + lack of knowledge in digital technologies→barriers
- ✓ GIS Training to >500 staff from the cooperatives' advisory services
- ✓ Next step→training in the digital farm book

CURSO

USO DE LA INFORMACIÓN GEOGRÁFICA EN COOPERATIVAS AGROALIMENTARIAS EN ENTORNO ARCGIS HUB

- Dirigido a: **Servicios agronómicos y veterinarios de las cooperativas.**
- Formato: **Online.**
- **La realización del curso permitirá el acceso posterior de la cooperativa a una licencia de acceso al sistema SIGCEX y al Cuaderno de explotación.**

¿Dispone tu cooperativa de una solución de cuaderno de explotación digital ya implementada?

The indicators

KPI
KPI_1 N Balance per Hectare
KPI_2 P Balance per Hectare
KPI_3 K Balance per Hectare
KPI_4 Crop Rotation
KPI_5 NH_3 Emissions per Farm
KPI_6 NH_3 Emissions per Hectare
KPI_7 Adoption of (Natural) Biocontrols on Farm
KPI_8 Pesticide Use on Farms
KPI_9 Carbon Sequestration per Hectare
KPI_10 Water consumption
KPI_11 Pesticide risk on Farms

Data flows

Mandatory request

Opportunity

C3 hispatec agrointeligencia

SIGC3X esri

Cuaderno digital de Explotación (CUE)

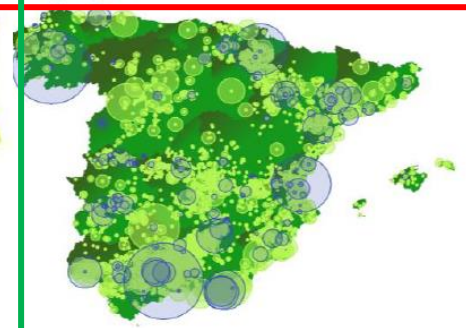
CCAA

Registro de Explotaciones Autonómico (REA)

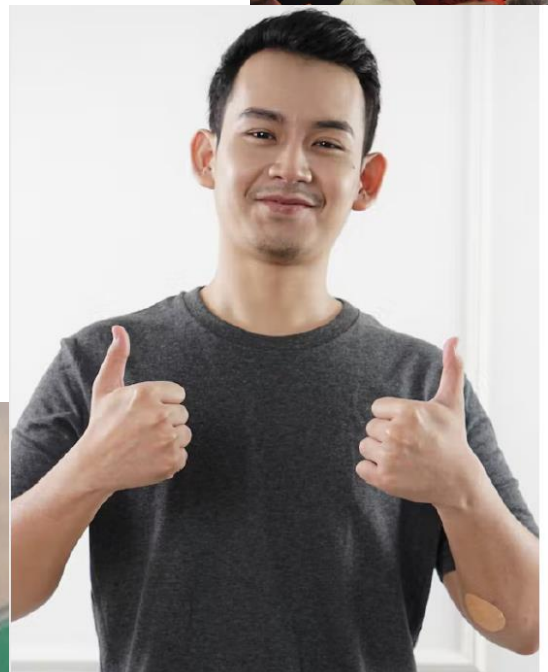
CCAA

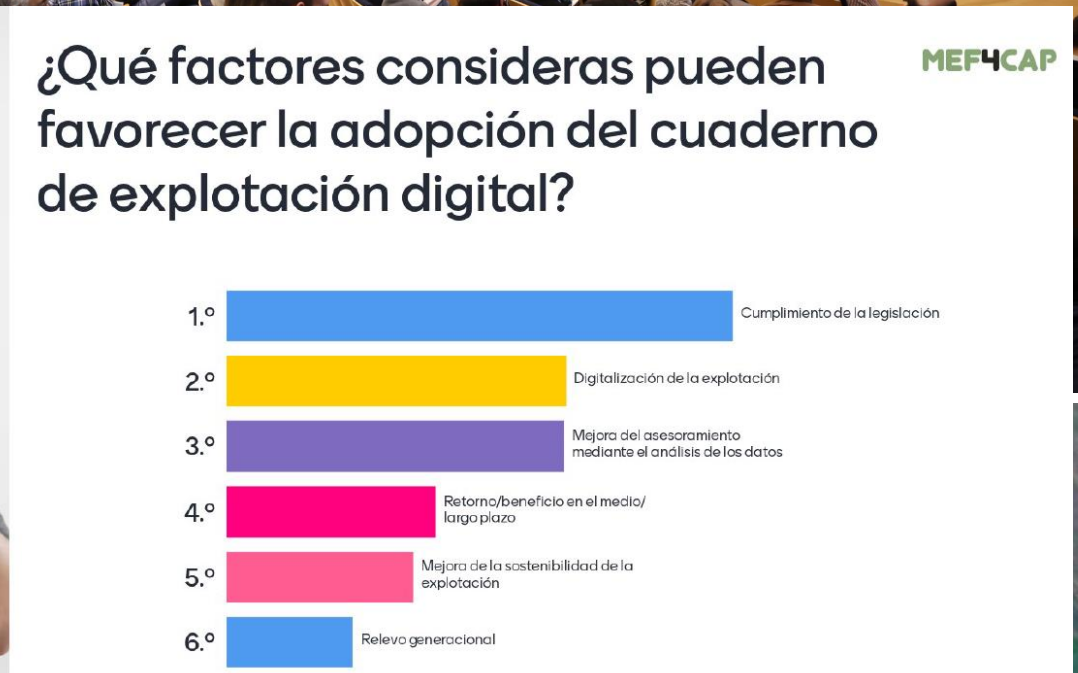
SIEX

Nacional



Comments and insights from the national workshops





INSTITUTO TECNOLÓGICO AGRARIO

Reflections on the applicability of the DC results to other contexts

COMMISSION IMPLEMENTING REGULATION (EU) 2023/564

of 10 March 2023

as regards the content and format of the records of plant protection products kept by professional users pursuant to Regulation (EC) No 1107/2009 of the European Parliament and of the Council

(Text with EEA relevance)

- **Obligation to record the information** set out in Annex I is established:
  - ✓ type of use (surface treatment, indoor treatment or treatment of seeds or plant propagating material)
  - ✓ plant protection product used (name and registration number)
  - ✓ date of use
  - ✓ application rate
  - ✓ location or area/unit treated
  - ✓ the size or quantity of the area or unit treated
  - ✓ and crop or use
- It specifies the **obligation for the professional user to transfer this information into electronic format at the latest 30 days after the date of use of the plant protection product.**
- **It shall apply from 1 January 2026**.

ANY QUESTION?

Presentation by:

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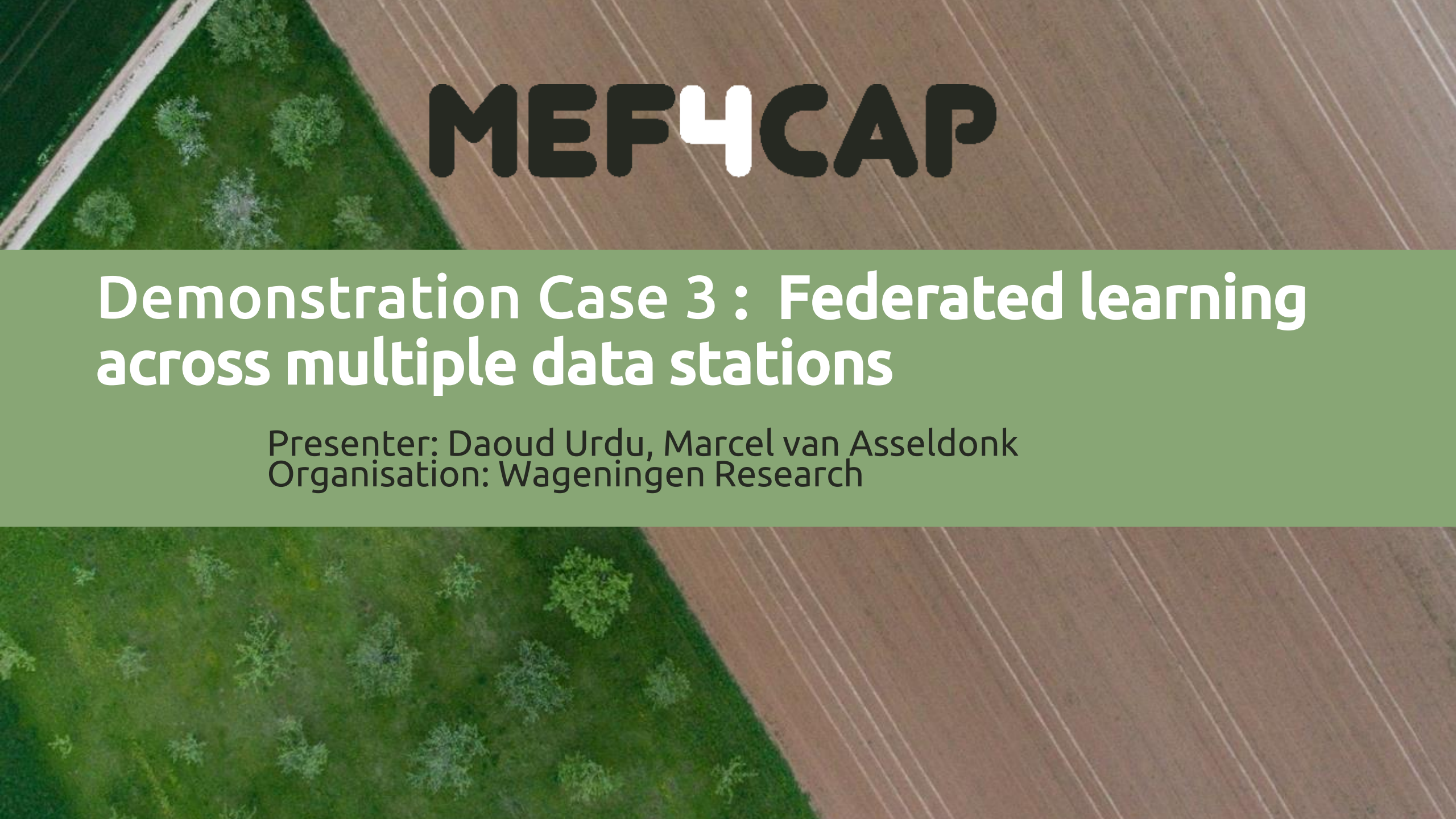


Demonstration Case 3 : **Federated learning across multiple data stations**

Presenter: Daoud Urdu, Marcel van Asseldonk
Organisation: Wageningen Research

Short description of the DC

- Context, rationale and objectives
  - From a compliance perspective: individual farmer data cannot be shared without consent
  - GDPR by-design: GDPR compliance is an essential motivation for this demonstration case.
- The stakeholder(s) considered: data providers, users, others if relevant
  - Data providers: FADN Liaison Agencies, for example Teagasc in Ireland, NRI in Poland and Wageningen Economic Research in the Netherlands
  - Users: CAP Policy analysts, for example researchers and policy makers
  - Data infrastructure providers, for example internal IT department or external IT company

The digital technologies

- The proposed federated learning setup allows data to be shared in a GDPR compliant manner. The raw source data is made autonomously accessible for analysis purposes and the user receives only result summaries
- See the next slide for an overview of reusable components

Reusable components

Towards Federated Learning

Data Station:
- Provides FAIR access to data and metadata
- Allows train (model to access and interface with data)

FAIR DATA POINT

Data Gateway:
- Authorization and
- Authentication with restricted access to data

VANTAGE

Train:
- Interacts with data (these are models that processes data including analysis)

docker

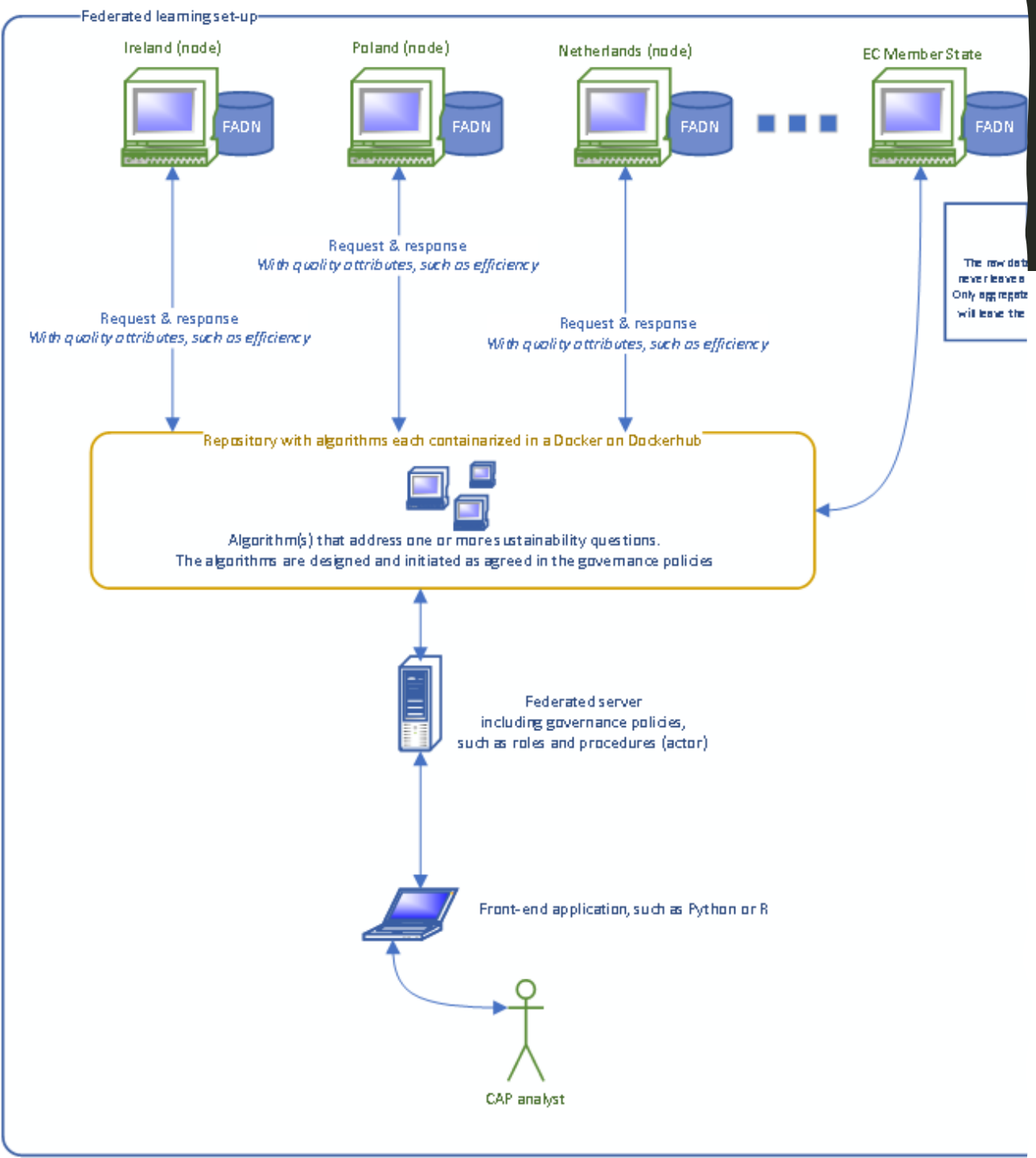
Tracking System:
The routing of models and transport infrastructure

The technology “readiness”

- What is the “readiness” (from a technological and social perspective) of the technologies suggested in this DC? Are these ready to be adopted ? Or do they need more time and if so, why?
  - Since this is a rather novel technology, the readiness from a technological perspective is rather low. This case have demonstrated the set-up and will publish a paper on the findings. From a social perspective, the readiness is even lower since no usability tests and no social impact assessment has been conducted

The indicators

- What are the resulting indicators ?
  - Additional diverse set of indicators collected by FADN liaison agencies in addition to FADN variables, including among others more social related indicators.



Data flow

Federated set-up for this demonstration case

Drivers for adoption

- What motivates the stakeholder(s) to adopt the technologies?
  - GDPR by-design, a privacy preserving infrastructure for improved data-sharing
  - Semantic Interoperability (data harmonization) is a potential and a precondition for the design, development and implementation of this technology

Barriers to adoption

- Which barriers do you think the stakeholder(s) faces, to adopt the technologies?
  - Organizational: existing business processes and procedures are there for a long time. It takes time and effort to change these.
  - Data harmonization and standardization requires coordination of bringing different stakeholders together and agree on the semantics.

Possible actions to favour adoption

- Given these barriers, which actions or measures do you think should be in place to overcome them? By whom?

BARRIER	ACTION	WHO SHOULD TAKE THIS ACTION?
Organisational	Define tasks for implementing the change (privacy preserving data sharing) for the FADN/FSDN	FADN Liaison Agencies
Data harmonisation	Define tasks for the coordination of bringing different stakeholders together and agree on the governance and semantics	FADN Liaison Agencies

Reflections on the applicability of the DC results to other contexts

other users, member states, indicators

- The results of this DC will be published in a scientific article and is expected to be useful for the scientific community in data science, artificial intelligence and agricultural policy. The technology could also be applicable to other food and agricultural contexts that require data sharing in a privacy friendly way, current examples could be the development of agricultural data spaces for the data economy.

ANY QUESTION?

Presentation by:

Daoud Urdu, Marcel van Asseldonk

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Demonstration Case 4
New ways for monitoring agri-environmental measures

Pablo Fernández Álvarez de Buergo

Cooperativas Agro-alimentarias de España

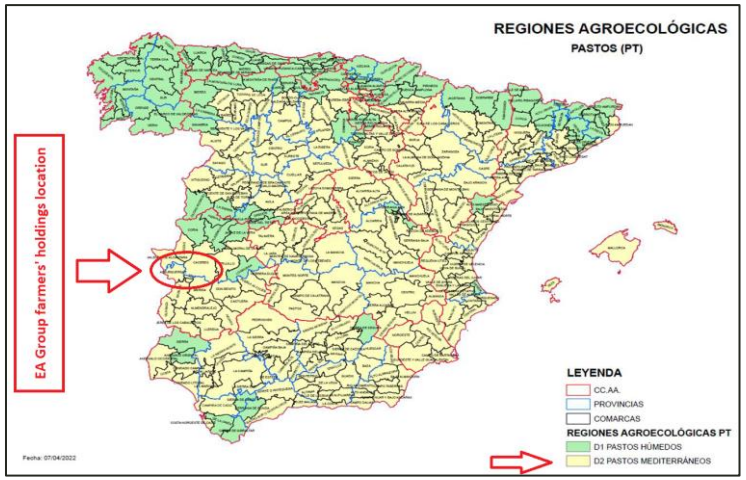
cooperativas agro-alimentarias España

Short description of the DC

General aim: To test how agri-environmental data is used and integrated between CAP and other environmental monitoring.

Easily replicable and affordable methodology for farmers in our cooperatives that:

- Demonstrates to paying agencies that herds graze outdoors at least 120 days per year with a maximum stocking rate of 1.2 LU/ha (extensive grazing eco-scheme).
- Provides proxy-information on carbon sequestration of livestock (through manure/slurry depositions).
- Provides information on the degree of intensification or abandonment of grazing areas.



The digital technologies

- **26 GPS trackers spread over three different flocks** (about 1,000 heads) to monitor one batch (about 250 sheeps) in each of them.
- **Three different GPS trackers technologies in place**:
  - SIGFOX
  - SIGFOX with SD storage
  - GSM (2G network)
- **Geographical Information System (GIS) to integrate** EO **data** (Sentinel-2) and near-real-time GNSS positioning services, including in-farm data such as areas (LPIS), herd features (type, age, cycle stage), etc..
- **Very low data submission rate per farm** (low connectivity in the área):
  - Alburquerque (SIGFOX): 5%
  - Torrejón el Rubio (GSM): <10%
  - Villanueva de la Serena (SIGFOX & SIGFOX SD): <10%

The technology “readiness”

- ✓ Commercial technology already in place and well tested (both for the GIS and GPS trackers).
- ✓ High average age of the Spanish farmers + lack of knowledge in digital technologies → barriers
- ✓ GIS Training to >500 staff from the cooperatives’ advisory services
- ✓ GPS trackers technology Works well for this DC targets using SD cards, but not for real time monitoring of the flocks→Connectivity must improve in rural areas

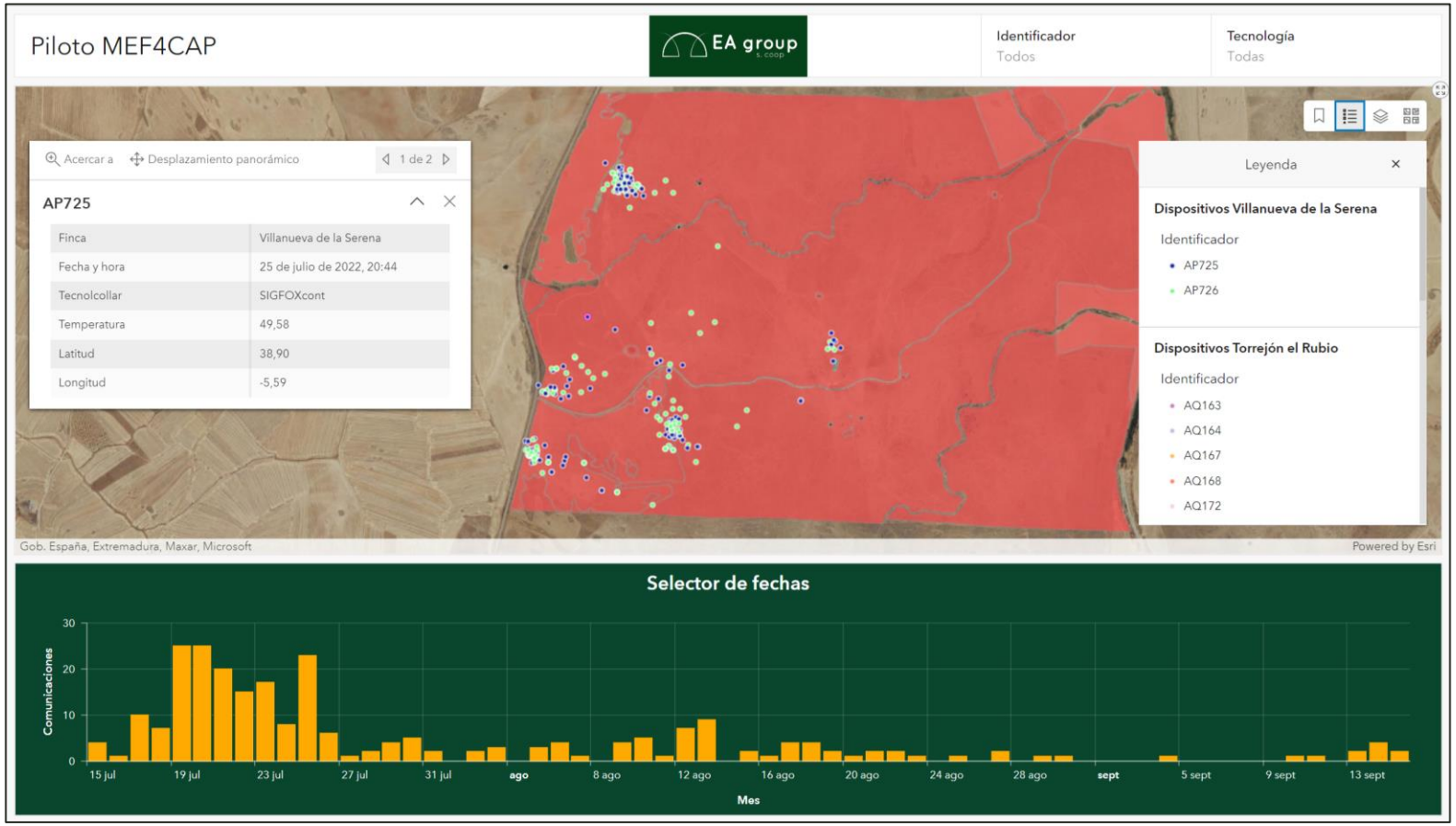
The indicators

KPI
KPI_1 Carbon Sequestration per Hectare
KPI_2 Cattle load per hectare
KPI_3 Days/hours of outdoor grazing

Data flows

- GPS trackers data (time, temp., etc.)

- EO data (Sentinel-2)
- In-farm data
  - ✓ Areas (LPIS)
  - ✓ Herd features (type, age, cycle stage)
  - ✓ etc..



Drivers for adoption

STAKEHOLDER	DRIVERS
Famers	Young farmers interest in the adoption of new technologies
Famers	Economic + time savings
Farmers	Measuring carbon sequestration will provide positive arguments
Advisory services	Performance improvement
Advisory services	Decrease of work load (long term)

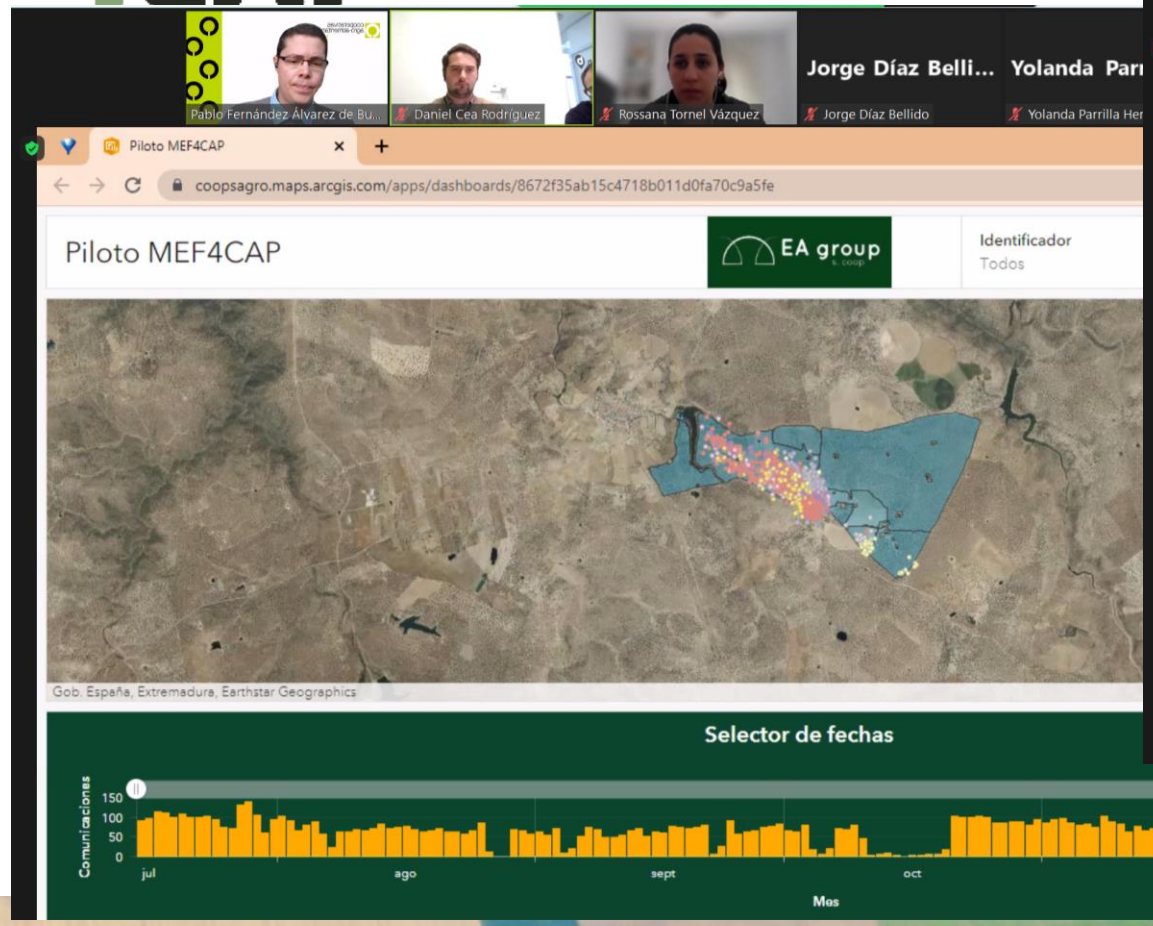
Possible actions to favour adoption

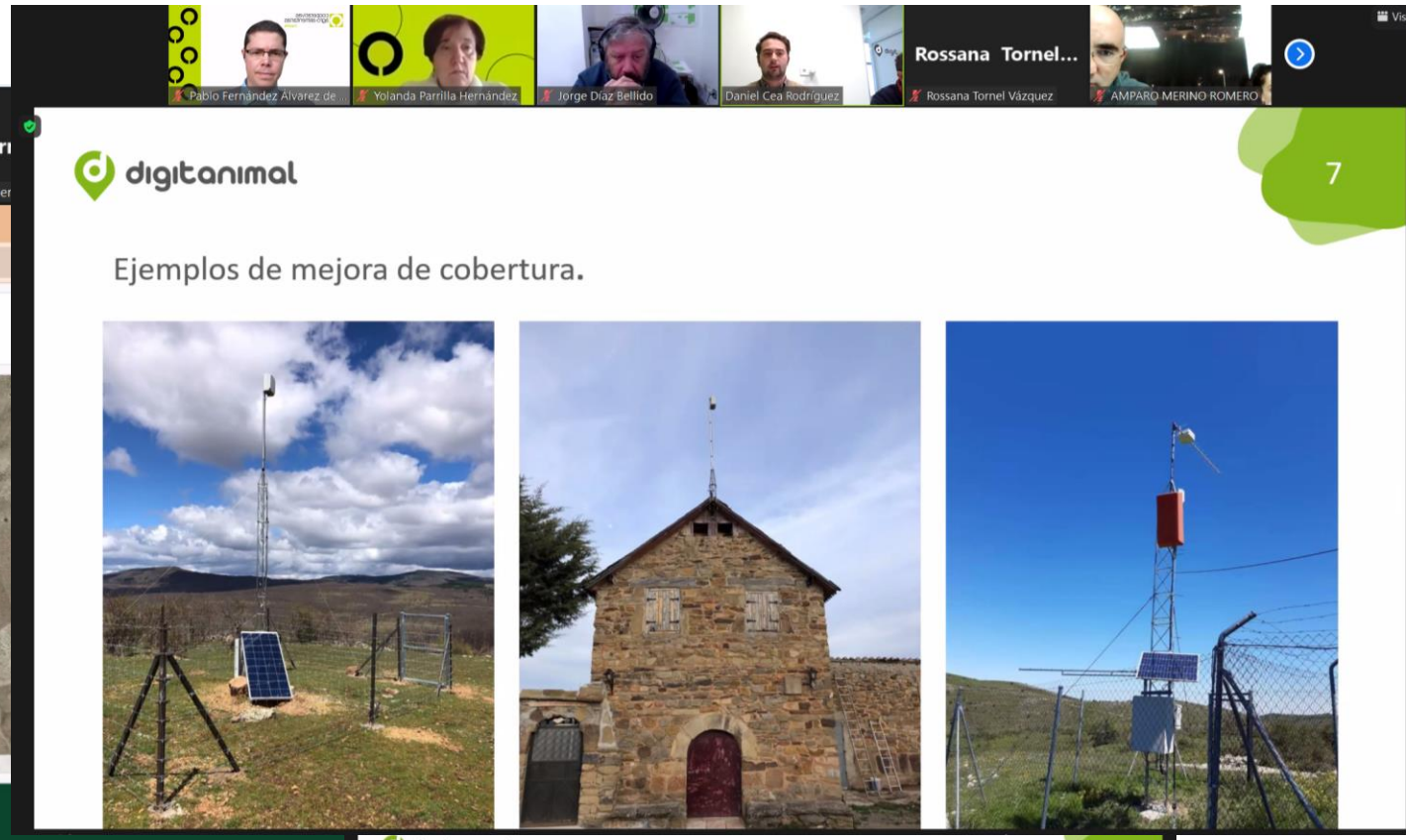
BARRIER	MEASURE	WHO SHOULD TAKE IT?
Farmers' age	Generational handover + training	Advisory services / Government
Lack of experience in digital techs	Training and real cases	Advisory services
Low connection in rural areas	Infraestracture investment	Government / Private companies
Farmer's data used for control	Strategy	Government
Economic cost (GPS trackers)	Affordable methodology / subsidies	Advisory services / Government

General Data Protection Regulation (GDPR)

Development of non-personal data exchange contracts based on the *Regulation (EU) 2018/1807* and on the COPA-COGECA code of conduct on agricultural data sharing.

Comments and insights from the national workshops





Reflections on the applicability of the DC results to other contexts

- Nowadays an affidavit is enough to comply with the extensive grazing eco-scheme requirements in Spain.
- In the near future the administration will take more demanding measures for the extensive grazing eco-scheme.
- The DC was presented to the Spanish Ministry staff on March 2023 (Advanced Monitoring Group, FEGA).
- Other EU countries have set similar eco-schemes where it could be replicated.
- It is important to take farmers' expectations into account.

ANY QUESTION?

Presentation by:

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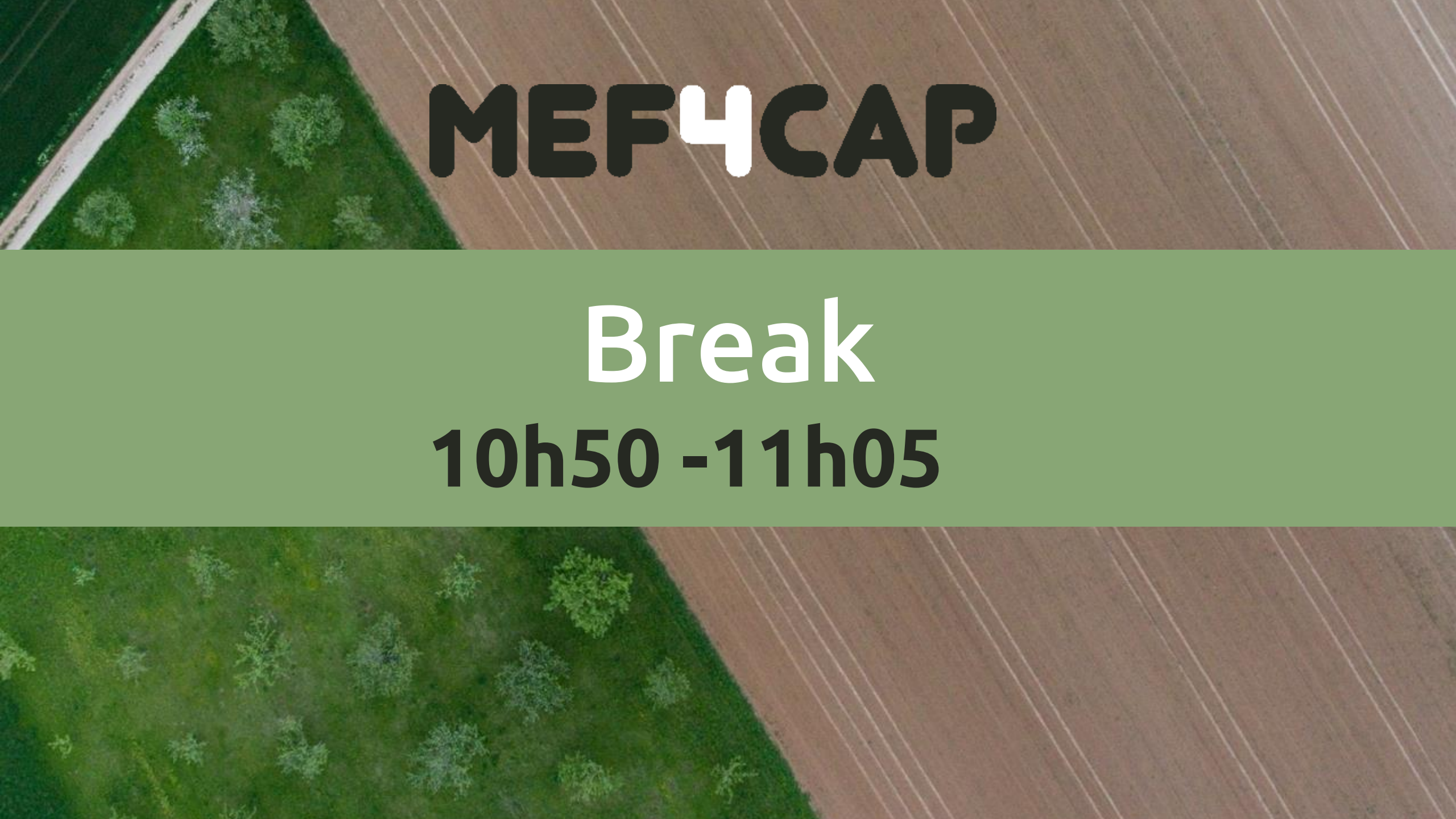


Break

10h50 -11h05

A generic framework for EU agricultural policy roadmap(s)

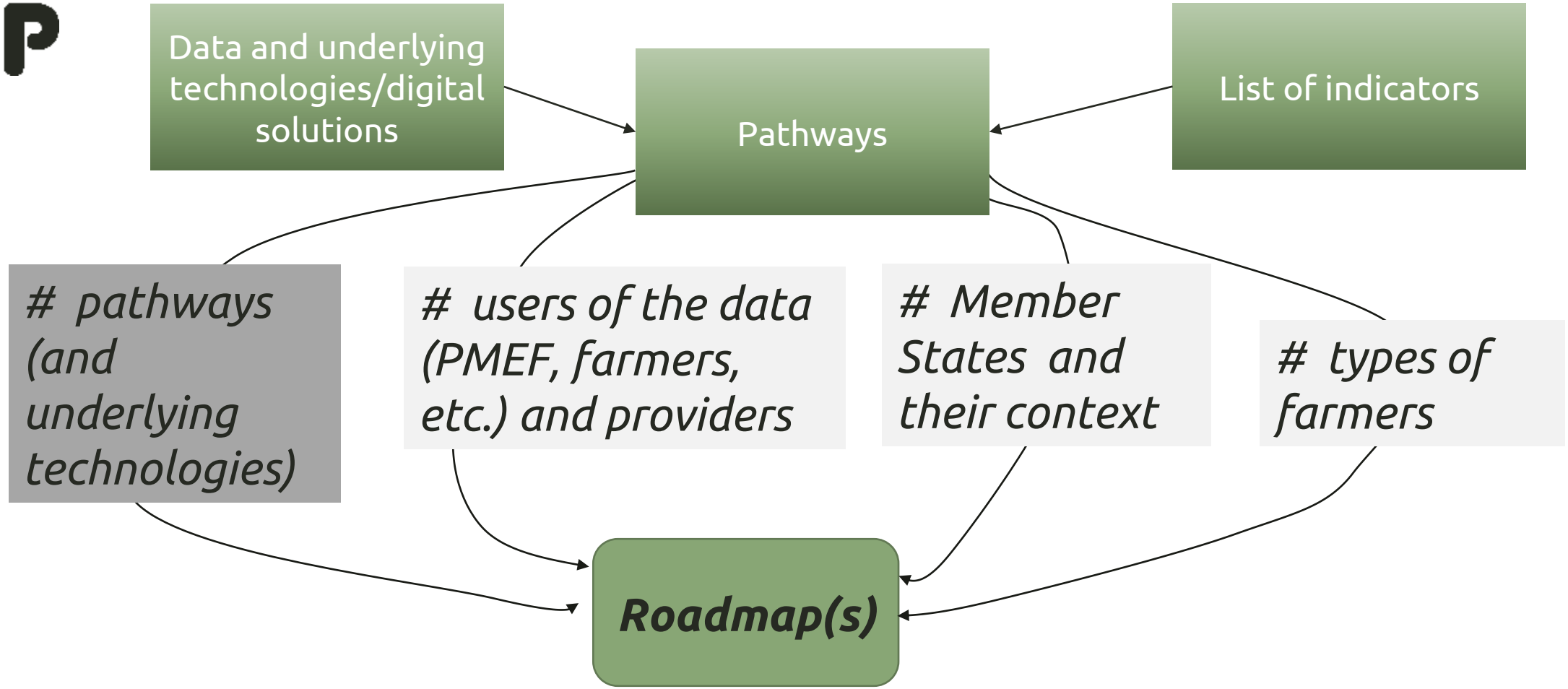
In MEF4CAP, pathways are the result of matching technologies with indicator needs or, in other words, "actions to compute the metrics"

A Roadmap for **monitoring EU agricultural policy** is seen as the process and the contextual elements (barriers, drivers) that ensure the sustainable generation of data and indicators needed by the users

The primary “user” is the **PMEF,** but **other stakeholders** (data providers and users) need to be considered if the process ought to be sustainable and fair.

Tomaso Ceccarelli and Rob Lokers

Not just one but more roadmaps ? depending on:



A generic framework for EU agricultural policy roadmap(s)

Different roadmaps can be identified at EU level depending on the **pathways,** the **stakeholders** involved, the **type of farmer**, the **Member State**, and relevant **contextual elements**

Reflecting on these roadmaps is **the main objective of the workshop**

A generic framework with data streams

Technologies & Data

- **Off-farm data**
  - Remote sensing S1, S2
  - Ortho-images
  - VHR
  - Geo data
- **Administrative DBs**
  - Beneficiaries
  - Parcels
  - Claims
- **Statistical DBs**
  - FADN
  - DGAGRI
  - EUROSTAT
  - Other...
- **FMIS - Digital farm books**
  - Fertilizers
  - Pesticides
  - Assets
- **On-farm data**
  - Livestock wearables
  - Machinery sensors
  - In-field sensors
  - In-door sensors
  - Geotagged photos
  - UAV
  - Financial & accounting data
- **Other** (food chain data, quality analytics, farm advisory/extension services, etc.)
  - Food chain data
  - Quality analytics
  - Other...

Pathways (match between technologies and indicators)

MEF4CAP (EU policy) Indicators

Economic Sustainability
- Age of Asset
- Income Volatility
- Use of Risk Management Tools
- Technology Adoption
- Farmer Producer Group Members
- Use of Forward Pricing of farm output
- Farm output sold as organic
- Hours worked on and off-farm
- Non-farm income

Environmental Sustainability
- Farm GHGs
- GHGs per ha
- Carbon Sequestration
- Ammonia emissions per farm
- Farm ammonia per ha
- Renewable Energy per farm
- N Balance
- P Balance
- N Use Efficiency
- P Use Efficiency
- Crop rotation
- Soil Cover
- Tillage Management Practices Against Erosion
- Pesticide Use
- Usage of Precision Farming Techniques
- Farmland Bird Index
- Grassland Butterflies Index
- Farm landscape features and their loss
- Presence of high nature value farming
- Adoption of Biocontrols
- Pollinators
- Water consumption

Social Sustainability
- Income level of young farmers
- Extent of farm specialisation by age of farmer
- Access to Finance and Credit
- Broadband availability and Broadband Speed
- Distance from services
- Off-farm Income
- Sales of veterinary antimicrobial agents
- Use of vet. antimicrobials in animal husbandry

correspondence with...

Agricultural policy objectives

1. Ensuring Viable Farm Incomes
2. Increasing Competitiveness (Productivity)
3. Strengthening Farmers' Position in Value Chains
4. Agriculture and Climate Mitigation
5. Efficient Soil Management
6. Biodiversity and enhanced eco system services
7. Structural Change and Generational Renewal
8. Jobs Growth and Rural Poverty
9. Health, Food and Anti-microbial Resistance

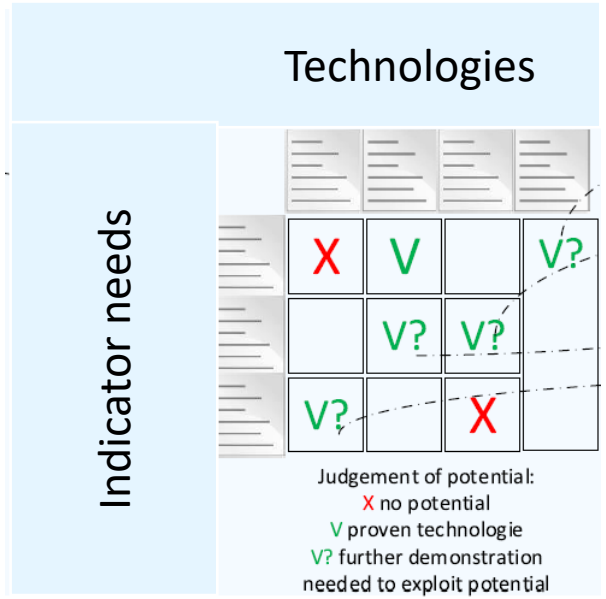
What is *in* the roadmap

For different users/stakeholders and Member States

Drivers

- Assesses CAP measures eligibility
- Responds to PMEF needs
- Addresses farmer management needs (e.g. efficiency gains, cost reduction, precision farming)
- Addresses other EU decision makers requirements
- Responds to other own (reputational) and societal needs
- .....

PATHWAY: **set of technologies to respond to CAP monitoring needs (indicator framework: positive match in the matrix, i.e. prove/further demonstration needed)**

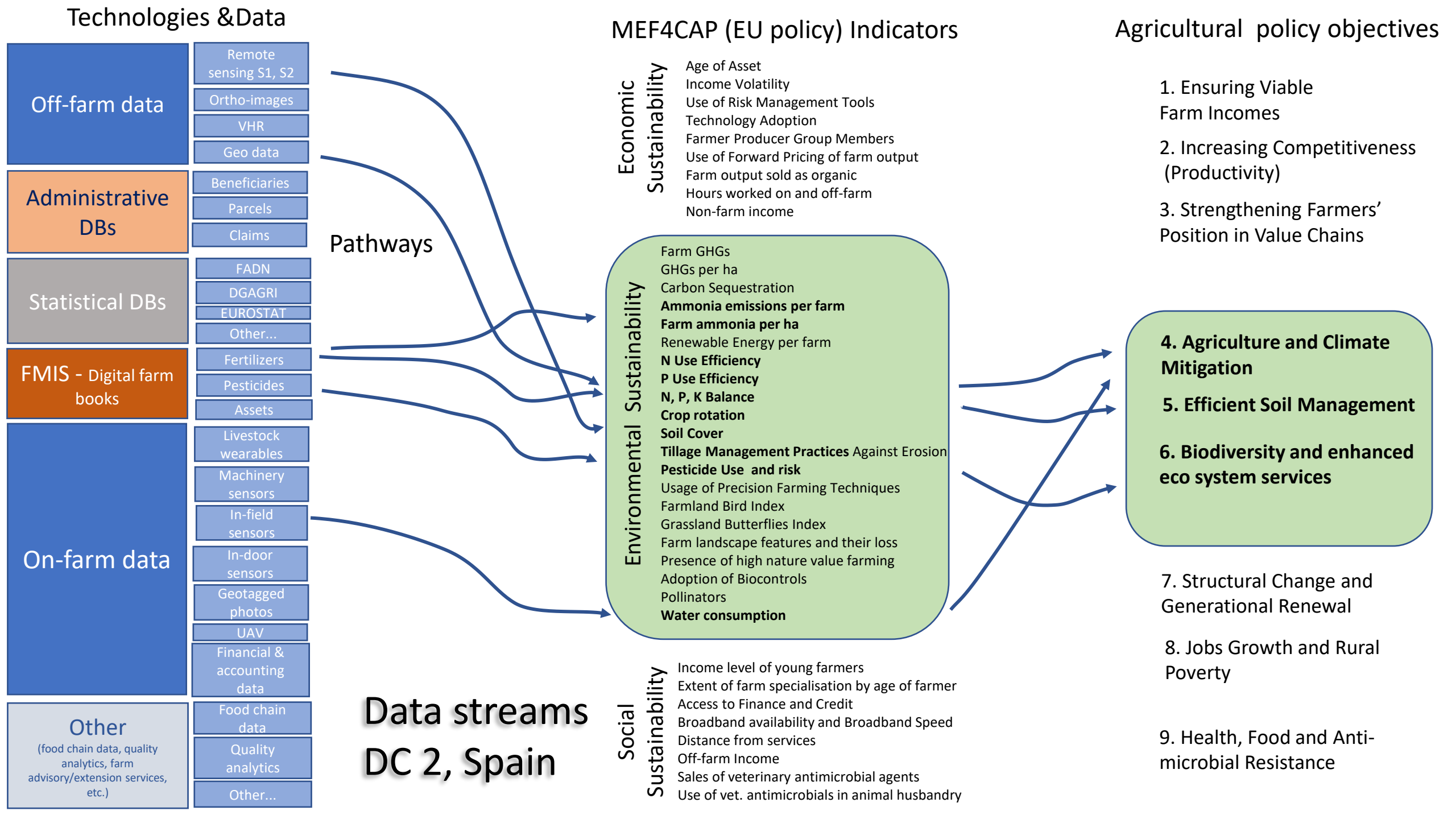


Barriers

- Administrative burden (farmers, advisors, Paying Agencies)
- Interoperability
- GDPR
- Data secrecy
- Farmers' trust
- Satellites (Sentinel) limitations
- Legislative framework
- Policies
- Digital skills
- .....

ROADMAP(S) for future CAP Monitoring

EU agricultural policy objectives


Technologies &Data
Off-farm data
Remote sensing S1, S2
Ortho-images
VHR
Geo data
Administrative DBs
Beneficiaries
Parcels
Claims
Statistical DBs
FADN
DGAGRI
EUROSTAT
Other...
FMIS - Digital farm books
Fertilizers
Pesticides
Assets
On-farm data
Livestock wearables
Machinery sensors
In-field sensors
In-door sensors
Geotagged photos
UAV
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Food chain data
Quality analytics
Other...
Pathways
Data streams
DC 2, Spain
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Economic Sustainability
Age of Asset
Income Volatility
Use of Risk Management Tools
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Roadmap, the example of DC 2 SP

Use of digital information flows in the agri-food sector

Drivers

- Need to **comply with regulations** in force (SIEX)
- Easing **decision making** (mid-long term) e.g., **benchmarking** of farms
- Tailored **farm advice**
- Improvement of **farm management** & thus, **economics** (mid-long term).
- **Young farmers interest** in digital technologies.

PATHWAY for FARMER COOPERATIVES

Environmental/soc- econ. indicators

Technologies/data sources:

- Remote sensing
- Geo data
- Digital farm book
- In-field sensors

Indicators/metrics:

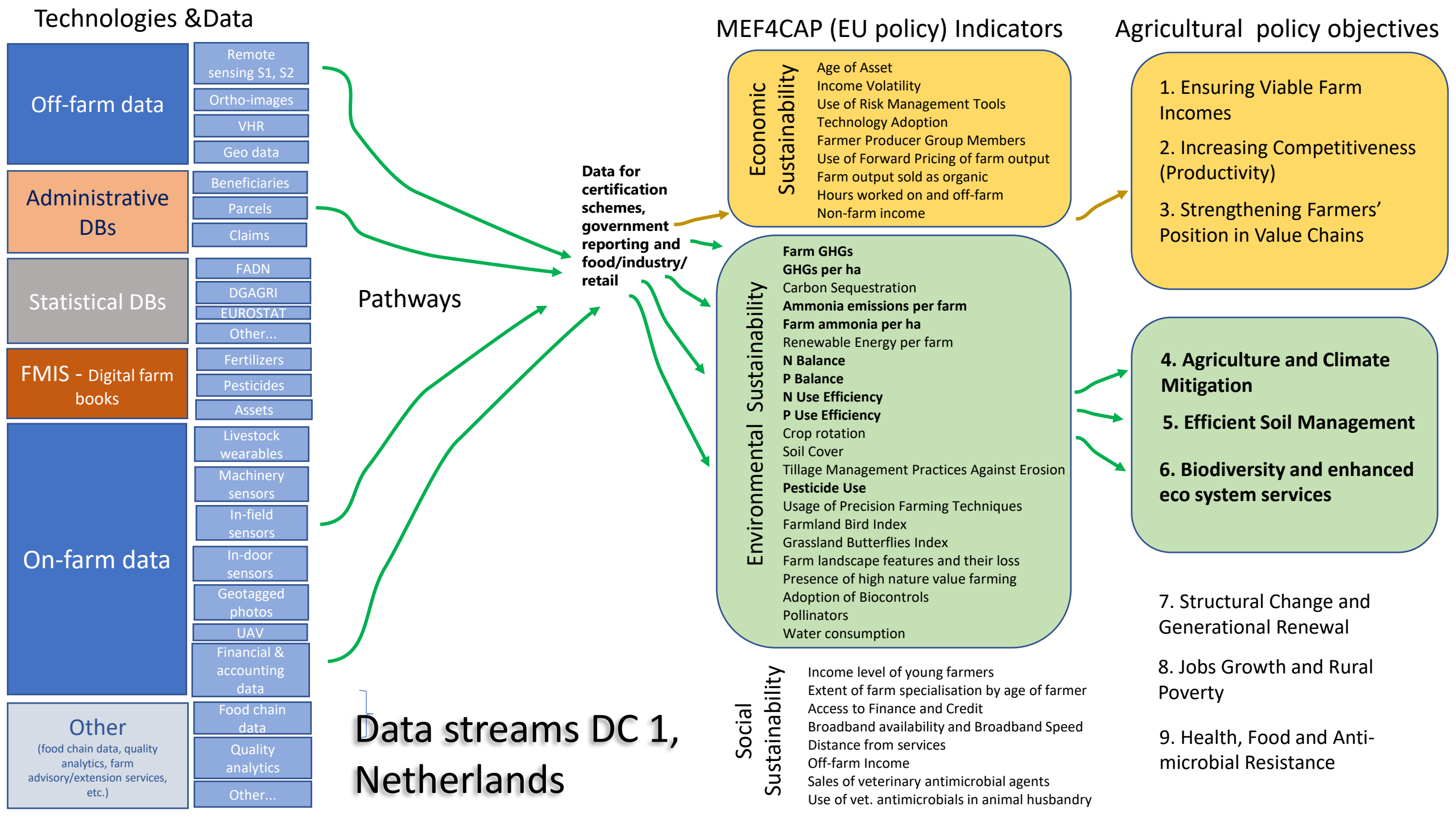
- Nutrients (NPK balance, efficiency, etc.)
- Pesticide use
- Ammonia emissions, etc.

Barriers

- **Lack of training**
- **Age of the farmers**, **lack of awareness** on digital technologies
- Administrative **burden**
- Low **connectivity** in rural areas
- Fear that farmer's **data are used for control** instead of for policy improvements.

ROADMAP for future CAP Monitoring

EU agricultural policy objectives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In-field sensors
In-door sensors
Geotagged photos
UAV
Financial & accounting data
Other
(food chain data, quality analytics, farm advisory/extension services, etc.)
Food chain data
Quality analytics
Other...
Pathways
Data for certification schemes, government reporting and food/industry/ retail
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9. Health, Food and Anti-microbial Resistance
Data streams DC 1, Netherlands

Roadmap, the example of DC 1 NL

Use of digital information flows in the agri-food sector

Drivers

•Farmers want **less administrative burdens**
• are interested in **their emissions** (if not yet sanctioned because of them)
• want **control over their data**

PATHWAY for: FARMERS

Environmental/soc- econ. indicators

Technologies/data sources

- Robotic accounting: digitization of invoices
- Sensor data integrated with accounting data in a farm dashboard

Indicators/metrics:

- Ammonia emissions
- Nutrients (NPK balance, efficiency, etc.)
- Pesticide use
- etc.

Barriers

- **full environment** of the farm (Up- and downstream industries, accountants etc.) **to adopt technology of digitized invoices**
- farmers need **external demand** (organic certification, CAP eco-schemes, private eco-labelling schemes, etc.) **for reporting environmental performance**.

ROADMAP for future CAP Monitoring

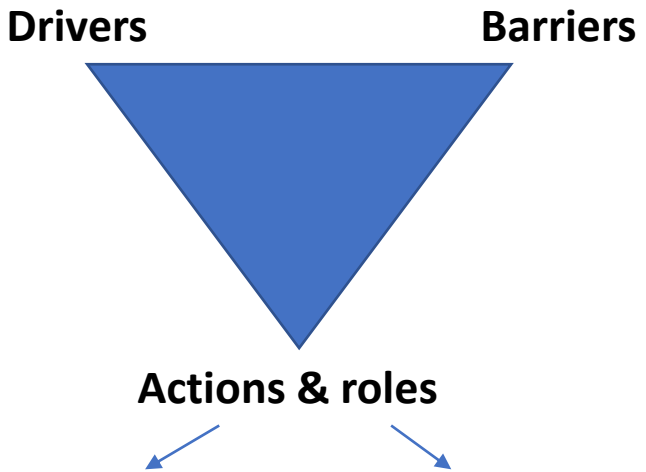
EU agricultural policy objectives

Summary of the Demonstration Cases

DC	In field/ livestock sensors	Remote sensing	FMIS/digital workbook	IACS	FADN	Financial	Other
DC1 NL	X	X		X	X	X	
DC1 IRL				X	X	X	
DC1 PL				X	X		
DC2 GR		X	X	X			
DC2 SP		X	X	X			
DC4 SP	X	X					

2 clusters (= potential roadmaps ?)

Finally, the EU roadmaps?



- Pathway specific
  - MS or area specific
    - User/provider specific
- Cross-cutting
  - ✓ Around concern/trust/ownership of data
  - ✓ Around burden reduction
  - ✓ Around digital skills
  - ✓ Around data... Overload for farmers
  - ✓ Around incentivizing the whole ecosystem

Mentimeter

Feedback from the participants and conclusions

Drivers and barriers

(Farmer's perspective)

- Need to **comply with regulations** in force (SIEX)
- Easing **decision making** (mid-long term) e.g., **benchmarking**
- Tailored **farm advice**
- Improvement of **farm management** & thus, **economics**
- **Young farmers interest** in digital technologies.

- **Data-driven decision making** on the farming practices to be applied supports the optimized use of inputs and thus, financial, and environmental profit (mid-long term).
- Allow **cross-farm information sharing** in a protected manner (farmer has access on applied practices and conditions in other farms in the area in pseudonymized manner).
- Allow **criteria-based benchmarking** of farms performance (based on time, area, farming activity type)
- **Automate reporting obligations** (e.g., subsidies, pesticides use, certifications for Organic, GlobalGAP, traceability for selling fruit/vegetables, etc.)
- **Save time – User friendly** visualization of farm's status.

- Efficient use of data to facilitate **farm-level analysis and decision making** by farmers
- Provides more comprehensive data presented in a user-friendly format
- Informs farmers in terms of **appropriate/identified KPIs** for their farm
- Allows for more **tailored/bespoke farm advice** based on the (summarised) data
- Provides data (and proof) on the **sustainability status** of the farm, and trends over time
- Allows for the **benchmarking of farms** relative to other farms or relative to a target level of performance (with a range of performance metrics (KPIs) possible)
- Aids in improved (and informed) **farm management**
- A more **digitally confident farmer** in an ICT era

- Farmers want **less administrative burdens**
- are interested in **their emissions** (if not yet sanctioned because of them)
- want **control over their data**

- interested in **improving economic results**.

Drivers and <u>barriers</u>

•**Lack of training**
•**Age of the farmers**,
lack of awareness on digital technologies
•Administrative **burden**
•Low **connectivity** in rural areas
•Fear that farmer's **data are used for control** instead of for policy improvements.

•**Lack of training/trust** on the potential benefits – farmers are not fully familiar with data-driven decision making. They still follow an empirical-based decision-making approach.
•**Administrative burden/workload** – especially with the manual importing of farming practices to digital calendars. Farmers are not providing any or inaccurate data to farm calendar.
•**Reluctance to share data.** The core benefit of the demonstrated approach is when data are aggregated and shared. Reluctance caused due to the fear of penalties or competition.
•Initial technological **investment cost.**

•Concern around **how the data will be used and by whom**, e.g. compliance/regulation
•Concern about **data privacy**: some farmers may want to keep all of their data private
•**Skillset lacking for some farmers:** Some may be unfamiliar with the dashboard concept and may struggle with dashboard navigation
•Reluctance among farmers or farm advisors to try something new - **inertia/fear,** attachment to traditional report formats
•**Risk of data overload,** uncertainty about which data is more/less important, which KPIs numbers indicate good/moderate/poor performance
•**Time constraints in learning/adapting**: farmers may perceive other farming tasks to be more important

- **full environment of the farm** (Up- and downstream industries, accountants etc.) **to adopt technology of digitized invoices**
- farmers need **external demand** (organic certification, CAP eco-schemes, private eco-labelling schemes, etc.) **for reporting environmental performance**.

- Collection of additional, more accurate data on fertiliser application at plot level **is a significant problem for farmers, if not economically motivated**