NIVA POLICY BRIEF No. 2
Agro-environmental and climatic indicators

Operationalising agro-climatic and agro-environmental indicators for future CAP

This policy brief presents the outcomes of a workshop (Paris, 5 February 2020) organised and hosted by NIVA H2020 project on the development of agro-environmental and agro-climatic indicators for monitoring the impacts of future CAP. The workshop's aim was to explore possibilities for the operationalisation of environmental performance through indicator monitoring with respect to the new CAP. Secondly, it is crucial to make the link between policy makers (European Commission DGs and national authorities) and activities on agri-environmental and agri-climatic indicators and on data re-use for environmental purposes as part of the NIVA project. The workshop included contributions from EC DG-AGRI, EC DG-CLIMA, EC DG JRC, Wageningen Research, INRAE and the European Environment Bureau.

In the context of the next CAP implementation of 2021-2026, there is an ongoing discussion on Performance Monitoring and Evaluation Framework as presented by DG-AGRI at the workshop, and currently under development with the Council of the European Union. That framework focuses on result, output and impact indicators, where impact indicators reflect the wider impact that should be achieved within society and the result and output indicators are monitored by the Member States towards this overall impact achievement. While note was taken of this development, it was not the scope of this workshop to provide input to this ongoing process. Instead, this workshop focused on more innovative and ambitious indicators that could be used in future CAP developments.

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Key findings

IACS data are very valuable to assess indicators but are not ready for analysis.
IACS systems contain valuable and useful data to calculate indicators for environmental and climate performance of farms, as they contain the crop sequence over years on parcels and the animal head counts. The access to IACS data across Europe is very diverse, and therefore complex. It is variably hampered by technical, legal or conceptual issues. Indicator development must provide context and guidance to improve third party use of IACS data for assessment of indicators.

Achieving relevant agri-environmental and agri-climatic indicators require a development process with involvement of all stakeholders, including farmers.
An indicator framework sets out different indicators at different levels that are connected through aggregation, for example, from parcel to farm to region levels. As the performance is strongly influenced by the field and the agricultural practices, the farmer is the main actor driving the performance. To monitor performance, indicators can be used, but for that they need to be relevant at all levels from farms to Member States and the European Commission). Therefore, all stakeholder including farmers need to be involved in indicator development.

Indicators need to be relevant for the farmer, not just about the farmer, to monitor performance and provide timely feedback.
The value of indicators and their assessment is to provide actionable knowledge to the involved stakeholders. The farmer is a special actor in this case, and the challenge here is to present the farmers with actionable information, on which he or she can directly improve his or her farm management and that links into ongoing farm practices and his or her knowledge level. There was little explicit consideration of the added value for farmers so far in the development of indicators.

Environmental performance reflects multi-annual land management.
As the CAP is moving from compliance to performance, it automatically transits to a multi-annual assessment of land management. Improvement in environment or climate is achieved by continuing the positively impacting farm practices on a multiannual timeframe. Any system for rewarding farmers for improving and maintaining the quality of their land should involve incentives for multi-annual land management.

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IACS data for Indicators

Data from the Integrated Administration and Control System (IACS), that is used to register farmer applications in an annual cycle has a recognised large potential for use in development of agri-environmental and agri-climatic indicators. Many case studies have shown individual examples of how such data is used, from the direct evaluation of the amount and number of applications (and subsidies paid) for certain measures under the CAP to more elaborate examples in combination with other data sources (e.g. remote sensing, farm management information systems). Such examples are often only local, at the level of a Member State or region. Commonly denoted barriers for wider adoption in the use of IACS data for such purposes are:

1. The poor accessibility of the data. Some Member States and their respective paying agencies actively and openly share this data, while others do not share this, and special procedures for access have to be followed;
2. The lack of standardisation of common elements across IACS systems complicating use, for example crop nomenclature between Member States or even regions and over years, parcel definitions and technical implementations in different file formats;
3. The lack of a multi-annual framework of IACS Data allowing for cross comparison across years.

The role of the farmer in agri-environmental and agri-climatic indicators

Farmers are a highly diverse group with different levels of training, ambitions, and cultural background. While there are ambitious farmers in environmental and climatic management of their farms, there are also farmers who are less connected to these debates. The challenge for agri-environmental and agri-climatic indicators is that they should be relevant to all farmers, and not just to the environmentally motivated, or to those who only carry out the minimum obligations. Indicators and their interpretation should ideally provide a positive encouragement to the farmer to address a need for society, while at the same time improving the farm performance also in economic terms. Here different opportunities exist, that need to be better tested with farmers and potentially their advisors to see what really works for them. An opportunity could be 1. to show farmers the environmental performance along different axes (like soil health, biodiversity, climate resilience) in one spider diagram; 2. To offer suggestions for improvement in concrete agricultural activities and the likely improvement this will bring; 3 to enable the benchmarking of farmers against a larger group of similar farms; 4 to indicate on a map the farm/CAP subsidies that can be paid out based on the adoption of environmentally-friendly farm practices on the farm. Examples of the operationalization of such opportunities exist in different Member States, and good (and bad) practices can be brought together to discover what works and what does not work for certain types of farmers.

Farmers are only one stakeholder in a wider set of stakeholders active around IACS data and the options for use of IACS data for other purposes, such as environmental and climatic indicators. Figure 1 below shows an overview of these stakeholders active around IACS data, that could potentially

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benefit more from it. However, many of the other actors will have a link to farmers in one way or another that has to be central to the use of IACS data.

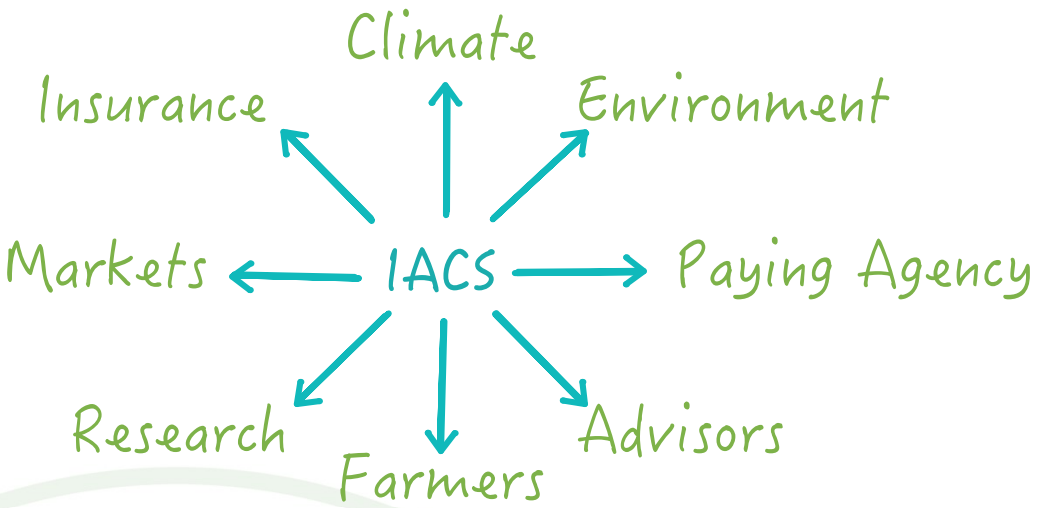

Figure 1 Different interest domains and actors that could benefit from the use of IACS data

This links to another important boundary condition for development of indicators for the farmer, which is that there is somehow an active data sharing taking place allowing other actors (market/value chain players, insurance, advisors) also to take their role in supporting the farmer in the smart environmental, climatic and economic decision making.

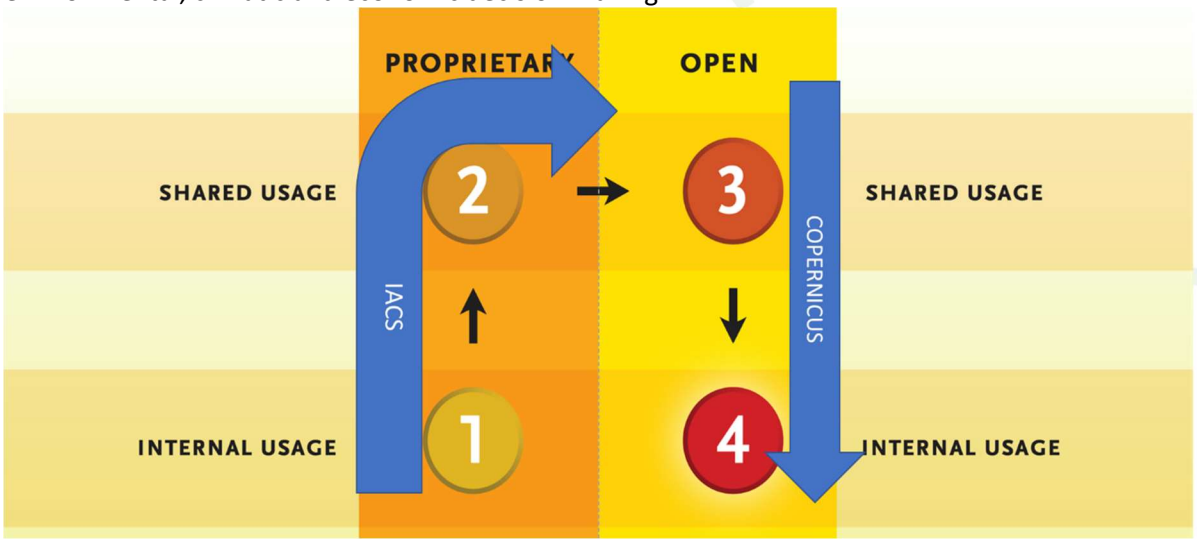

Figure 2 Data sharing framework (van der Wal, Personal Communication) with the development of IACS data and Copernicus EO data plotted in: most shared data sources (2) are originally developed for internal usage (1). Other are developed for open, shared usage (3) and then internalised (4) by organisations, like Copernicus data. Ideally IACS data, though made for administration and control, could be designed for open and shared usage.

Opportunities in indicator development

INRAE presented candidate agri-environmental and climatic indicators addressing different CAP objectives and 5 categories of environmental issues related to:

- Climate mitigation: Carbon budget, reduction of nitrogen fertilisers
- Water quality: nitrate leaching, pesticides, herbicides, fungicides
- Biodiversity: biodiversity conservation, biological control, pollination

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- Soils: quality, erosion
- Landscapes: aesthetic value

These candidate indicators all combine IACS data (parcel information), Copernicus data (vegetation) and farmer data (agricultural practices). All indicators reflect field activities (crops, soils, grassland, (agro)forestry etc.). Participants agreed that methane was missing from the list of indicators. Methane is an important livestock related climate gas and concerns the emissions from barns (among others).

For indicator calculations, INRAE proposed a TIER-ed approach with increasing level of complexity, requiring gradually more data from different sources, and more advanced algorithms. TIER 1 would then be the simplest, based on a combination of IACS Data with remote sensing data as both these data sources are in principle available everywhere with wall-to-wall coverage. As an example, in the case of carbon budget, it could be the carbon influx calculated by combining the crop from IACS with the ground cover and vegetation indices from Sentinel data. In TIER 2 and 3 data sources like Farm Management Information Systems, soil samples, biodiversity species observations, etc could then be added, to feed more complex process models for crop growth, soil erosion, species dispersion.
It was decided at the workshop that NIVA elaborates three specific indicators:

1. Carbon Budget;
2. Biodiversity Conservation, and
3. nitrate leaching.

The project will work on at least a TIER 2 approach, as the indicators should be innovative and forward oriented, beyond the current state of the art. It was recognised that an implication of this choice is that approaches for calculation remain more regional due to the lack of standardised data access for sources like FMIS, soil samples, etc.

Agricultural practices at the core of indicator development

To assess the impact of agriculture concerning environment, biodiversity, climate and water, it is crucial to have reliable, consistent and objective data on agricultural practices as carried out by the farmer. Agricultural practices make out how a farm performs: In particular specific choices in crop management including crop rotation, the use, type and timing of fertilizer, crop protection agents, irrigation or bio stimulants and the choice in crop varieties (e.g. drought sensitive, or disease-resistant) determine the impact of farms in the environmental or climatic domains, but also in farm-economic terms.
Crop rotations are an important strategic choice of the (arable) farmer in managing his or her farm, which can be derived from the sequence of crops captured by consecutive IACS applications. Even though this is a possibility, there is not general accepted way of doing this, and innovation and research are needed to establish such a method. As rotations have a multi-annual character, the consistency of IACS data over the years becomes more important. Also in between main crops, important steps happen in rotations such as (winter) cover crops and fallow periods, which have an important impact on some agri-environmental and agri-climatic indicators, such as carbon storage in the soil.

Next to IACS data, Earth Observation (EO) data can be used to detect agricultural activities. For many years, Earth Observation (EO) data is used to derive indicators on the state of the land and agriculture, especially on a regional scale. Many aspects can be seen, such as land cover and land use and the extent and progress of vegetative growth, but also land abandonment. Recent developments,

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triggered by the wealth of satellite data from the Copernicus programme, show that EO data can play a role in agricultural monitoring also at a finer spatial resolution of individual parcels or farms. Here a set of agricultural practices can be monitored, which are crucially in the calculation of agri-environmental and agri-climatic indicators. The agricultural events or practices that can be followed with good confidence are the succession of crops over years through the detection of growth curves (including cover and winter crops) and linked indicators such as the start of the crop growth and the harvest of the crop, as these changes have the most apparent digital signatures in colour changes (from brown to green at crop emergence, for example). An operational agricultural activity such as ploughing is an activity that can be detected also with good confidence using EO data, given its highly disruptive character.

However, finally, there are many agricultural activities that are much more difficult to detect (or even impossible) using EO data, such as irrigation, fertilisation and crop protection measures, even though they are crucial for calculating agri-environmental and agri-climatic indicators. These require other data sources, and potentially farmer interaction, for example, through a geo-tagged photo app where a farmer uploads a picture of his or her agricultural activities. The link to farm machinery, Farm Management Information Systems (FMIS), or other sector data sources can help to get these data, however, these data sources are highly diverse and fragmented at this stage.

In one of NIVA's use cases, the above-mentioned indicators are developed. These are based on IACS data and Copernicus data and other relevant auxiliary data to be identified during the project. The project also works on recommendations for reuse of parcel boundaries (as part of the IACS systems) and harmonisation of crop codes. To improve awareness and stimulate innovative approaches, the project organises a 'rotation hackathon' to calculate typical multi-annual indicators of environmental performance. This could incentivise Member States to maintain and/or improve their data sharing.

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The NIVA project

A consortium of paying agencies, research institutes and private sector organisations collaborate to build the next level CAP governance tools. The project is designed to absorb the latest e-tools and digitisation trends to simplify the CAP governance, to reduce administrative burden to farmers and to close the gap between IACS data use and potential broader use.

The NIVA project works in 9 use cases each focusing on a particular aspect of the CAP governing tools. The use case “monitoring agro-environmental indicators” deals with IACS data sharing for impact assessment in the environmental and climate domains. It looks at integrating the IACS data, Earth Observation data from the Sentinel 1 and 2 satellite systems of the Copernicus programme and auxiliary data like soil and weather maps and farmer specific data.

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