Farm Registry data model

1. Executive summary

A Farm Registry is a registry of an administrative, public and informative nature that centralizes and unifies agricultural information and allows the (public) administration and the farmers to query all the data about farms and their agricultural parcels and to facilitate administrative procedures. In shorter words, it is an official registry that describes and records where the farm is, what the farm produces and how the farm produces.

The aim of this system is the unification of existing public administration databases regarding agrarian matters; the principle is to integrate the information provided by farmers to the competent authorities.

A Farm Registry aims to become a centralised system that may be used by farmers for managing their activities and that should also be integrated in future IACS due to the new CAP context (CAP post-2022). The Farm Registry is expected to be one of the source database for the future Seamless Claim that is promoted by the CAP post-2022.

NIVA has investigated the requirements coming from recent European Union Directives and other initiatives and based on these common requirements, the NIVA project has developped a common Farm Registry data model applicable in all EU Member States .

This common data model is a good starting point that will enable common outputs, such as common indicators or harmonised data publication. These common outputs may be helpful for farmers, for Paying Agencies or for anyone having interest in agriculture data.

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2. Common requirements from EU legislations

The main purpose of agriculture is food production, but agriculture has also a strong impact on environment and climate change. This is recognized by various EU initiatives, such as the Farm2Fork strategy (that is part of the Green Deal). The F2F strategy is a comprehensive 10-year strategy aiming to address the challenges of producing and consuming our food in a fair and sustainable way by reconciling what we eat within the capacity of our planet. It intends to reduce the environmental and climate impact of how we produce and consume food, ensure food security and citizens' health through access to sufficient, nutritious, sustainable food, and preserve the affordability of food while generating fairer economic returns for everyone involved in the supply chain.

Another key EU policy is of course the new CAP: for the period 2023-27, the common agricultural policy will be built around ten key objectives. Focused on social, environmental and economic goals, these objectives will be the basis upon which EU countries design their CAP strategic plans.

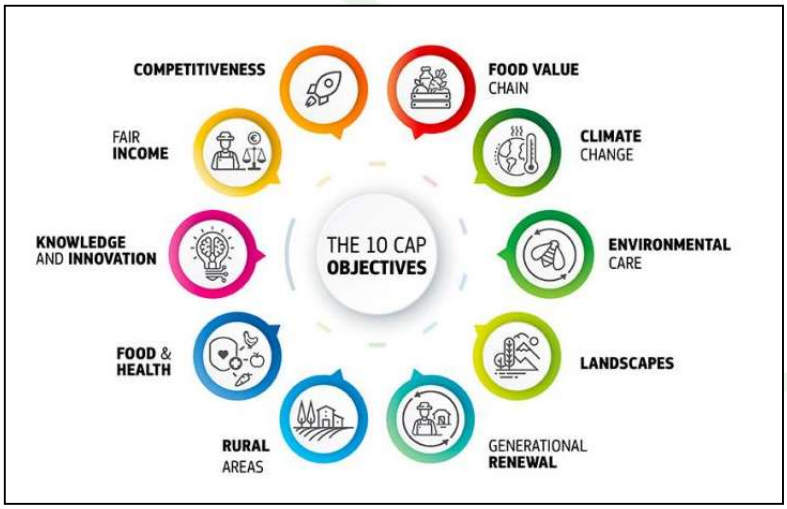

Figure 1: The ten key objectives of the new PAC

The NIVA Use Case on Farm Registry (UC3) has carefully collected and analysed the various requirements coming from these EU initiatives. These common requirements have been integrated in the common data model. **This is why the data model is integrating new data** about use of fertilizers, about use of Plant Protection Products and about other agricultural activities.

For instance, F2F strategy sets out some clear targets to be achieved by 2030 in some areas (e.g. on pesticide use and organic farming).

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Farm Registry data model

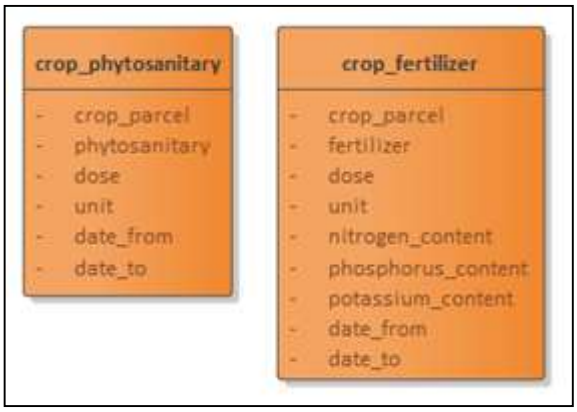

Figure2: Extract of the Farm Registry data model

A poll conducted during the Paying Agency workshop on IACS data sharing on the 30th of March 2022 is confirming that this this new data is data that is widely required.

Microsoft Word - PA workshop minutes D1.0 (niva4cap.eu)

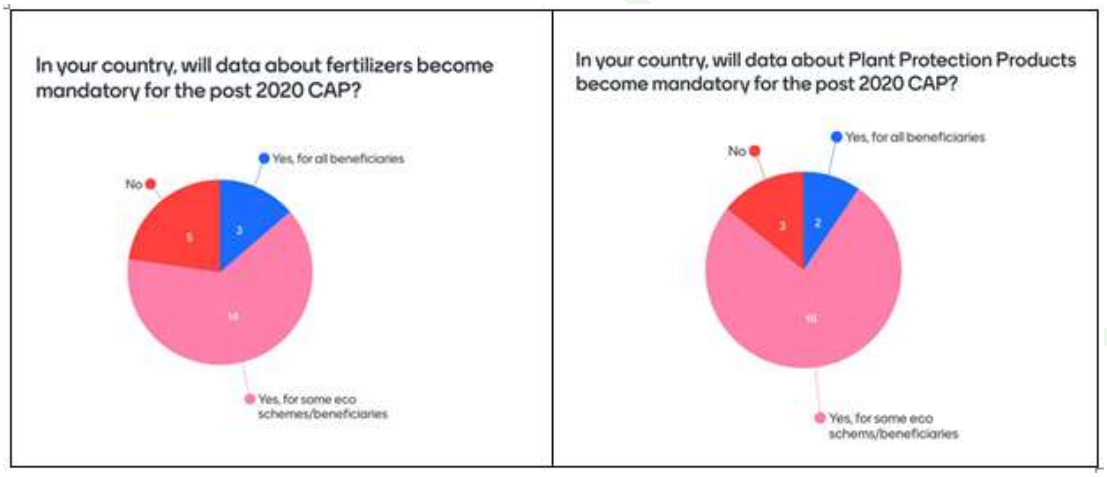

Figure 3: With new CAP, some data about fertilizers or Plant Protection Products will be included in IACS by most PAs

3. Farm Registry data model and its potential use by farmers

Until now, Farm Management Information Systems (FMIS) are not yet used by a wide range of farmers, the situation varying a lot depending on countries and regions.
However, the use of digital means such as FMIS for recording applied practices is expected to be continuously adopted by more farmers during the next years due to introduced legislation, but also because it is more efficient for the everyday activities of the farmers.
For instance, the national regulations of some Member States, as an application of the Nitrate Directive and of Regulation (EC) N° 178/2002 (Food safety), are mandated the Field Book

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content, a Field Book being “an electronic (or paper-format) document used by farmers for keeping track of agricultural activities performed in their agricultural parcels.“
The requirements coming from these regulations may be integrated in commercial tools, but some EU initiatives are pushing Member States to supply free tools for farmers. Another initiative is FaST (Farm Sustainability Tool for Nutrients): FaST should enable farmers, nutrient management planning and recording. A nutrient management tool has to be provided by Member States to beneficiaries.
Therefore, it is quite logical that the common data model of Farm Registry that has been designed to capture the requirements of the most recent EU legislations and initiatives might be used to define the content to be managed by tools for farmers.
Such experience took place in Spain, with the development of an electronic tool based on the Farm Registry content.
In a first phase, the Farm Registry was presented during DataAgri event (Zaragoza, Spain, 14-15 November 2021) and, besides this dissemination opportunity, a survey was defined to be filled by the event attendees in order to investigate their potential interest for a mobile “Farm Registry” application. There were 57% of participation of farmers and 43% of other profiles. 98.9% of the users have tablet or smartphone in their exploitation and therefore, they could use easily the Farm Registry in their daily work. 86% of the users answered that they work with Public Administrations using web pages and services. But despite of this good ratio, only 35.1% were using e-tools daily in their farms or exploitations.
Besides these general questions, the most important points were related to the Farm Registry itself and 85.1% of the users found the idea useful and interesting for their activities.
In a second phase, TRAGSA Group (NIVA partner) has collaborated with UPA[1] to develop an electronic tool called “cuaderno de campo”. UPA is the professional organization that groups, represents and defends the interests of professionals in agriculture and livestock in Spain. UPA is the organization that brings together the majority of the agricultural sector: family farms whose owners are small and medium farmers and ranchers. UPA has more than 80,000 members throughout Spain: professional farmers and ranchers in all sectors and in all autonomous communities.

The "Cuaderno de campo" application is based on the proposed NIVA data model and it responds to the basic concepts required to maintain a Farm Registry: Where is the holding? What does the farm produce? How it is produced on the farm?

The application features and attributes univocally define the farm, they record the general type of activity and the actual geometry of the plot. This application also stores general information at the parcel level about the basic use. Some adaptation took place about what is grown on the farm, when and how it is irrigated, the cultivated species, the cultivation systems, fertilization, phytosanitary products, etc... by use of different auxiliary concepts.

The data model is capable of maintaining information regarding the doses of fertilizers applied, in addition to their type, and the amounts of phosphorus or potassium supplied. This information links directly to the FaST system. Finally, the activities module reports when a

[1] https://www.upa.es/upa/inicio/

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certain task has been carried out (planting, harvesting...) and the phytosanitary module collects when and what type of product has been applied.

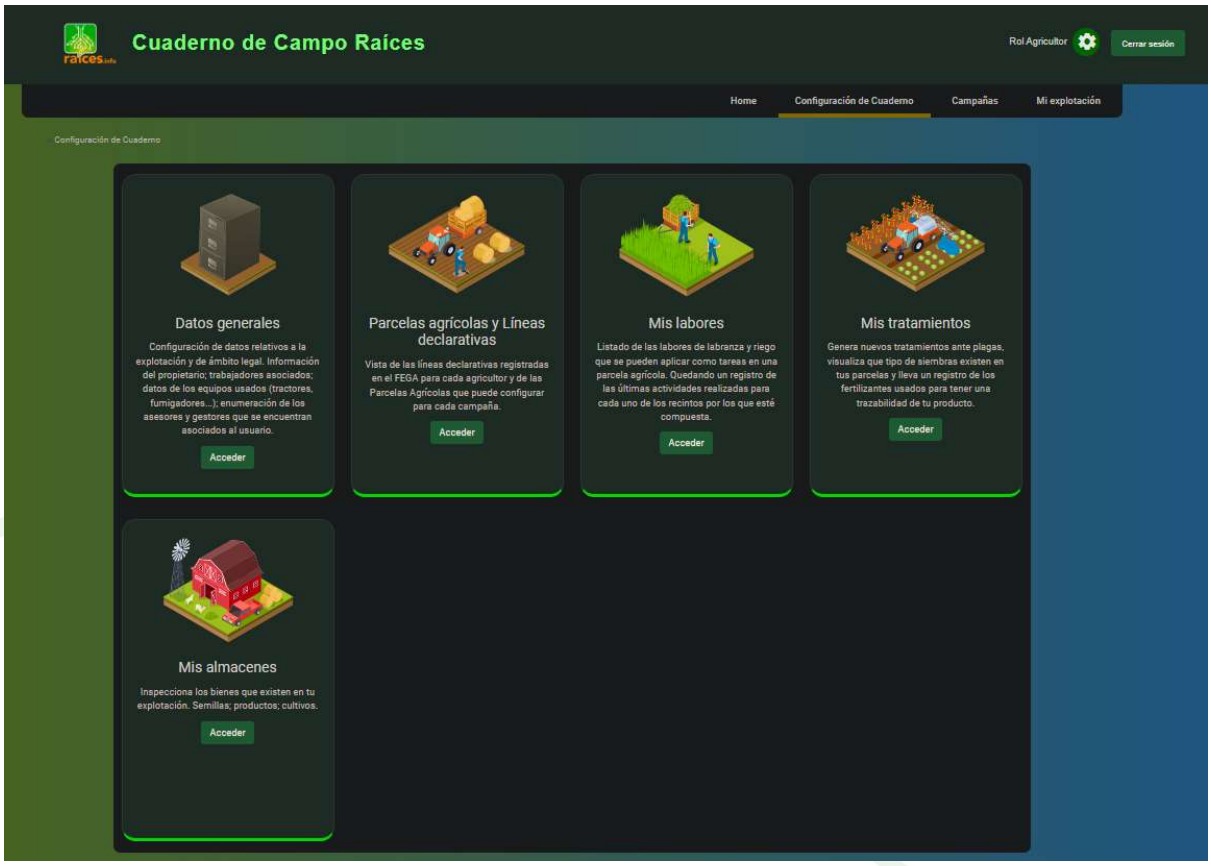

Figure 4: The main page of the "cuaderno de campo"

4. Farm Registry for the Seamless Claim

The Automatic Claim is defined in the new CAP (CAP 2023-2027) more exactly in article 65 par.4 (f), of the Horizontal EU Regulation No 2116/2021, as such: 'automatic claim system' means an application system for area- or animal-based interventions in which the data required by the administration on at least individual areas or animals claimed for aid are available in official computerised databases managed by the Member State and made available to the beneficiary where necessary.

The Automatic or Seamless Claim aims to simplify the process of managing payments for CAP interventions and to pay the beneficiaries quickly and without sanctions. The basic principle is that farmers just declare their activities (without claiming for payments) and it is the Paying Agency who informs them about the eligibility rules they are respecting and the related potential payment schemes.

The Seamless Claim has been implemented by one of the NIVA Use Cases (UC5b) and tested in Italy on BISS, Young Farmers scheme and Eco-Scheme. A comparison was conducted with the payments based on Geo Spatial Aid Application (GSAA) on a sample of around 600 farms: payments have increased approximately by 4 %. This increase of payments is due to the lack of penalties.

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Farm Registry data model

More continuous transfer of farmer data, to be submitted once data is captured in the farmer system (FAST, Field Book, FMIS …) rather than annual application is also expected to reduce the risk of errors and so of penalties.
The expected work flow is shown in the following figure.

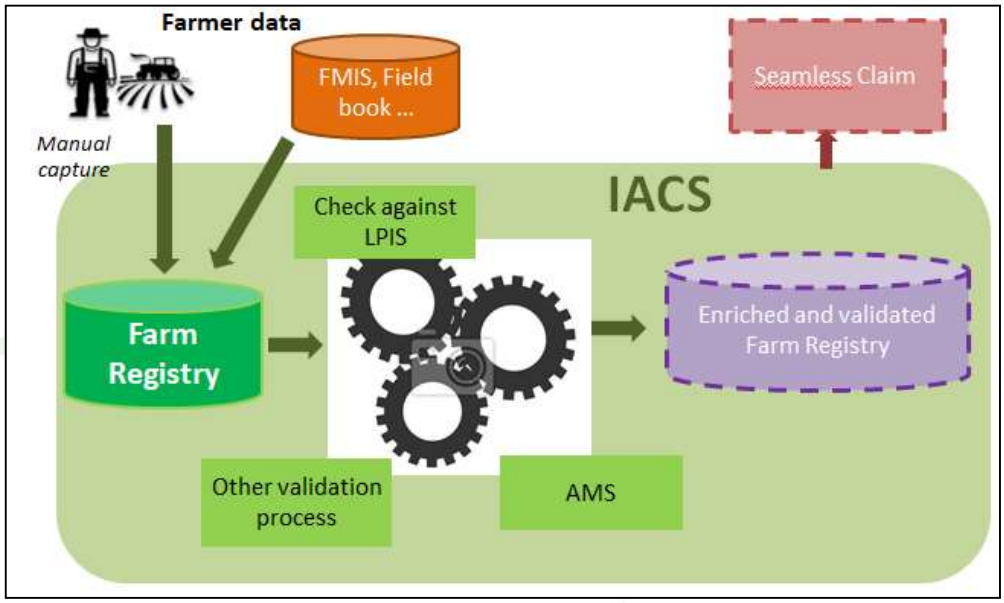

Figure 5: The workflow from Farm Registry to Seamless Claim

1. In fully operational phase and in ideal conditions, the expected data flow is that farmers capture (at least) the necessary data identified by the Farm Registry in a dedicated tool. However, in practice, this won't always be the case on short term.

2. On the Paying Agency side, the Farm Registry is devoted to store the information received by farmers in a continuous way; this information is expected to be provided either from manual data capture from farmers or from automatic data exchange from farmer Information System (Field Book, current FMIS solutions, FAST tools, ….); of course, this exchange would be quite easier if the farmer tool is itself using the Farm Registry data model as in the "cuaderno de campo" example.
3. This Farm Registry is then submitted to several validation processes such as the comparison with LPIS for geometry checking or with the results coming from the Area Monitoring System for activities checking.

4. Once validated and possibly enriched, the Farm Registry should be integrated in the whole IACS system where it will provide very useful information for the Seamless Claim system, enabling farmers to get payments without having the risks of errors in their declaration and therefore of penalties.

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In order to suit with the requirements of the Seamless Claim, the NIVA data model for Farm Registry has been designed to receive farmer data in a continuous way.

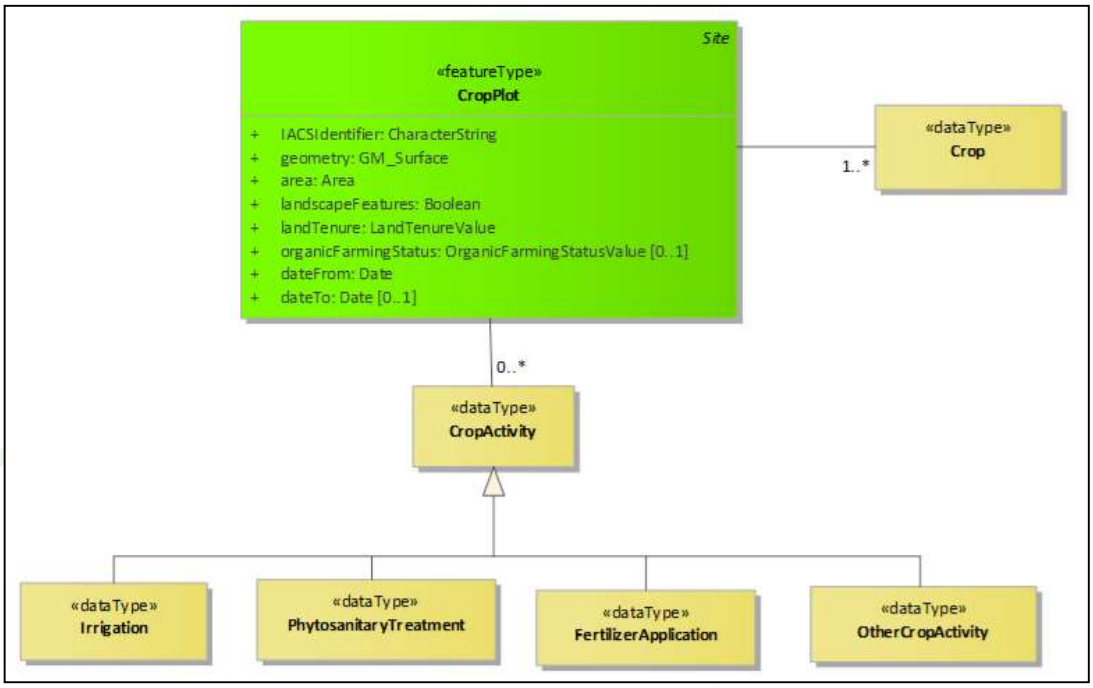

Figure 6: The data model stores separately static and dynamic data

The main class of objects, i.e. the feature type CropPlots is dedicated to store once the (relatively) static information of the CropPlot, mainly its geometry.
Ancillary data types are devoted to store the dynamic information about the crops cultivated on the Crop Plot or the activities performed on this Crop plot.

5. A common data model enables common outputs

- **Example 1: The farmer dashboard of UC1C (Farmer Performance)**

The NIVA Use Case on Farmer performance (UC1C) has developed a farmer dashboard that enables farmers to get indicators on their farm and to compare them with indicators of similar farms. This farmer dashboard is expected to be usable in any EU Member State.

A preliminary condition for this pan-European use is to employ a common data model and to design the indicator definition from this common model. In practice, for the design of its backend database, UC1C (Farmer performance) has re-used and extended the data model initially designed by the NIVA Farm Registry Use Case.

The data used in the farmer dashboard is expected to come from farmer field records, that may be natively registered in digital tools, such as Field Books, FMIS (Farm Management Information System).

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Farm Registry data model

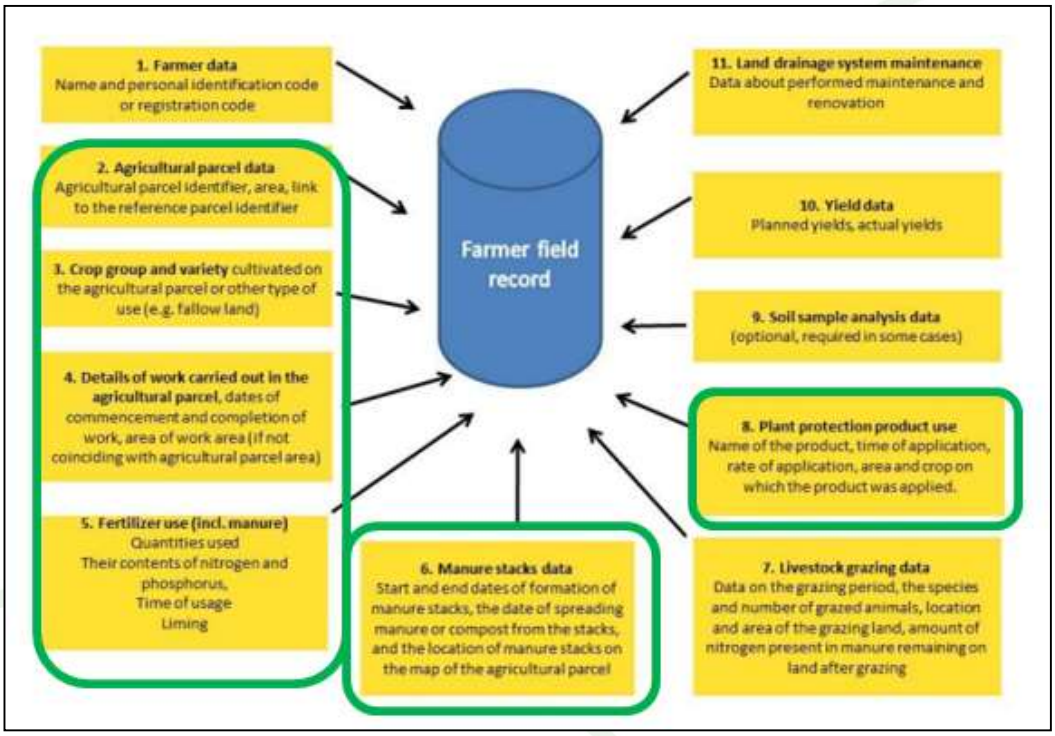
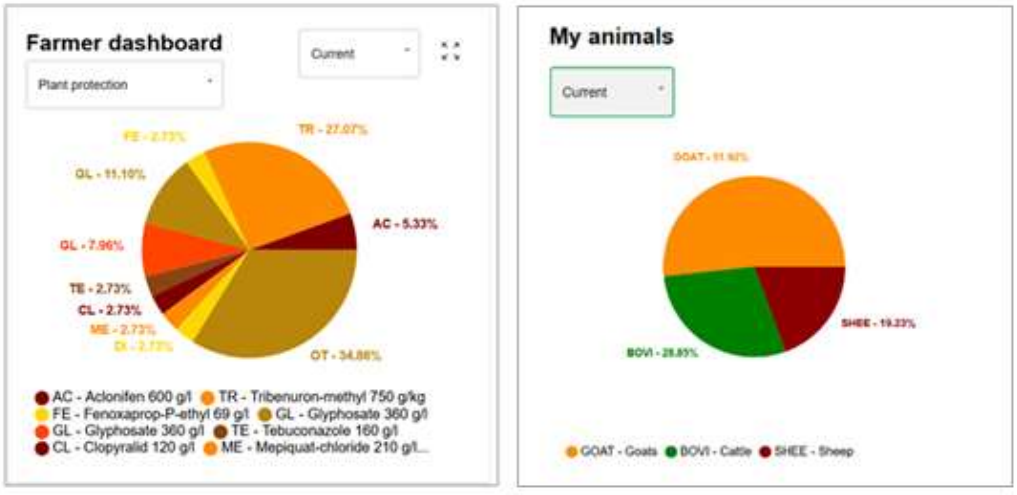


Figure7: Data from farmer field records mainly used for the farmer performance dashboard.



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Plant protection name	Active substance	Total amount used during the year	Average amount per hectare	Related cultures
Estet 600 EC	2,4-D 600 g/l	43.86 litres	0.5 Litres	Crops
Input	Spiroxamine 300 g/l	187.85 litres	0.79 Litres	Crops
Puma Universal	Fenoxaprop-P-ethyl 69 g/l	69.62 litres	1 Litres	Crops
Nufarm MCPA 750	MCPA 750 g/l	39.23 litres	0.52 Litres	Crops
Barbarian Super 360	Glyphosate 360 g/l	261.44 litres	4.06 Litres	Crops
Propulse	Prothioconazole 125 g/l	22.49 litres	0.78 Litres	Crops
Fenix	Aclonifen 600 g/l	56.22 litres	1.95 Litres	Crops
Decis Mega	Deltamethrin 50 g/l	2.79 litres	0.14 Litres	Crops
Stomp CS	Pendimethalin 455 g/l	28.11 litres	0.97 Litres	Crops
Targa Super	Quizalofop-P-ethyl 50 g/l	88.25 litres	0.99 Litres	Crops
Moddus 250 EC	Trinexapac-ethyl 250 g/l	33.75 litres	0.17 Litres	Crops
Sekator OD	Mefenpyr-diethyl 250 g/l	13.31 litres	0.12 Litres	Crops
Axial 50 EC	Cloquintocet-mexyl 12.5 g/l	162.93 litres	0.82 Litres	Crops

Figure 8: Extracts of the farmer performance dashboard

- **Example 2: The Farm Registry viewer (UC3)**

The NIVA UC3 (Farm Registry) has designed not the common data model for the Farm Registry, but also some web services and tools to enable the management and display of the related database.

One of these tools is a viewer intended to be used as a dashboard for Paying Agencies. In addition to enable the visualisation of geographic data (where the farm is located), it includes predefined queries whose results are displayed in tables and histograms.

This viewer includes three main functions: the representation of parcels (with statistics at farm level on total surface of the farm, number of parcels, average parcel surface), the visualisation of crops (and statistics about type of crop produced according to EPPO standard, total surface per crop, percentage of surface in relation to the overall surface) and statistics on activities (surface treated with phytosanitary products , surface irrigated, surface treated with fertilizer)

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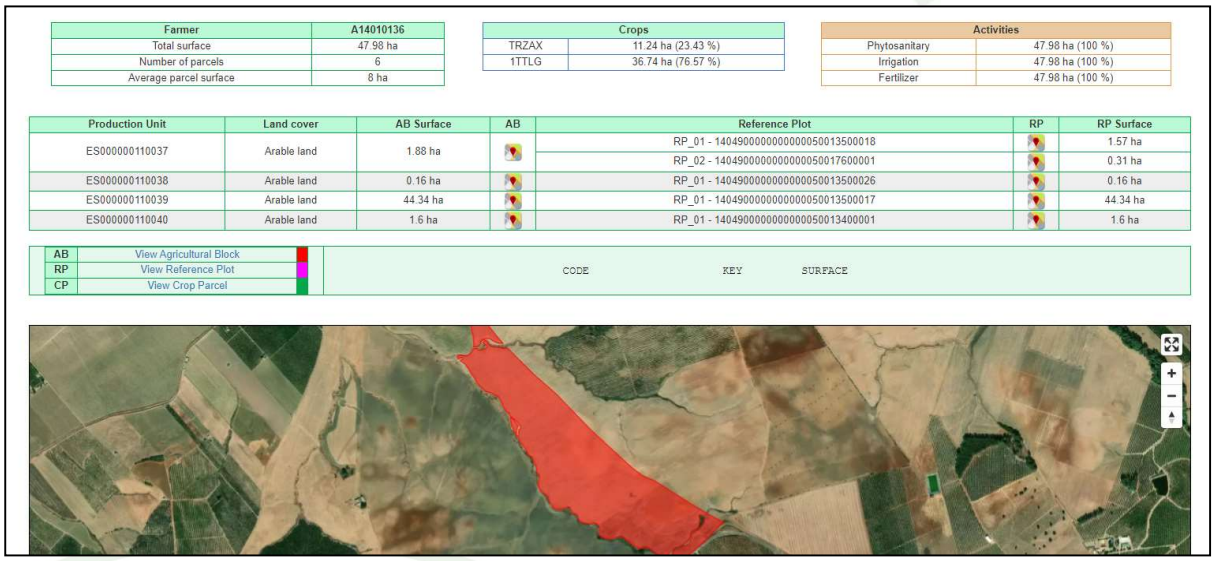

Farmer	A14010136
Total surface	47.98 ha
Number of parcels	6
Average parcel surface	8 ha

Crops	
TRZAX	11.24 ha (23.43 %)
1TTLG	36.74 ha (76.57 %)

Activities	
Phytosanitary	47.98 ha (100 %)
Irrigation	47.98 ha (100 %)
Fertilizer	47.98 ha (100 %)

Production Unit	Land cover	AB Surface	AB	Reference Plot	RP	RP Surface
ES000000110037	Arable land	1.88 ha		RP_01 - 14049000000000000500135000018		1.57 ha
				RP_02 - 14049000000000000500176000001		0.31 ha
ES000000110038	Arable land	0.16 ha		RP_01 - 14049000000000000500135000026		0.16 ha
ES000000110039	Arable land	44.34 ha		RP_01 - 14049000000000000500135000017		44.34 ha
ES000000110040	Arable land	1.6 ha		RP_01 - 14049000000000000500134000001		1.6 ha

AB	View Agricultural Block
RP	View Reference Plot
CP	View Crop Parcel

CODE KEY SURFACE

Figure 9: Extract of the farm registry viewer (statistics at farm level)

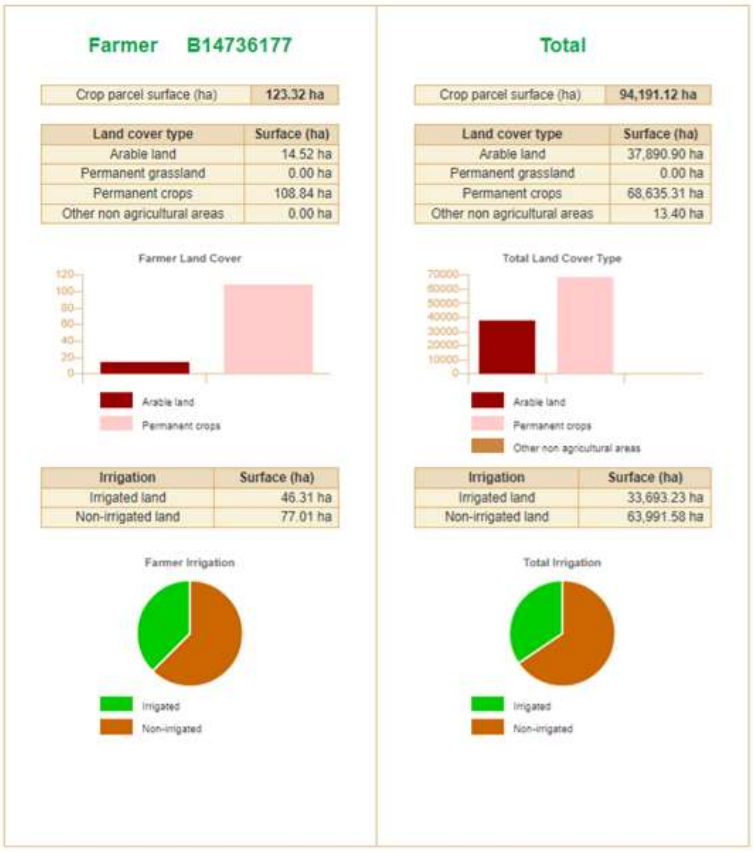

Figure 10: Extract of the farm registry viewer (statistics at farm level and at region level)

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Example 3: Common indicators for CAP monitoring at MS level

The new CAP (CAP post 2022) aims to measure the performance rather than the pure conformance. This should be done through output, results and impact indicators. The content defined by the Farm Registry data model is expected to support the computation of impact-related indicators.

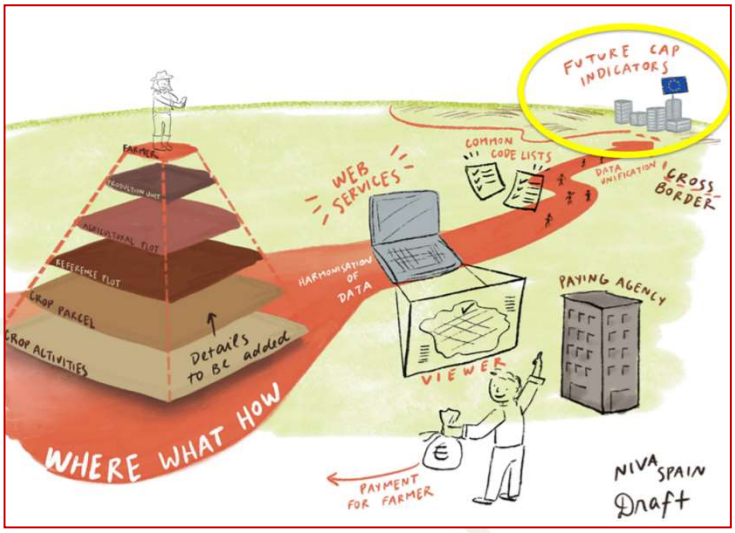

Figure 11: The farm registry content in support to future CAP indicators

The NIVA Use Case on agro-environmental monitoring (UC1B) has experienced the design and computation of indicators on carbon storage, risk of nitrate lixiviation and biodiversity. Simple indicators at Tier 1 are using only widely available data, mainly current IACS data and Sentinel images. Their computation is relatively easy and has been tested in large areas of several countries.

Results are available on : https://zenodo.org/communities/niva4cap/?page=1&size=20

There is also strong interest for more accurate or more complete indicators at Tier 2, but these indicators are quite more difficult to compute mainly because they are requiring farmer data especially about use of fertilizers or phytosanitary products. Unfortunately, this data is not yet present in IACS, but only in best case in the various tools (FMIS, Field Book …) used by farmers.

During the NIVA project time, the main difficulty was to get farmer permission for their data reuse but the lack of standardisation was also quite time-consuming. The availability of a Farm Registry based on the NIVA common data model would facilitate greatly the computation of agro-environmental indicators.

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Farm Registry data model

Indicator	Carbon	Nitrate lixiviation	Biodiversity
Topic	 Climate change	 Water quality	 Biodiversity
Indicator Tier 1	CO_2 flux based on the crop vegetation cycle (respiration, photo-synthesis)	Based on the crop sequence impact	Based on landscape characteristics (parcel size, crop richness and diversity, quantity of semi-natural elements)
Indicator Tier 2 Requirements	Import of organic amendment Biomass export (yield data)	Use of fertilizers may also have impact (despite of Nitrate Directive)	Agricultural practices (mainly use of plant protection products) have also an impact
Indicator Tier 2 Current status	Farmer data required significant preparation & standardisation (done by farmer organisation) Tested only in France	Indicator not developed	Indicator not developed

Table 1: Content of Farm Registry would have been useful to compute NIVA agro-environmental indicators

The interest of the NIVA Farm Registry data model has also been recognised by ENRD (European Network for Rural Development). The ENRD has set up an Evaluation Knowledge Bank that collects the tools and methods from various European projects considered of interest for the monitoring of the national CAP related policies. The Farm Registry data model and its accompanying web services are one of the 4 NIVA tools recorded in this an Evaluation Knowledge Bank.

This need of harmonised data model was also recognised by the participants to the DataAgri event (Zarogoza) mentioned in a previous chapter as 92.2% of the users highlight that it would be very interesting a common shared data model across Europe related to CAP and IACS Data.

Example 4: INSPIRE

The theme Aquacultural and Agriculture Facilities is one of the 34 themes of the INSPIRE Directive. Public bodies that are data owners or custodians of such data should therefore make this data accessible (at least) for public bodies through view and download services. In addition, to enable easy pan-European use, the related data should be harmonised, according to the data models defined in the INSPIRE data specifications.

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Though not having the whole content of INSPIRE models on agricultural facilities, Paying Agencies have a significant part of it and might in several Member States be the best candidate responsible body for the publication of this sub-theme data.

This is why the NIVA Farm Registry data model has taken into account the INSPIRE model.

NIVA has reused some INSPIRE concepts (mainly the Sites) to make more explicit what can be matched between the INSPIRE and the NIVA data model.

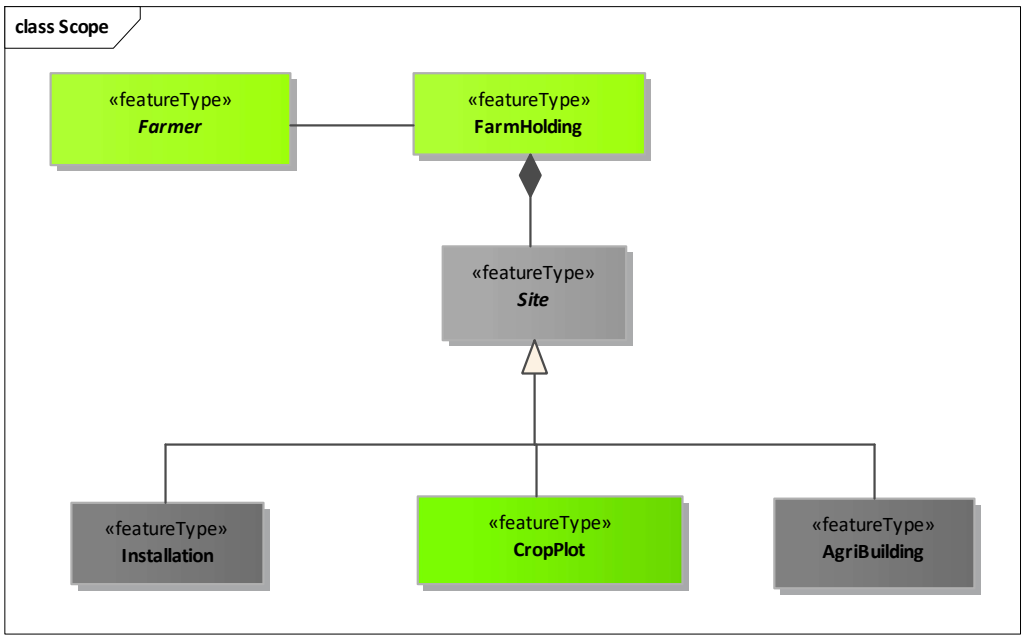

Figure 12: Comparison between NIVA and INSPIRE data models

According to the extended INSPIRE data model, a Farm Holding is composed of Sites that may be Agricultural Buildings, Installations or Plots, each site having the ability to carry information about activities and animals.

On one side, the NIVA model has a more limited scope as it is not including buildings and installations; it is including only a simple description of the Farm Holding itself, its relation with the Farmer managing. On the other side, the NIVA model has a strong focus on and detailed description of the description of the Crop Plots and on the crop related activities.

Example 5: High Value Datasets (HVD)

The list of HVD that is accompanying the Open Data Directive has been published by end of summer 2022 in almost final version but it has not yet been adopted. According to the regulation, High Value Datasets are expected to be published as open data and to be made easily available.

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The current (but not yet voted) list on High Value Datasets is requiring data about animals on Reference Parcels. However, Paying Agencies don't have this information at reference parcel level but at farm level.

This is why the NIVA data model is proposing a feasible and (relatively) harmonised way to provide this information, by attaching the data about animals on the Farm Holding feature type.

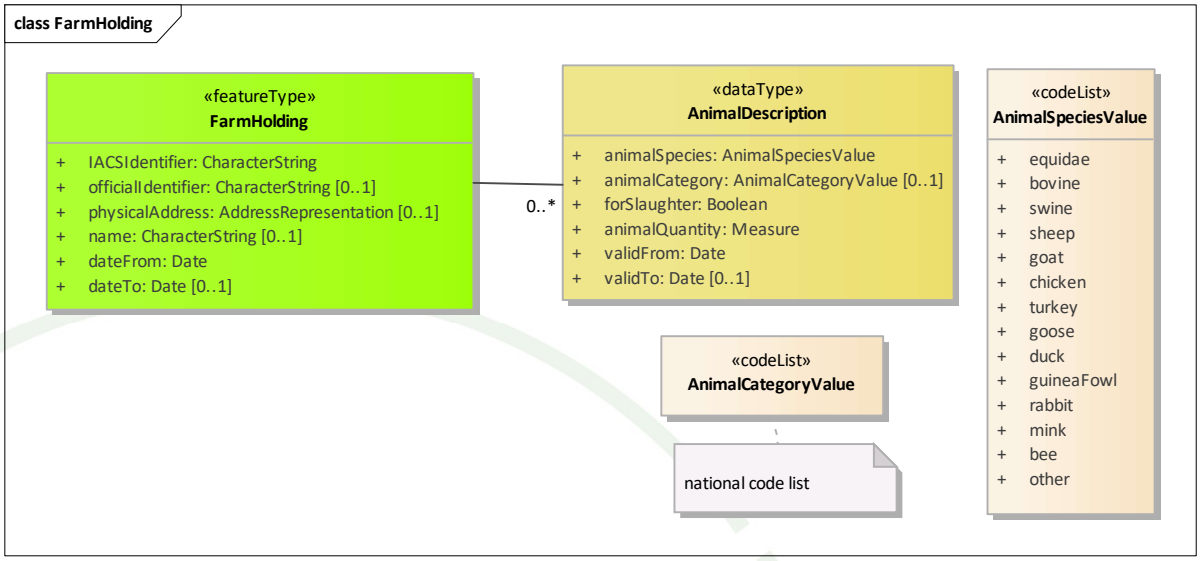

Figure13: The NIVA proposal for publication of animal data

6. Methodology and related documents

In the first phase of NIVA project, this common data model was designed by Spanish partners under Use Case "Farm Registry" (UC3), who defined the expected content. It was developed as a logical model accompanied by the physical structure of the related database and by web services aiming to manage the data imports. Andalusia Paying Agencies has tested this set of tools; the tests have shown the feasibility of migrating existing data from a regional agency to a national centralized registry. Some tests were also performed by ARIB, the Estonian Paying Agency, demonstrating the validity of the Farm Registry concepts at European level.
The documents related to the UC3 data model and accompanying tools may be found on the NIVA Gitlab: nivaeu · GitLab
In the second phase, the Work Package Harmonisation and Interoperability (WP3) has recognised the interest of this common data model as candidate standard and has decided to promote it in its deliverable D3.2 Common Semantic Model – M42. While keeping quite similar content, a conceptual model in UML (Unified Modelling Language) has been designed in order to make the model even more generic. This model may be found on the NIVA web site: Deliverables – Niva4cap

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7. Background on NIVA.

Modernisation of the Common Agricultural Policy depends in no small part on ongoing digitisation of the Agricultural sector. The Integrated Administration and Control System (IACS) is the key instrument for CAP governance in each member state. Currently, implementations of IACS vary greatly between member states. New IACS Vision in Action (NIVA) delivers a suite of digital solutions, e-tools and good practices for e-governance and initiates an innovation ecosystem to support further development of IACS and to facilitate data and information flows. In NIVA 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 data content of the Farm Registry has proved to be of key interest in the context of future CAP (CAP 2023 - 2027); the Farm Registry is one of the starting points of the future Seamless Claim system, its content is required for assessing performance and the common data model should contribute to publication of more harmonised data.

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