



The Standards People

IoT Conference 2023

Sustainability using semantics in the agricultural supply chain with SAREF4AGRI

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TNO innovation
for life

4th of July 2023



PLOUTOS





Ploutos Project

In a nutshell

The Ploutos project aims to **rebalance** the **agrifood value chain**, transforming it into one that works for the benefit of society and the environment. The project develops three pillars: **Behavioural Innovation**, **Sustainable Collaborative Business Model Innovation** and **Data-driven Technology Innovation**, supported by a **Sustainable Innovation Framework** that enables a systemic approach to evaluating agri-food sector innovation.



PLOUTOS has received funding from EU's programme H2020 under GA 101000594



Ploutos Consortium

H2020 funded, 3 year, €8.5M project, 2020-2023

33 partners, 13 countries including farmers' organisations and farm businesses, food industry companies, traders/distributors, food brand owners, SMEs, a certification party, NGOs, public authorities/public service providers, DIHs

Coordinator



Partners



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Overview of Sustainable Innovation Pilots

Ploutos will deploy SIPs to co-design, pilot, validate & assess approaches against their economic, environmental and social performance.

No	Descriptive title	Countries Involved	Sector	Value chains
1	Supporting a frozen fruit value chain with small farmers, to optimise production, reduce environmental footprint and re-use the data for certification and subsidies	Greece	Frozen Fruit	1
2	Better food-chain contracts for improved durum wheat production	Italy	Arable / Pasta	1
3	Empowering consumers through crowdsourcing to take back control over their food and create healthy, sustainable, fair-trade products	France, Greece, UK, Germany, Belgium	Cross-sector	≥10
4	Traceability solutions covering the horticulture greenhouses value chain to improve operations, sustainability performance and brand recognition	Spain	Vegetables	1
5	Smart Farming on rural farms demonstrating its benefit in the wider agri-food community and co-creating new food products and services	Ireland	Livestock, arable / Food tourism	≥2
6	Applying soil-passport approach rewarding land-owners/users and a precision farming solution to increase soil health and sustainability	Slovenia	Cross-sector	≥2
7	Supporting wine producers in taking advantage of the changes in labelling regulations and enhancing their sustainability performance	Cyprus	Wine	1
8	Carbon Farming: compensating farmers for climate friendly soil management	Netherlands	Cross-sector / Organic	≥2
9	Facilitating the transfer of surplus food from farms to socially disadvantaged groups, by aligning logistics and processes	Serbia, N. Macedonia	Cross-sector	≥2
10	Increase sustainability in the grapevine sector by introducing payments for ecosystem services provision and parametric insurance to support losses from sustainable approaches	Italy	Fruit	1
11	Improving the sustainability of Balearics agri-food chains with Smart Farming and by using the collected info to organise agri-tourism activities	Spain	Vegetables / Agri-Tourism	1



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Ploutos Common Semantic Model: Guiding Principles

- ✓ The (PCSM) should be a *small, core model* that covers the main common concepts in the agrifood domain ranging from the *farm* via the *supply chain* to the *consumer*
- ✓ Supporting all Ploutos *SIP agrifood use cases*
- ✓ Based on standard *ontology engineering principles*, RDF, OWL
- ✓ Maximal *reuse* and possible *extension* of existing ontologies - ones that are available, accessible and not proprietary
- ✓ Ploutos namespace: <https://www.tno.nl/agrifood/ontology/ploutos/common#>
- ✓ Downloadable from: <https://gitlab.com/Ploutos-project>



PCSM: Reuse of existing ontologies

Prefix	Name	Base URI	Scope
ENVO	Environment Ontology	http://purl.obolibrary.org/obo/envo.owl#	Ecosystems, environment, geographical components and processes
S4AGRI	SAREF4AGRI	https://saref.etsi.org/saref4agri/	Smart appliances and devices for agricultural purposes
SSN	Semantic Sensor Network	http://www.w3.org/ns/ssn/	Sensor networks and processes
SOSA	Sensor Observation Sample Actuator	http://www.w3.org/ns/saso/	Observations, actuations and samples from sensors and actuators
OM	Ontology of units of Measure	http://www.ontology-of-units-of-measure.org/resource/om-2/	Units hierarchy for measurements
Weather	BIMERR Weather Ontology	https://bimerr.oit.linkeddata.es/def/weather#	Weather phenomena and parameters
GS1	GS1 web vocabulary	https://gs1.org/voc/	Supply chain product information including certification
Ploutos	Ploutos Common Semantic Model	https://www.tno.nl/agrifood/ontology/ploutos/common#	Supply chain actors and operations



Reuse and extension approach

For each new concept or property:

1. Try to find an existing ontology that already defines this concept/property.
2. Try to find an existing ontology with a scope that covers the new concept/property.
3. Try to find an existing ontology for which the scope might be easily enlarged to cover the new concept/property.
4. Define the new concept/property in the PCSM.



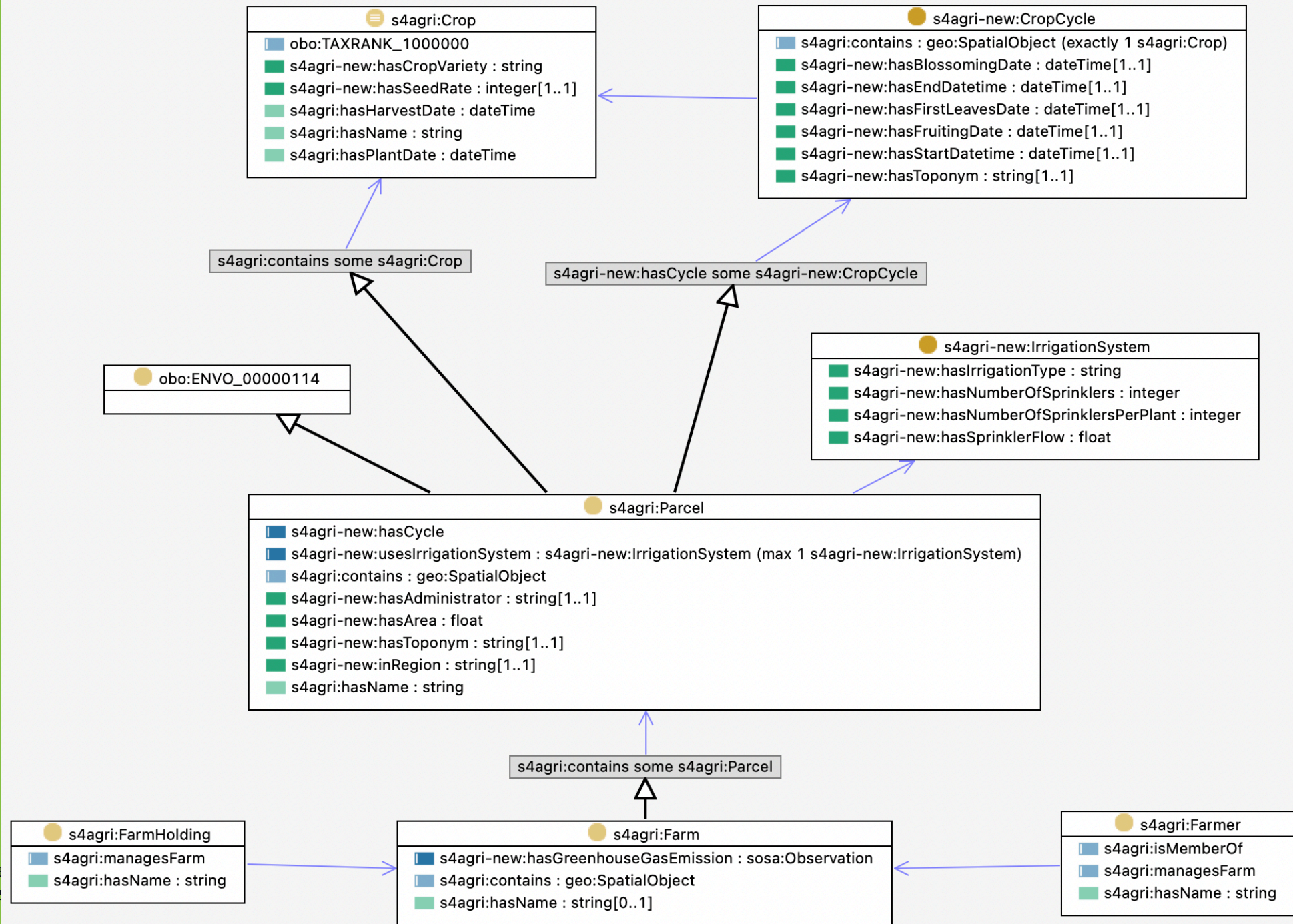
PCSM:

Saref4Agri Reuse:

- Farm
- Farmer
- FarmHolding
- Parcel
- Crop
- ...more...!

Saref4Agri Extensions:

- Parcel additional properties
- CropCycle with properties on crop stages
- IrrigationSystem with properties on type, sprinklers and flow
-more...!



PLOUTOS has received funding from the European Union Horizon programme H2020 under GA 101000.

PLOUTOS Pilot Frozen Fruit Value Chain

- Small Greek farmers (cooperative)+ processor + multinational customers,
- Objective: optimize production, reduce environmental footprint and re-use data for certification and subsidies.
 - Challenges: farms are small, different microclimate zones, high inputs costs, lack of financial resources for investments, old production methods result in increased inputs consumption while damaging the environment.
 - Need to reduce their production costs and increase their revenues in an environmentally friendly way.
 - “ALTERRA is a food processing company working closely with Proodos in order to produce high quality frozen fruit products, offering better prices to farmers for high quality products, but they need to prove the high quality to their customers and being able to get a *certificate like GLOBALG.A.P* and, the local brand label.”
- Key Partners: NEUROPUBLIC, ALTERRA-Processing Industry, PROODOS-Farmers Union



Use case: Certification conformity

1. Actor assessing conformity to GlobalGAP certificates:
 - ▶ Integrated Farm Assurance V5.2 Control Point and Compliance Criteria
 - ▶ Farm Sustainability Assessment V2.1
2. Control points for which data is available at the food company + farmer
3. Data elements needed to satisfy these control points
4. In PCSM reuse of Saref4Agri and extension proposals
5. Developed certification app to collect evidence for proving conformity to the certificates



GlobalGAP IFA V5.2 Control Points

AF 1.1.2: Is a recording system established for each unit of production or other area/location to provide a record of the livestock/aquaculture production and/or agronomic activities undertaken at those locations?

- ▶ Give me a record for an **area** on a **farm** that describes the **agronomic activities** during a specific **time interval**?

CB 4.2: Do records of all applications of soil and foliar fertilizers, both organic and inorganic, include the following criteria: Field, orchard or greenhouse reference and crop? Application dates? Applied fertilizer types? Applied quantities? Method of application?

- ▶ Give me a record for a **field** on a **farm** that gives the **crop**, **application date**, **applied fertilizer type**, **applied quantities** and **method of application**?



GlobalGAP FSA V2.1

CB 6.4 Intervention: The producer shall show evidence that in situations where pest attacks adversely affect the economic value of a crop, intervention with specific pest control methods will take place. Where possible, non-chemical approaches shall be considered.

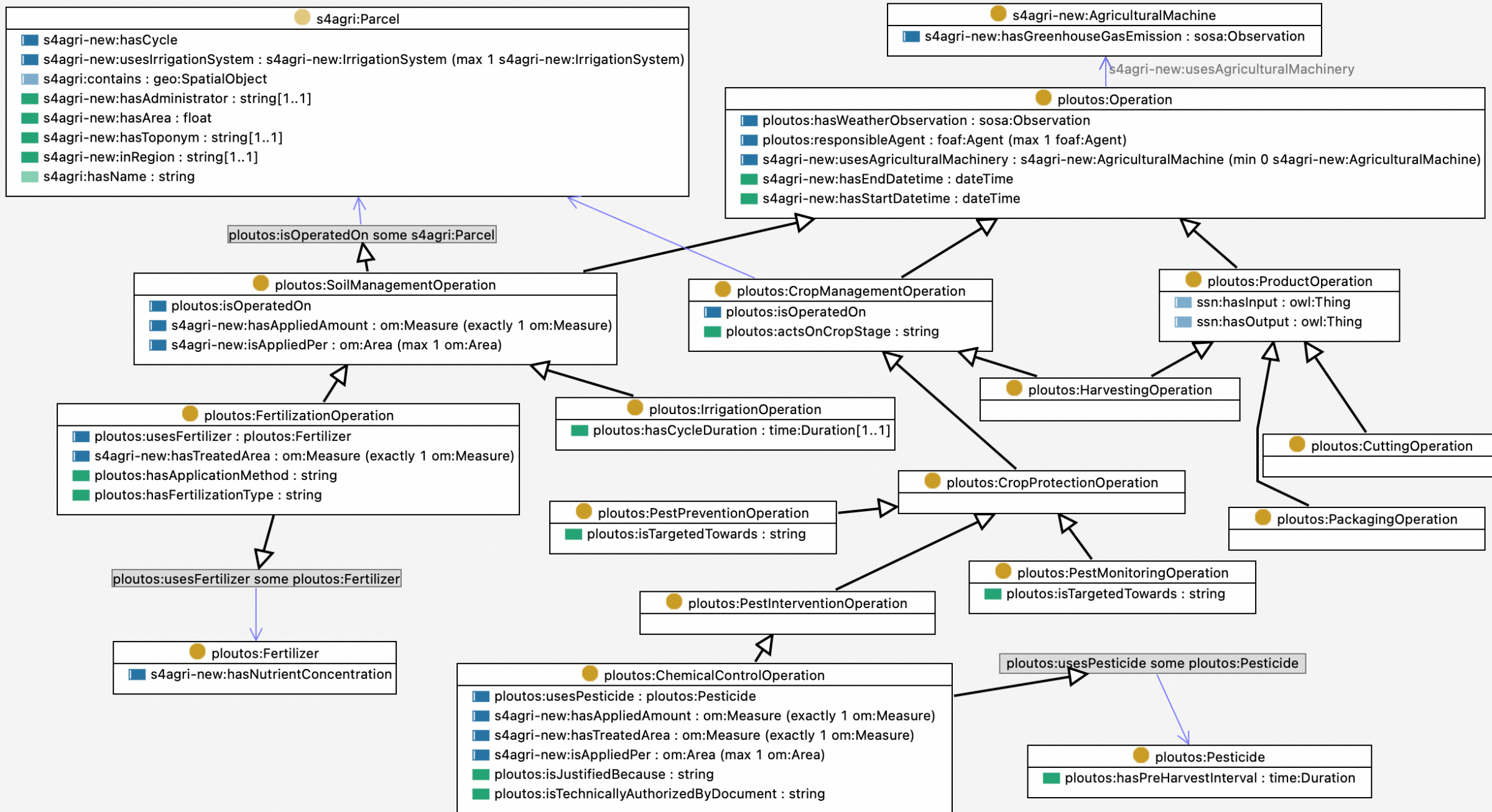
- ▶ Give me a record for a crop on a field of a farm that contains a list of activities to control pests including field code, commercial name of the drastic ingredient, quantity, reason, pre-harvest interval (PHI), application tool and growing stage?

FSA 24: Do you identify sources of greenhouse gas and do you measure and monitor your emissions?

- ▶ Give me a record for a farm of an estimation of the amount of kilograms of carbon equivalent per ton of product including the calculation formula and sources of greenhouse gas emission?



PCSM - Certification Conformity Assessment



Ploutos Registry and Discovery Directory

Conformity assessment organization



Certification application



Ask certification checklist info

Ploutos Model Common RDF

Semantic

GLOBALG.A.P. Answer certification checklist info



KM

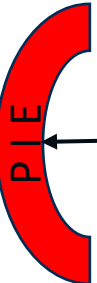
API

Warehouse management System

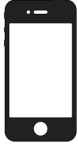


Fruit processing factory

Food Company



Traceability app backend



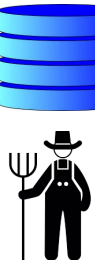
Ask info on traceability

Answer info on traceability

EUROCert Answer certification checklist info

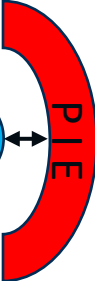
Answer info on traceability

Smart farming services




API

KM



KM = knowledge mapper

Certification app



Username


auditor

Password

.....

LOGIN

Version 1.2.0



Code

Enter inspection code

SEARCH

LOGOUT

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Give Me A Record For A Field On A Farm That Gives The Crop, Application Date, Applied Fertilizer Type, Applied Quantities And Method Of Application?

Certification app

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Give Me A Record For A Field On A Farm That Gives The Crop, Application Date, Applied Fertilizer Type, Applied Quantities And Method Of Application? ^

- Copper Hydroxide v
- Dodine v
- Difenoconazole v
- Paraffin Oil/(CAS 64742-46-7) v
- Dithianon v
- Etofenprox v
- Glyphosate v
- Copper Hydroxide v
- Dodine v
- Ziram v
- Paraffin Oil/(CAS 8042-47-5) v
- Acetamiprid v
- Lambda-Cyhalothrin v

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Give Me A Record For A Field On A Farm That Gives The Crop, Application Date, Applied Fertilizer Type, Applied Quantities And Method Of Application? ^

- Copper Hydroxide v
- Dodine v
- Difenoconazole ^
- Area Value: **4021.1 L M²**
- Applied Value: **45.0 L M²**
- Start: **2021-03-12**
- End: **2021-03-12**
- Paraffin Oil/(CAS 64742-46-7) v
- Dithianon v
- Etofenprox v
- Glyphosate v
- Copper Hydroxide v
- Dodine v

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Give Me A Record For A Field On A Farm That Gives The Crop, Application Date, Applied Fertilizer Type, Applied Quantities And Method Of Application? ^

- Copper Hydroxide ^
- Area Value: **4021.1 L M²**
- Applied Value: **150.0 L M²**
- Start: **2021-02-01**
- End: **2021-02-01**
- Dodine ^
- Area Value: **4021.1 L M²**
- Applied Value: **128.0 L M²**
- Start: **2021-02-20**
- End: **2021-02-20**
- Difenoconazole ^
- Area Value: **4021.1 L M²**
- Applied Value: **45.0 L M²**
- Start: **2021-03-12**
- End: **2021-03-12**

Next steps

- ▶ Finalization of the certification app to show the use case results
- ▶ Bring in the Saref4Agri extension proposals into an ETSI standardization trajectory
- ▶ Work on additional agrifood use cases to derive new Saref4Agri extensions as part of a new European agrifood project QuantiFarm



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- ▶ Detailed reports on this work are available on the Ploutos website: <https://ploutos-h2020.eu/about/#deliverables>
- ▶ Academic paper published at Semantic Web Journal (<https://www.semantic-web-journal.net/content/data-sharing-agricultural-supply-chains-using-semantics-enable-sustainable-food-systems-0>)

