



ONTOLOGIES

Community of Practice

Crop Ontology, Agronomy Ontology and others

Elizabeth Arnaud
Ontologies CoP Lead



Digital Solutions Team Lead
Alliance Bioversity-CIAT

Alliance



Platform for
Big Data
in Agriculture



WELCOME!



The Ontologies Community of Practice brings together researchers, modelers, information specialists, data managers, and ontology experts from the CGIAR research network, academia, and the private sector, thus creating a critical mass of expertise to tackle the major issues related to semantics for **FAIR data** in agri-food science.

The CoP provides the ideal forum for co-learning and knowledge exchange on ontologies and for guiding consistent data annotation, as well as the deployment of quality ontologies in databases and repositories. The CoP stimulates exchanges between domain experts and experts in ontology design, knowledge modeling, ontology-driven applications, and semantic web technologies

The CoP is led by the Alliance of Bioversity International and CIAT and was launched by the CGIAR Platform for Big Data in Agriculture.

This webpage presents the different working groups of the CoP, lists the tools developed

Get in touch

CoP Lead

Elizabeth Arnaud | [Email](#)
Elizabeth leads the Ontologies CoP and is a scientist at the Alliance of Bioversity International and CIAT in Montpellier, France

CoP Communication

Céline Aubert | [Email](#)
The International Food Policy Research Institute, France

[Read the Ontologies CoP paper](#)

[Visit the Ontologies CoP YouTube channel](#)



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ENGAGE

Interact with community members through our LinkedIn Group.



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Share your expertise in our working groups.

[See our Working Groups](#)

COMMUNITY NEWS

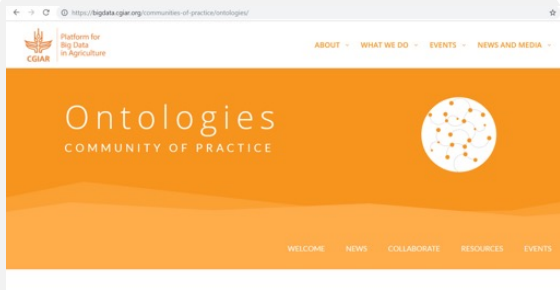
<p>Webinar - Governance operational model for ontologies (GOMO) August 9, 2021 / Hannah Craig This webinar by the Ontologies Community of Practice presents work on making WebProtégé compatible with a labelled property graph representation ...</p>	<p>Webinar - Ontology tools provided by EB: OLS, ZOOMA, OXO June 29, 2021 / Lorna Pizzaro Madari This webinar by the Ontologies Community of Practice presents OLS, ZOOMA, & OXO - platforms developed by the ontology tools team ...</p>
<p>Webinar - Advances of the Crop Ontology website and graph visualization using graph database April 6, 2021 / Lorna Pizzaro Madari Webinar on how to use the new version of the Crop Ontology website ...</p>	<p>FAO cooperates with CGIAR to increase interoperability between food and agricultural information systems June 8, 2021 / Lorna Pizzaro Madari CGIAR and FAO announce new collaboration aiming to enhance data sharing in the food and agricultural sector through the AGRFOVOC ...</p>

<https://bigdata.cgiar.org/communities-of-practice/ontologies/>

To engage in the Community of Practice

Web site

<https://www.youtube.com/c/OntologiesInAgriculture>



bigdata.cgiar.org/communities-of-practice/ontologies/



18 Webinars



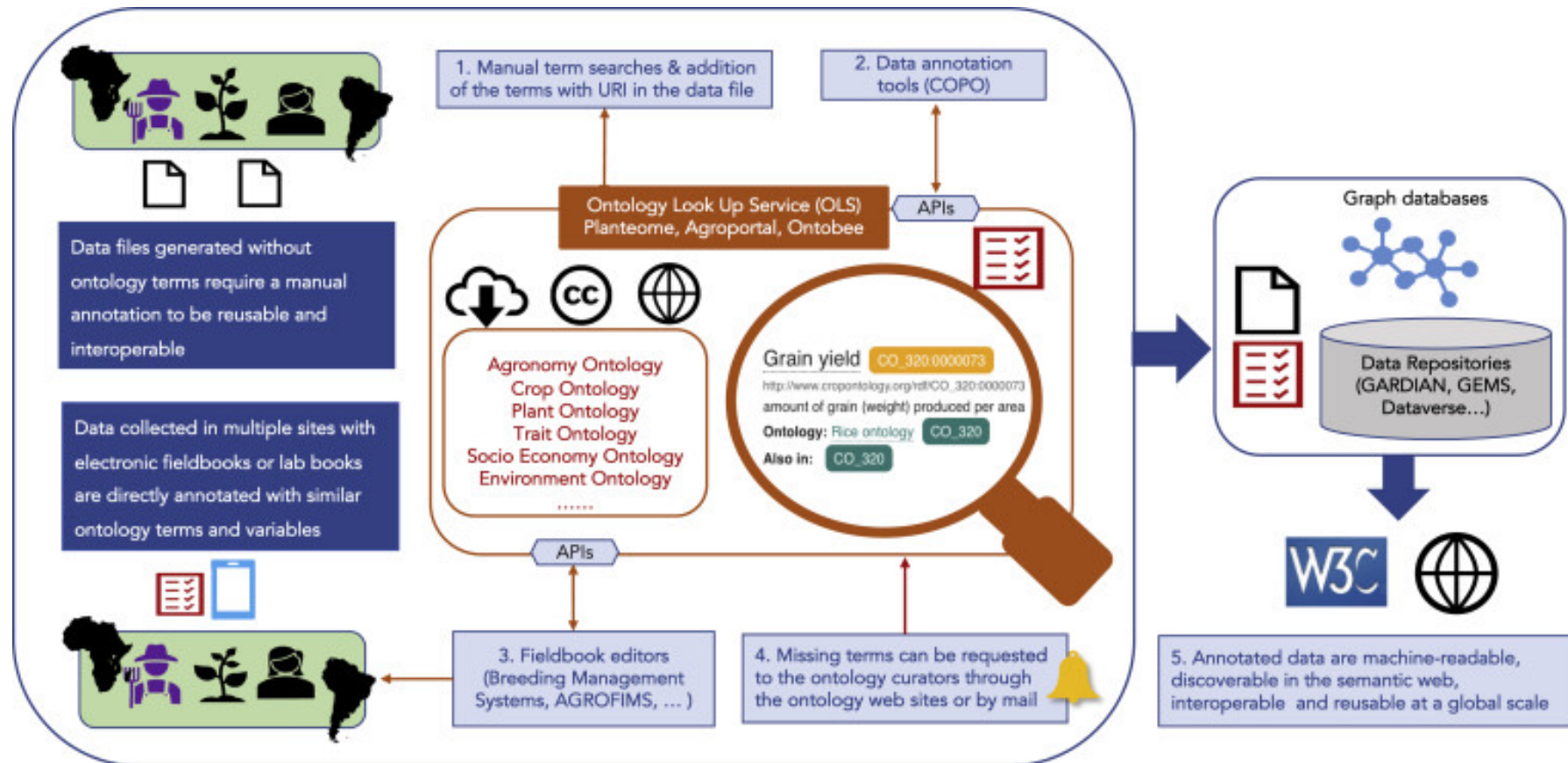
224 members

<https://www.linkedin.com/groups/13707155/>



Newsletter

472 suBscribers



The Ontologies Community of Practice: A CGIAR Initiative for Big Data in Agrifood Systems. Arnaud E. et al, Patterns J., Vol. 1, Issue 7, DOI:<https://doi.org/10.1016/j.patter.2020.100105>

To date

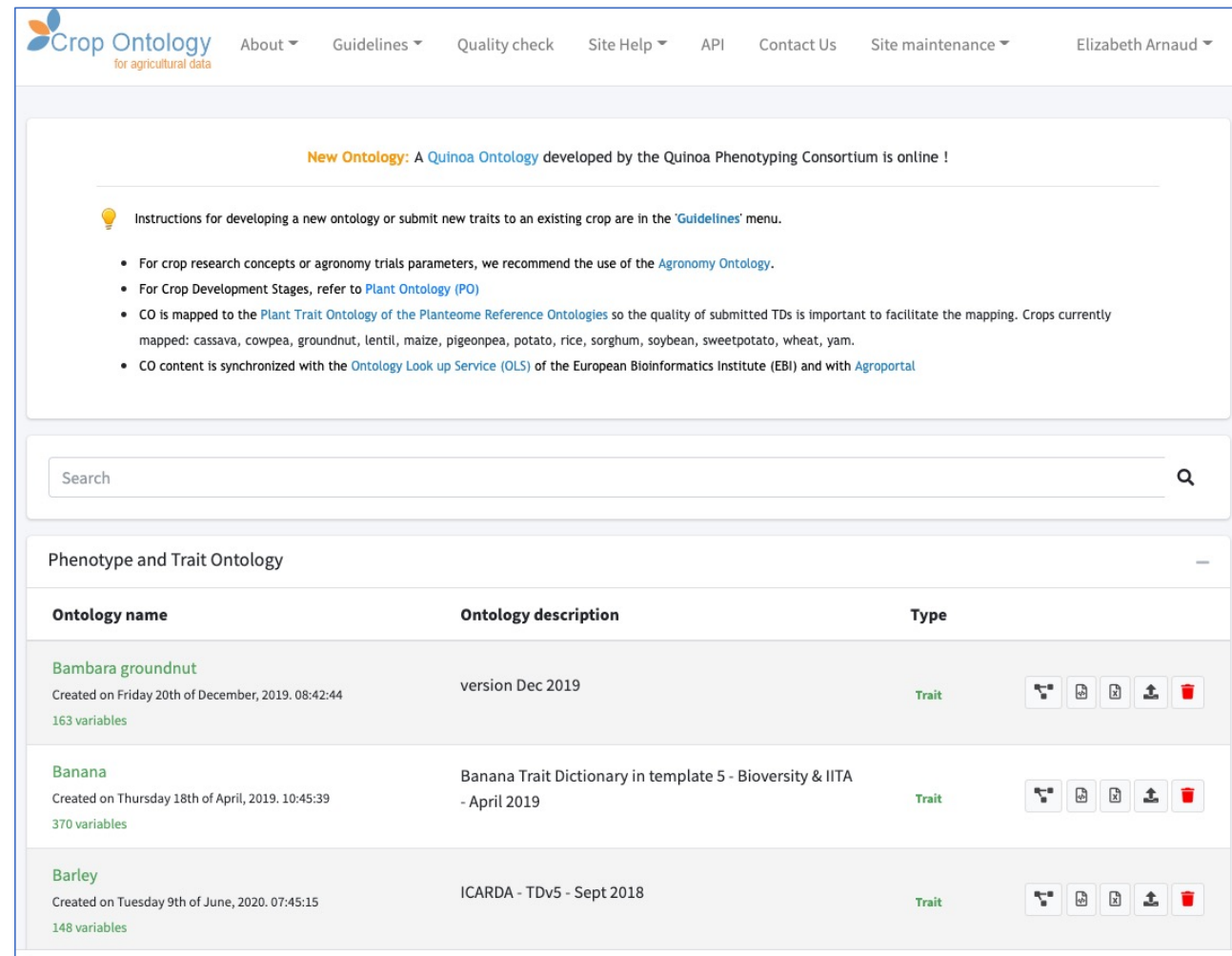
- 32 species
- > 4,300 traits
- > 6,300 variables



Last crop: **Quinoa** by the
Quinoa Phenotyping Consortium

CC-BY 4.0

Created in 2009 by the Integrated Breeding Platform for breeders' traits



The screenshot shows the Crop Ontology website interface. At the top, there is a navigation menu with links for About, Guidelines, Quality check, Site Help, API, Contact Us, Site maintenance, and a user profile for Elizabeth Arnaud. A prominent announcement states: "New Ontology: A Quinoa Ontology developed by the Quinoa Phenotyping Consortium is online!". Below this, a lightbulb icon indicates instructions for developing a new ontology or submitting new traits, with a link to the 'Guidelines' menu. A list of recommendations follows:

- For crop research concepts or agronomy trials parameters, we recommend the use of the [Agronomy Ontology](#).
- For Crop Development Stages, refer to [Plant Ontology \(PO\)](#)
- CO is mapped to the [Plant Trait Ontology of the Planteome Reference Ontologies](#) so the quality of submitted TDs is important to facilitate the mapping. Crops currently mapped: cassava, cowpea, groundnut, lentil, maize, pigeonpea, potato, rice, sorghum, soybean, sweetpotato, wheat, yam.
- CO content is synchronized with the [Ontology Look up Service \(OLS\)](#) of the European Bioinformatics Institute (EBI) and with [Agroportal](#)

 A search bar is located below the announcement. The main content area displays a table titled "Phenotype and Trait Ontology" with the following columns: Ontology name, Ontology description, and Type. The table lists three ontologies:

Ontology name	Ontology description	Type
Bambara groundnut Created on Friday 20th of December, 2019. 08:42:44 163 variables	version Dec 2019	Trait
Banana Created on Thursday 18th of April, 2019. 10:45:39 370 variables	Banana Trait Dictionary in template 5 - Bioversity & IITA - April 2019	Trait
Barley Created on Tuesday 9th of June, 2020. 07:45:15 148 variables	ICARDA - TDv5 - Sept 2018	Trait

 Each row includes a set of icons for actions like edit, delete, and share.



Beet Ontology



Lead center



Collaborators



Navigation

Term, Trait, Method, and Scale

- Beet Ontology
 - Abiotic stress
 - Agronomical
 - Biotic stress
 - Environmental
 - Fertility
 - Morphological
 - Physiological
 - Quality

Term details

Key	Value
term_id	CO_333:ROOT
ontology_id	CO_333
ontology_name	Beet Ontology
language	EN

Vitis Ontology



Curator



Sources



Navigation

Term, Trait, Method, and Scale

- VITIS
 - Abiotic stress
 - Agronomical
 - Biochemical
 - Biotic stress
 - Morphological
 - Phenological
 - Technological

Term details

Key	Value
term_id	CO_356:ROOT
ontology_id	CO_356
ontology_name	VITIS
language	en

GUIDELINES FOR CREATING CROP-SPECIFIC ONTOLOGIES TO ANNOTATE PHENOTYPIC DATA



for agriculture data



Brassica Ontology



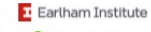
Curators

Sophie Durand, INRAE

Lead Center



Collaborators



Navigation

Term, Trait, Method, and Scale

- Brassica
 - Abiotic stress
 - Agronomical
 - Biochemical
 - Biotic stress
 - Morphological
 - Phenological
 - Quality

Term details

Key	Value
term_id	CO_348:ROOT
ontology_id	CO_348
ontology_name	Brassica
language	EN

Wheat Ontology



Curators

Rosemary Shrestha, CIMMYT
Julian Pietragalla, IBP GCP

Contributors

CIMMYT - Carlos Guzmán, Hector González, Enrique Autrique, Javier Pena, Pawan Singh, Matthew Reynolds, Tom Payne, Velu Govindan

Crop lead center



Collaborators



INRAE - Cyril Pommer

JIC - Luzie Winge

Cornell Univ. - David Waring

Navigation

Term, Trait, Method, and Scale

- Wheat traits
 - Abiotic stress
 - Agronomical
 - Biotic stress
 - Morphological
 - Phenological
 - Physiological
 - Quality

Term details

Key	Value
term_id	CO_321:ROOT
ontology_id	CO_321
ontology_name	Wheat
language	EN

Beet Ontology

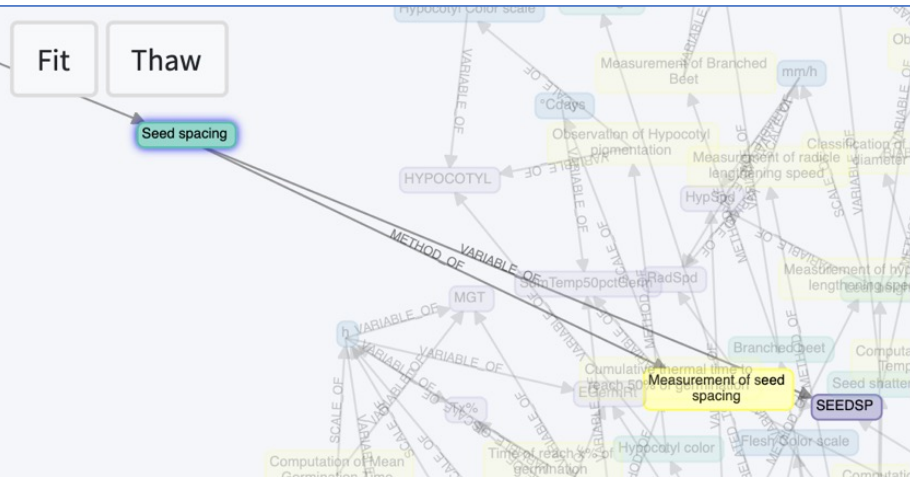


Navigation

📄=Term, 🟢=Trait, 🟡=Meth

- 🟢 Productivity
- 🟢 Productivity
- 🟢 Productivity
- 🟢 Productivity
- 🟢 Productivity
- 🟢 Productivity
- 🟢 Productivity
- 🟢 Seed spacing
- 🟡 Measur
- 🟢 cm
- 🟢 Spring popul
- 🟡 undefined
- 🟢 Stand homogeneity
- 🟢 Total Bolting plant count
- 📄 Biotic stress
- 📄 Environmental
- 📄 Fertility
- 📄 Morphological

- 🟢 trait
- 🟡 method
- 📄 variable
- 📄 term
- 📄 scale



CO_333:000024 (Seed spacing)

Parents:

CO_333:Agromonical (Agromonical)

Children:

CO_333:200020 (Measurement of seed spacing)

CO_333:100032 (SEEDSP)

scale_class

- 📄 Total Bolting plant count
- 📄 Biotic stress
- 📄 Environmental
- 📄 Fertility
- 📄 Morphological

language




Variables

variable_synonyms	Seed Spacing
institution	Institut Technique de la Betterave
scientist	Daphné Verdelet
date	2017-09-26T00:00:00

32 Crops To Date

Crop	Code
Andean Roots and Tubers	332
Bambara groundnut	366
Barley	323
Beet	333
Brachiaria (Forages)	345
Brassica	348
Cassava	334
Castor bean	347
Chickpea	338
Coconut	326
Coffee	361
Cotton	358
Cowpea	340
Faba bean	365
Finger Millet	328
Flax	362
Forages	342
Groundnut (Peanut)	337
Lentil	339

Maize	322
Melon	364
Mungbean	346
Musa (Banana)	325
Oat	350
Pearl Millet	327
Phaseolus (Common Bean)	335
Pigeon Pea	341
Potato	330
Protein crops	349
Quinoa	367
Rice	320
Sorghum	324
Soybean	336
Sugar Kelp	360
Sunflower	359
Sweet Potato	331
Vitis	356
Wheat	321
Woody plants	357
Yam	343
Walnut	363

-  INRAe curator
-  INRAe contributor
-  Codes for INRAe but no file

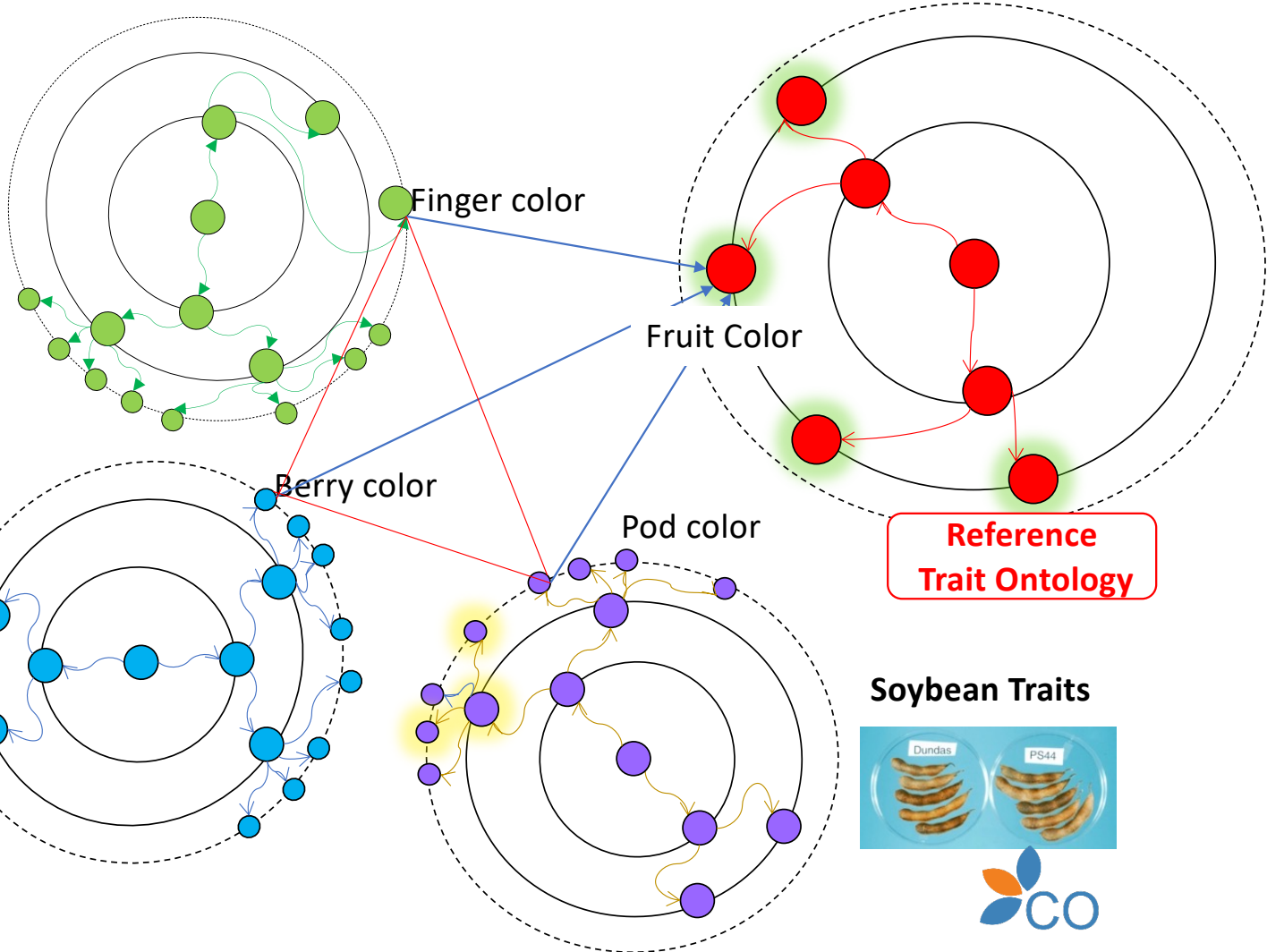


percode | percrop

Common Reference Ontology



Banana Traits



Tomato Traits

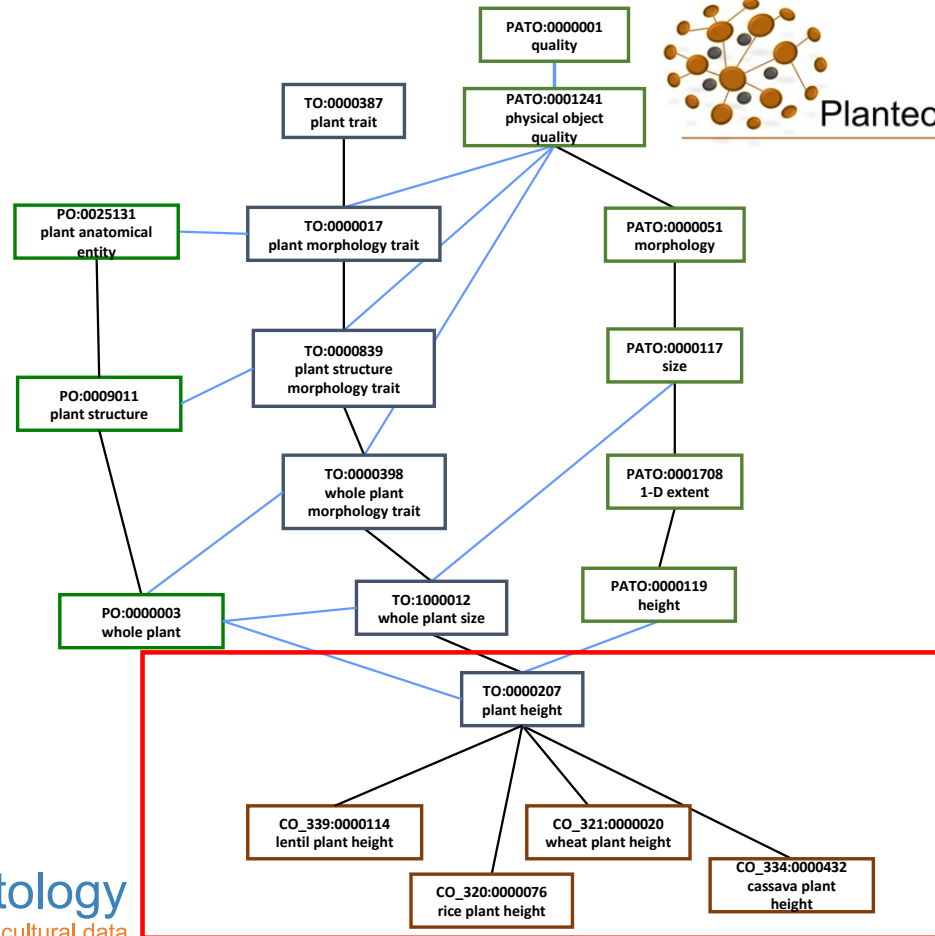


Soybean Traits



Integration of Species-Specific Ontologies with the Trait Ontology of Planteome

	# traits	# manually curated
CO_320_rice	157	5
CO_321_wheat	266	9
CO_322_maize	200	31
CO_324_sorghum	130	27
CO_331_sweetpotato	195	27
CO_334_cassava	163	16
CO_336_soybean	83	2
CO_339_lentil	68	11
CO_341_pigeonpea	62	9
CO_343_yam	159	40



potato
cowpea
groundnut

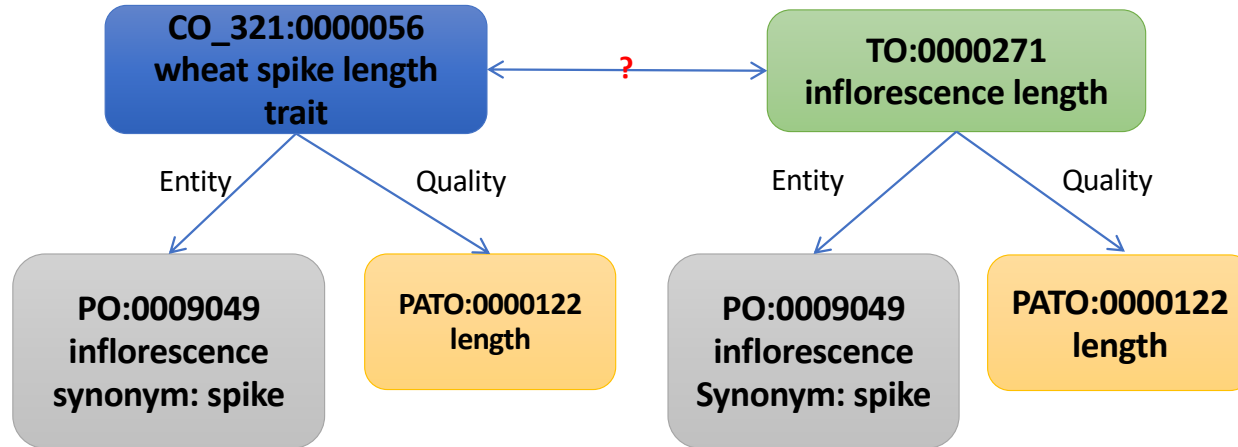




Automated Mapping is based on Design Patterns For example: Entity-Quality pattern

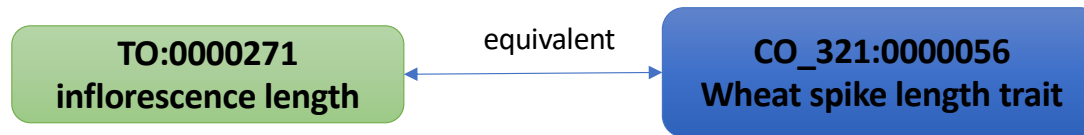


Manual curation



Reasoner infers that these terms are exact matches

Inference



Marie-Angélique Laporte
Crop Ontology, Alliance Bioversity International-CIAT





Adding Value Chain Actors & Preferences on Food products' Qualities

- Boiled Cassava
- Boiled Plantain
- Boiled Potato
- Boiled Sweet potato
- Boiled Yam
- Fried Sweet potato
- Attieke (Cassava)
- Eba
- Cassava Fufu
- Gari
- Pounded Yam
- Matooke



BILL & MELINDA GATES foundation

From the Lexicon to the Sensory Trait dictionary for Matooke



Matooke Samples
Photo: NARO

Trait name (Attribute)	Trait class (Type)	Trait description
Matooke surface yellowness intensity	Appearance	Color of the surface of the sample from light yellow to bright yellow
Matooke homogeneity of surface colour	Appearance	Uniformity of color of the surface of the sample

Type	Attributes	Definition	How to measure?	Scale
Appearance	Yellow	Color of the surface of the sample from light yellow to bright yellow	When you receive the sample, observe the surface and evaluate the intensity of the color and its homogeneity	0: very light yellow 10: bright yellow
	Homogeneity of colour	Uniformity of color of the surface of the sample		0 : heterogeneous 10 : homogeneous

Method name (How to measure)	Method class	Method description	Formula
Appearance method	Sensory descriptive measurement	When you receive the sample, observe the surface and evaluate the intensity of the color	
Appearance method	Sensory descriptive measurement	When you receive the sample, observe the surface and evaluate the homogeneity	

Scale name	Scale class
yellowness scale 0-10	Ordinal
color homogeneity scale 0-10	Ordinal
firmness scale 0-10	Ordinal

A Community Of Curators

Curators of the species ontologies in 2021

Bambara Groundnut	Liliana Andres, South King Cross University
Banana	Marie-Angélique Laporte, Alliance Bioversity-CIAT, Naama Menda; BTI
Barley	Ramesh Verna and Fawzy Nawar, ICARDA
Beet	Daphne Verdelet and Cyril Pommier, INRAE
Bracharia	Valheria Castiblanco and Luis Miguel Hernandez, Alliance Bioversity-CIAT
Brassica	Wiktor Jurkowski, Earlham Institute
Cassava	Afolabi Agbona, IITA and Naama Menda, Boyce Thompson Institute
Castor Bean	Salihu, B. Z., NCRI, Nigeria
Chickpea	Roma Das and Abhishek Rathore, ICRISAT
Common Bean	Guerrero Alberto Fabio, Alliance Bioversity-CIAT
Cotton	Jing Yu, Washington State University
Cowpea	Sam Ofodile and Tunde Agbaje, IITA
Faba Bean	Fouad Maalouf, ICARDA
Groundnut	Abhishek Rathore, ICRISAT
Lentil	Julian Pietragalla, IBP
Maize	Rosemary Shrestha, Kate Dreher, CIMMYT and Julian Pietragalla, IBP

Mungbean	Julian Pietragalla, IBP
Oats	David Waring, Cornell University
Pearl Millet	Roma Das and Abhishek Rathore, ICRISAT
Pigeon Pea	Roma Das and Abhishek Rathore, ICRISAT
Potato	Vilma Hualla, Elisa Salas, Thiago Mendes, CIP
Rice	Jeffrey Detrás, IRRI
Sorghum	Abhishek Rathore, ICRISAT
Soybean	Rex T. Nelson, USDA
Sugar Kelp	David Waring, Cornell University
Sunflower	Evan Staton, University of British Columbia
Sweet Potato	Jolien Swanckaert, CIP
Vitis	Eric Duchêne, INRA
Wheat	Rosemary Shrestha, CIMMYT and Julian Pietragalla, IBP
Woody Species	Celia Michotey, INRAE and Ines Chaves, IBET

Main Databases using Crop Ontology



<https://www.integratedbreeding.net/>



[Breedbase.org](https://breedbase.org)



<https://urgi.versailles.inra.fr/Tools/GnpIS>

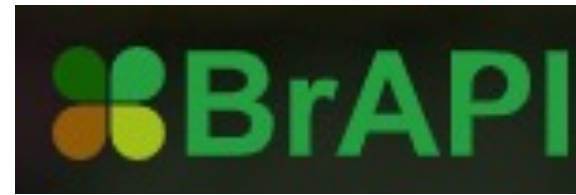


<https://agroinformatics.org/>

Main Standards Associated to Crop Ontology and Agronomy Ontology



<https://www.miappe.org/>



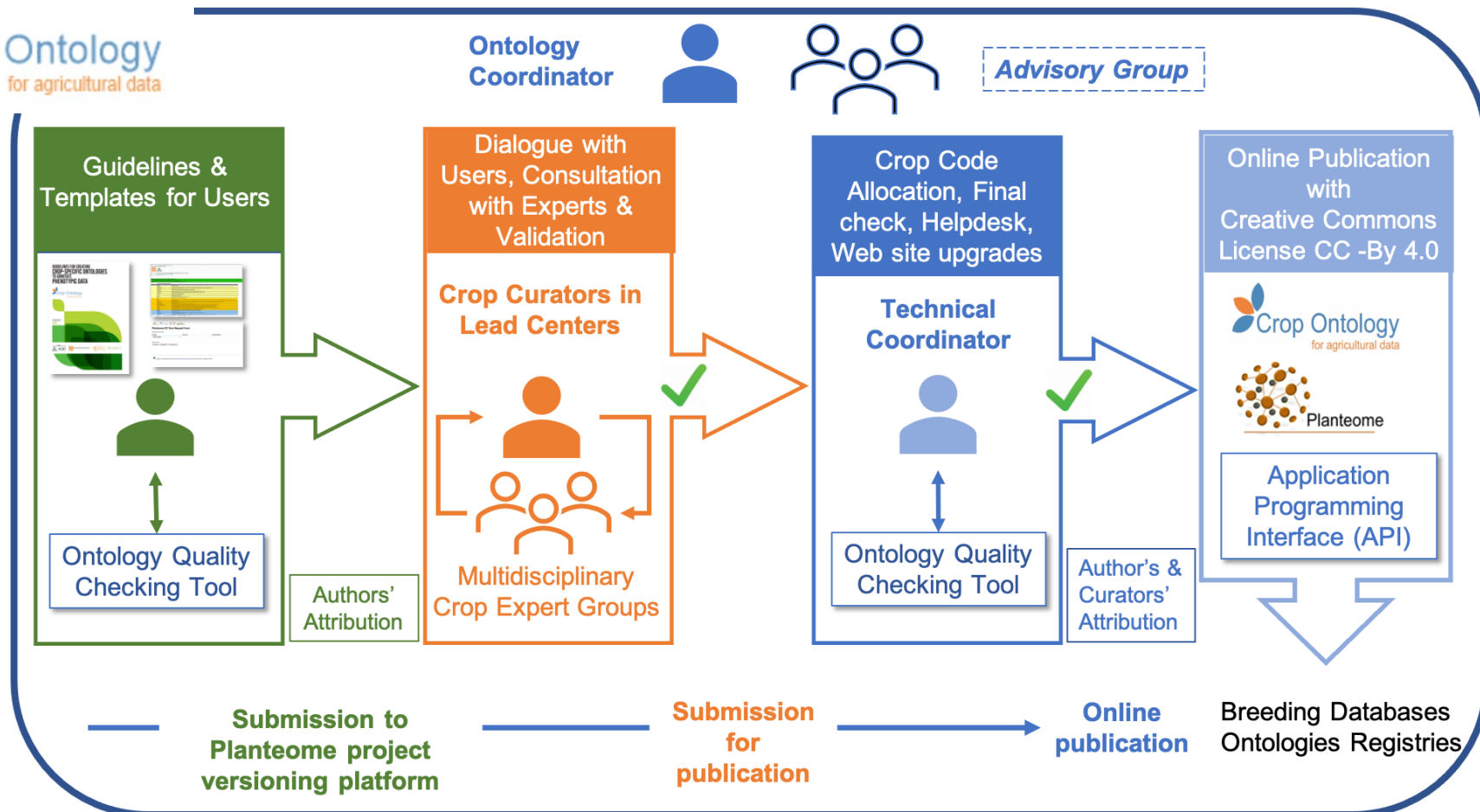
<https://brapi.org/>

Metadata Properties	
Metadata Classes	
Concept	
Contributor	
Coverage	
Creator	

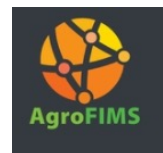
Examples	
vocab	
Identifier	http://purl.org/cg/terms/vocab
Definition	Source of the concept
Comments	One of the following: AGROVOC, GACS, AgrO, CO
Examples	AGROVOC
identifier	

<https://agriculturalsemantics.github.io/cg-core/cgcore.html>

Quality Control Process and Governance



Agronomy Ontology (AgrO) content



<https://github.com/AgriculturalSemantics/agro>



ABOUT AgrO

An ontology is a formal representation of a disciplinary domain, representing a semantic standard that can be employed to annotate data where key concepts are defined, as well as the relationships that exist between those concepts (Gruber, 2009). Ontologies provide a common language for different kinds of data to be easily interpretable and interoperable allowing easier aggregation and analysis.

The Agronomy Ontology (AgrO) provides terms from the agronomy domain that are semantically organized and can facilitate the collection, storage and use of agronomic data, enabling easy interpretation and reuse of the data by humans and machines alike.

To fully understand the implications of varying practices within cropping systems and derive insights, it is often necessary to pull together information from data in different disciplinary domains. For example, data on field management, soil, weather and crop phenotypes may need to be aggregated to assess performance of particular crop under different management interventions.

However, agronomic data are often collected, described, and stored in inconsistent ways, impeding data comparison, mining, interpretation reuse. The use of standards for metadata and data annotation play a key role in addressing these challenges. While the [CG Core Metadata Schema](#) provides a metadata standard to describe agricultural datasets, the [Agronomy Ontology](#) enables the description of agronomic data variables.

Contact us

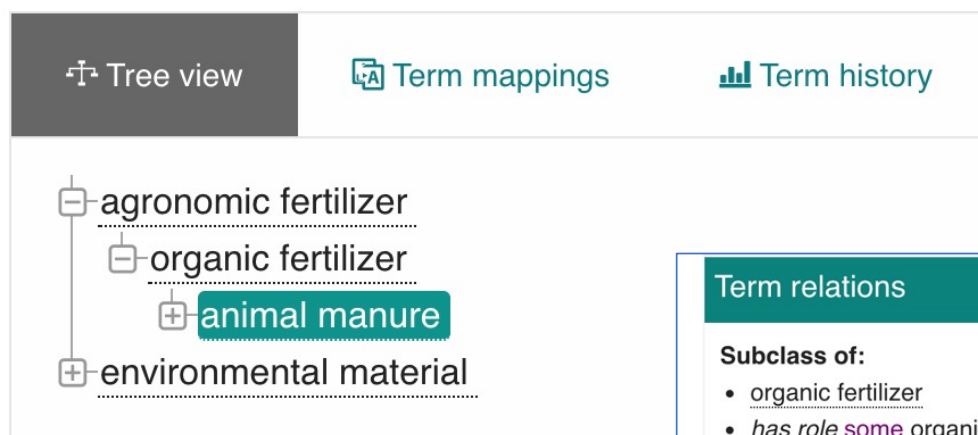
Céline Aubert
Consultant - IFPRI
Email: aubertceline@gmail.com

Marie-Angélique Laporte
Associate Scientist
Alliance Bioversity International-
CIAT
Email: m.laporte@cgiar.org

Elizabeth Arnaud
Scientist | Email
Alliance Bioversity International-
CIAT
Email: e.arnaud@cgiar.org

Medha Devare
Senior research fellow | Module lead
Big Data Platform

Organic matter mostly derived from animal feces which can be



Term information

creator

<https://orcid.org/0000-0002-8213-0815>

description

The excreta of animals, with or without an admixture of bedding or litter, fresh or at various stages of further decomposition or composting.

Term relations

Subclass of:

- organic fertilizer
- has role some organic fertilizer role
- participates in some agronomic fertilization process

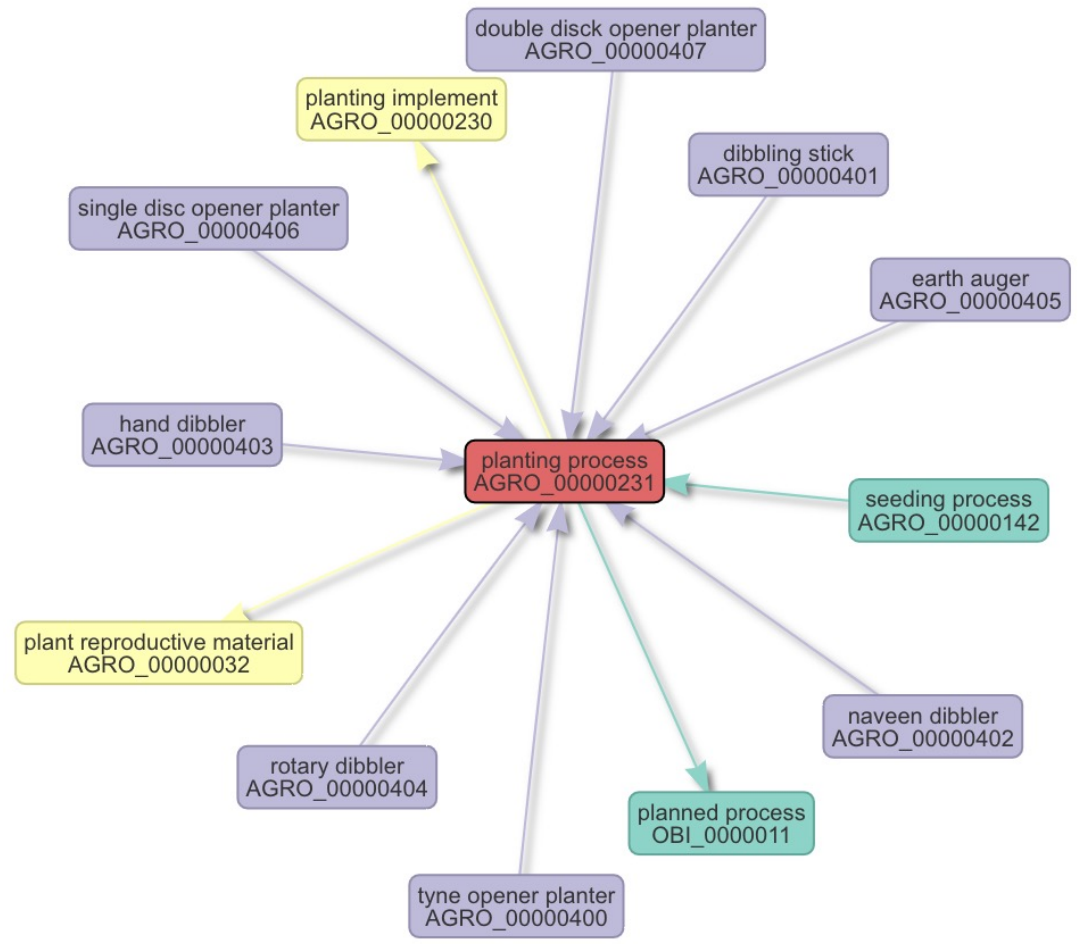
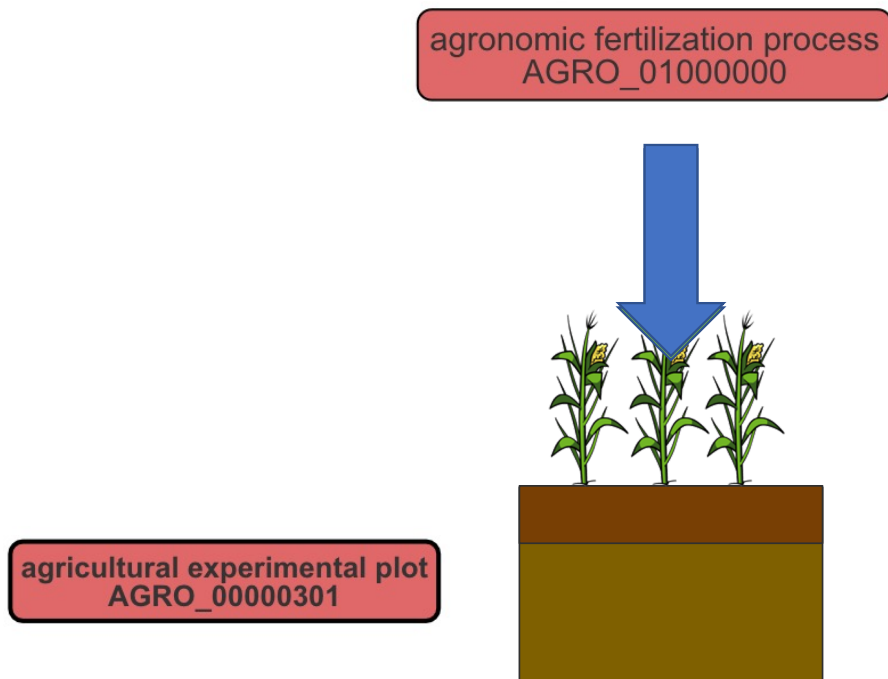
Related from:

inheres in

- area density

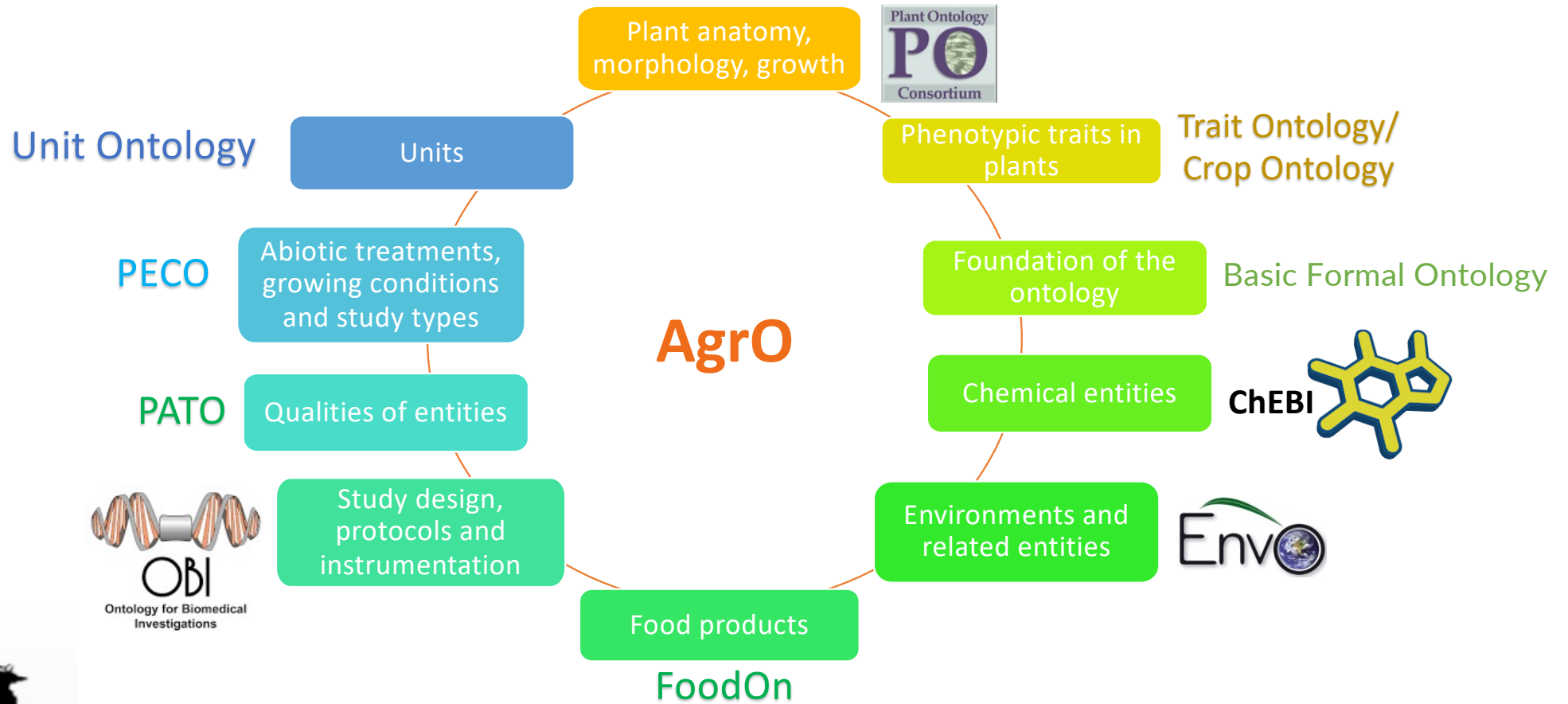


AgrO structure



Ontologies reused in AgrO

Mapped to AGROVOC (FAO)



April 2020

AgrO content

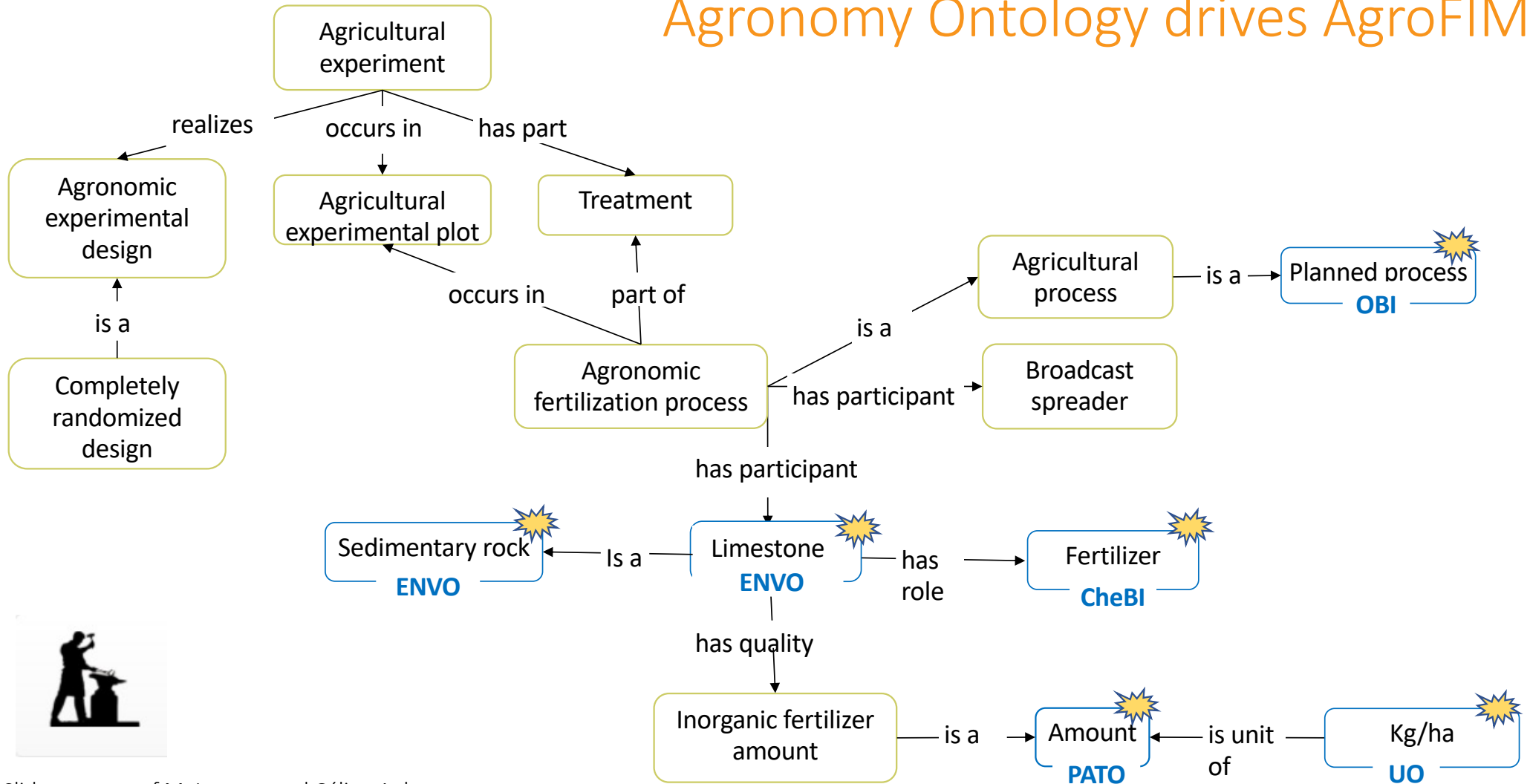
- planned process
 - agricultural process
 - agricultural experiment
 - agronomic fertilization process
 - crop cultivation process
 - crop residue management process
 - crop rotation process
 - dessication process
 - harvesting process
 - irrigation process
 - land levelling process
 - liming process
 - monoculture
 - much removal process
 - pest control process
 - plant transplanting process
 - planting process
 - propping process
 - pruning process
 - rotation phase
 - seedbed preparation process
 - sequence process
 - storage process
 - treatment

- experiment
 - agricultural experiment
 - crop rotation experiment
 - crop yield experiment
 - inter-cropping experiment
 - long-term experiment
 - mono-cropping experiment
 - sequence experiment
 - short-term experiment
- agricultural implement
 - chemical pest control implement
 - fertilization implement
 - harvest implement
 - baler
 - binder
 - combine harvester
 - flail
 - mowing implement
 - scythe
 - sickle
 - tedder
 - irrigation equipment
 - land levelling implement
 - planting implement
 - dibbling stick
 - double disk opener planter
 - earth auger
 - hand dibbler
 - naveen dibbler
 - rotary dibbler
 - single disc opener planter
 - sowing implement
 - broadcast spreader
 - drum seeder
 - furrow opener
 - hoe
 - seed drill
 - manual oilseed drill
 - tyne opener planter
 - residue management implement
 - tractor

- agronomic fertilizer
 - inorganic fertilizer
 - calcium carbonate
 - limestone
 - magnesium carbonate
 - nitrogen fertilizer
 - NPK fertilizer
 - phosphorus fertilizer
 - potassium fertilizer
 - potassium chloride
 - potassium nitrate
 - sodium selenate
 - organic fertilizer
 - alfalfa meal
 - animal manure (AGRO:00000079)
 - bagasse
 - biofertilizer
 - blood meal
 - bone meal
 - bovine dairy liquid manure
 - charcoal
 - compost
 - fish fertilizer
 - green manure
 - oil cake
 - oil meal
 - peat soil
 - sludge



Agronomy Ontology drives AgroFIMS

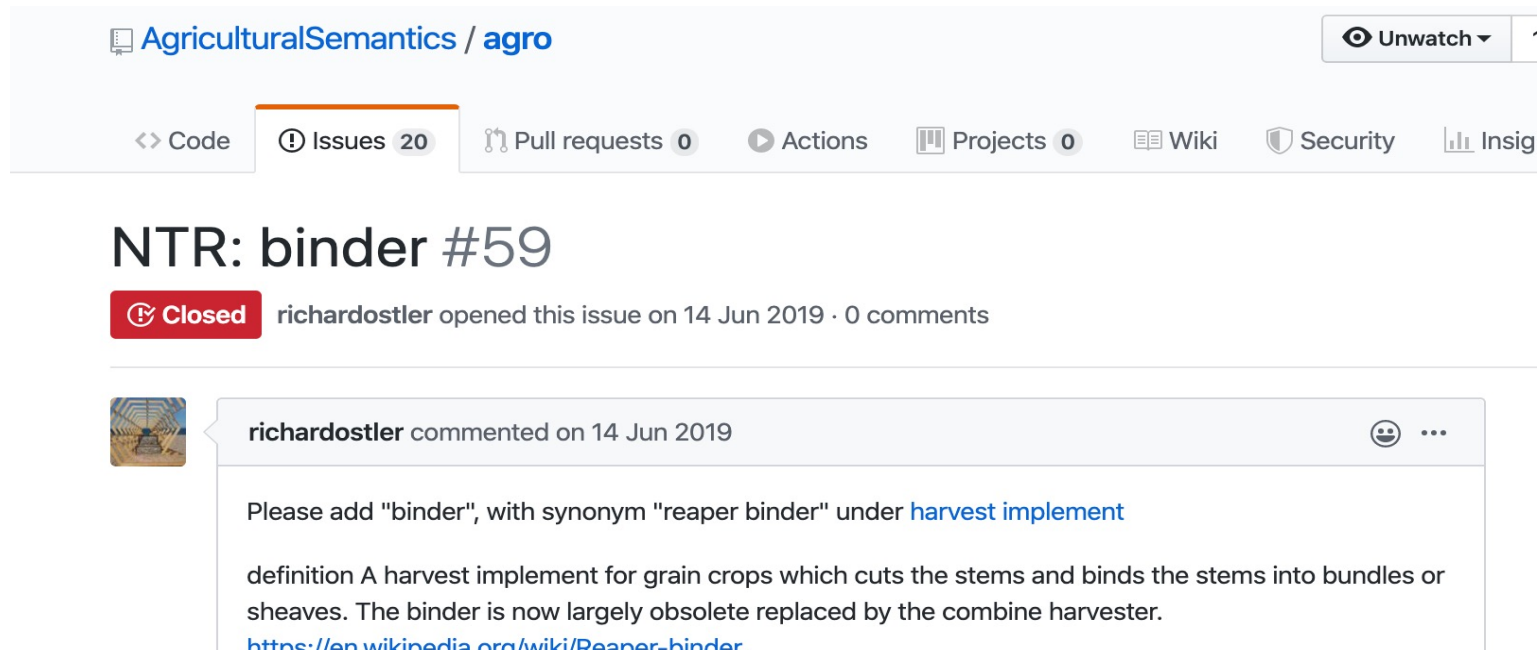


Slide courtesy of M. Laporte and Céline Aubert

Participate via GitHub

Open an issue to request new terms, new synonyms, and provide any feedback

<https://github.com/AgriculturalSemantics/agro/issues>



The screenshot shows the GitHub interface for the repository 'AgriculturalSemantics / agro'. The 'Issues' tab is selected, showing 20 issues. A specific issue titled 'NTR: binder #59' is highlighted, marked as 'Closed' and opened by 'richardostler' on 14 Jun 2019. The issue description requests the addition of a new term 'binder' with the synonym 'reaper binder' under the 'harvest implement' category. It includes a definition: 'A harvest implement for grain crops which cuts the stems and binds the stems into bundles or sheaves. The binder is now largely obsolete replaced by the combine harvester.' and a link to a Wikipedia page: 'https://en.wikipedia.org/wiki/Reaper-binder'.



http://agroportal.lirmm.fr/

Agrology Ontology

Last updated: July 1, 2021

Showing 20 results

Summary | Classes | Properties | Notes | Mappings | Widgets

Details

Acronym	AGRO
Visibility	Public
Description	Agro, the Agronomy Ontology, describes agronomic practices, techniques, and variables used in agronomic experiments. Agro is being built using traits identified by agronomists, the ICASA variables, and other existing ontologies such as ENVO, UO, PATO, IAO, and CHEBI. Further, Agro powers AgroFIMS, the Agronomy Fieldbook and Information Management System modeled on a CGIAR Breeding Management System to capture agronomic data.
Status	Alpha
Format	OWL
Contact	Céline Aubert, c.aubert@cgiar.org Marie-Angélique Laporte, m.a.laporte@cgiar.org
Categories	Agricultural Research, Technology and Engineering, Natural Resources, Earth and Environment
Groups	OBO Foundry, Rice Data Interoperability working group

Search...

Agrology Ontology (AGRO)

Agro, the Agronomy Ontology, describes agronomic practices, techniques, and variables used in agronomic experiments

Uploaded: 7/1/21

Rice Ontology (CO_320)

Rice Trait Dictionary in template v 5.0 - IRRI - March 2016 - Based on SES, RD, UPOV variables and on variables used by CIAT, FLAR and the GRISP Phenotyping Network variables

Uploaded: 4/16/19

5 | 2,459

Wheat Ontology (CO_321)

Wheat Trait Dictionary in template v5.

Uploaded: 4/16/19

1 | 8 | 1,899

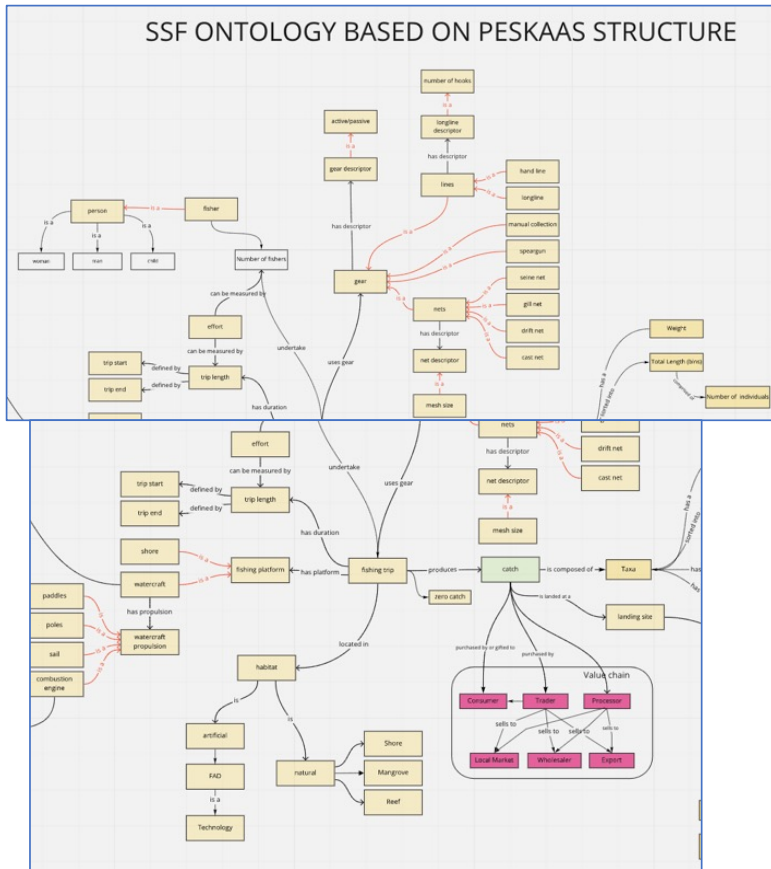
Woody Plant Ontology (CO_357)

This ontology list all variables used for woody plant observations

Uploaded: 4/16/19

5 | 1,073

Small Scale Fisheries and Aquaculture Ontology



- fish ontology
 - small scale fisheries ontology
 - agricultural household survey
 - agricultural process
 - piscicultural process
 - agricultural process qualities
 - catch
 - aquatic animal products
 - aquatic mammals
 - aquatic plants
 - crustaceans
 - diadromous fishes
 - freshwater fishes
 - landing site
 - marine fishes
 - molluscs
 - taxa
 - catch qualities
 - fish feed ingredients
 - fish feed ingredients qualities
 - fishing platform
 - gear
 - gear qualities
 - household
 - household member
 - household member qualities
 - site
 - small scale fishery
 - value chain
 - water body
 - brackish water body
 - fresh water body
 - habitat
 - marine water body
 - water body qualities

In development with WorldFish scientists as domain experts and data managers

Will comply with the OBO Foundry principles



Jacqueline Muliro



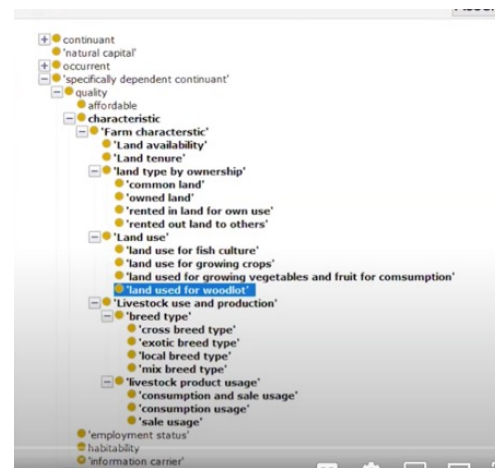
Socio Economic Ontology SEONT



The SEONT was created with mixed top-down (from questionnaires) and bottom-up methodology (reusing existing concepts from 13 ontologies)

SEONT objective is to annotate the surveys conducted with **RhoMIS**, **Advanced system for rural household surveys** – 30,732 surveys to date

<https://www.rhomis.org/>



Soonho Kim



Modules:

- Household composition & characteristics
- Farm characteristics (land availability, land use, livestock use...)
- Income and Assets
- Gender (Asset ownership,; decision control, empowerment)
- Food security and dietary diversity
- Extension services & innovation

OBO Foundry Principles

High quality

Community-verified

Interoperable ontologies

Logically well-formed

Scientifically accurate

Quick Summary

The following summarizes each principle. See individual pages for details.

- P1) **Open** - The ontology MUST be openly available to be used by all without any constraint other than (a) its origin must be acknowledged and (b) it is not to be altered and subsequently redistributed in altered form under the original name or with the same identifiers.
- P2) **Common Format** - The ontology is made available in a common formal language in an accepted concrete syntax.
- P3) **URI/Identifier Space** - Each ontology MUST have a unique IRI in the form of an OBO Foundry permanent URL (PURL).
- P4) **Versioning** - The ontology provider has documented procedures for versioning the ontology, and different versions of ontology are marked, stored, and officially released.
- P5) **Scope** - The scope of an ontology is the extent of the domain or subject matter it intends to cover. The ontology must have a clearly specified scope and content that adheres to that scope.
- P6) **Textual Definitions** - The ontology has textual definitions for the majority of its classes and for top level terms in particular.
- P7) **Relations** - Relations should be reused from the Relations Ontology (RO).
- P8) **Documentation** - The owners of the ontology should strive to provide as much documentation as possible.
- P9) **Documented Plurality of Users** - The ontology developers should document that the ontology is used by multiple independent people or organizations.
- P10) **Commitment To Collaboration** - OBO Foundry ontology development, in common with many other standards-oriented scientific activities, should be carried out in a collaborative fashion.
- P11) **Locus of Authority** - There should be a person who is responsible for communications between the community and the ontology developers, for communicating with the Foundry on all Foundry-related matters, for mediating discussions involving maintenance in the light of scientific advance, and for ensuring that all user feedback is addressed.
- P12) **Naming Conventions** - The names (primary labels) for elements (classes, properties, etc.) in an ontology must be intelligible to scientists and amenable to natural language processing. Primary labels should be unique among OBO Library ontologies.
- P16) **Maintenance** - The ontology needs to reflect changes in scientific consensus to remain accurate over time.





Merci!

Contacts:

Elizabeth Arnaud e.arnaud@cgiar.org

Marie-Angélique Laporte: m.a.@cgiar.org