

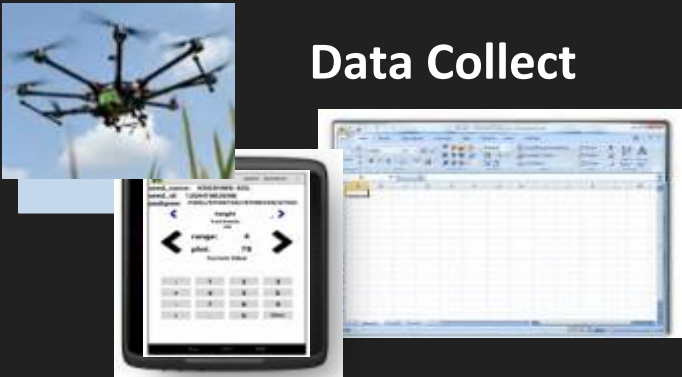
Semantics for Crops & Tools for Data Annotation

Elizabeth Arnaud, Bioversity International

Data Harmonization along the data management workflow and across IT tools

Semantics for harmonization & interoperability

Data Collect



Data storage



Data Analysis



Data Access



- BMS Fieldbook
- Banana Fieldtask
- KSU Fieldbook
- AGROFIMS fieldbook
- KDSmart
- ODK surveys

DECODING
The Data Ecosystem

- BMS
- RTB NextGen Databases
- AGROFIMS
- Breeding4Rice
- KDExplore
- Dataverse, CKAN
- MARLO/MEL

- IBP
- HIDAP
- FarmDesign
- Crop models
-

- GARDIAN



GARDIAN

FAIR Data in Agriculture



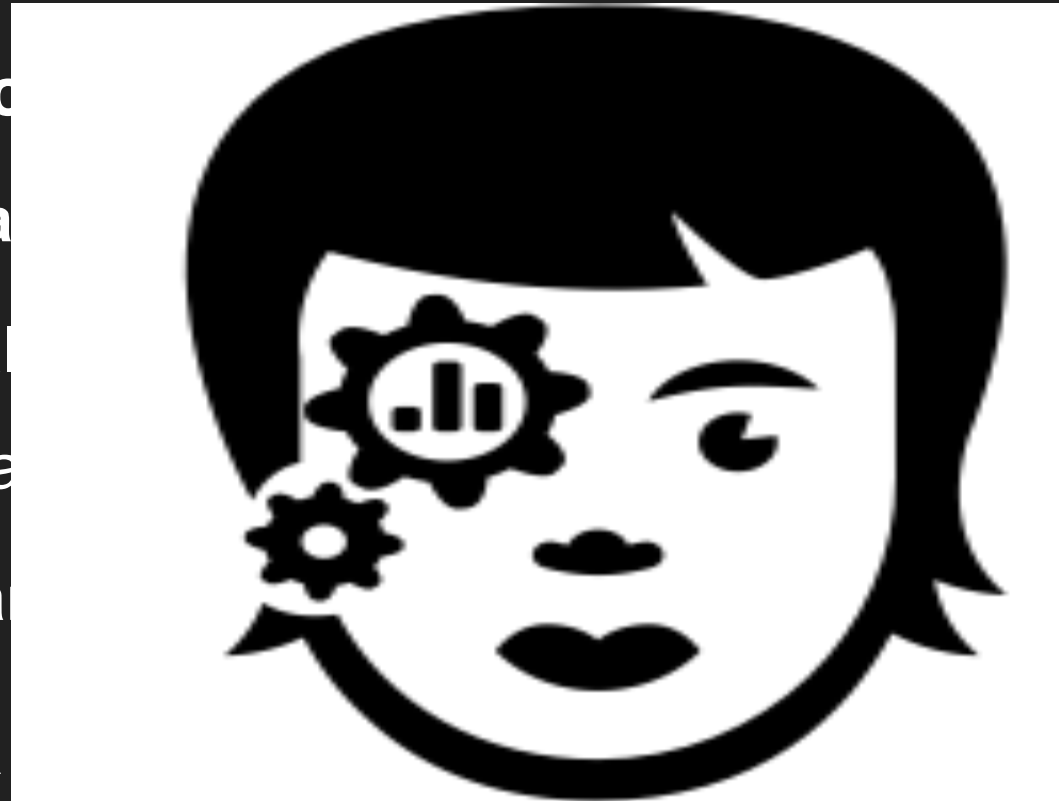
Interoperable - The most difficult to achieve and requires ontologies/controlled vocabularies
identification of key objects (Ontologies)
Use of proper concept identifiers

What is a vocabulary?

- **Controlled vocabularies:**
 - provide a **shared vocabulary** for a domain (all the terms)
 - provide **textual definitions** that describe the intended meaning of the classes in vocabularies
 - provide standard **identifiers for concepts** describing a given domain
- **Facilitate data publication and data access**

What is a vocabulary?

- **Controlled vocabularies**
 - provide a vocabulary
 - provide textual labels
 - provide standard classes in vocabulary
 - provide standard definitions
- **Facilitate data**



and meaning of the

ing a given domain

What is an ontology?

- **Ontologies:**

- provide standard **identifiers for classes and relations** that represent the phenomena within a domain
- provide a **vocabulary** for a domain
- provide **textual definitions** that describe the intended meaning of the classes and relations in ontologies
- provide **machine-readable axioms** and definitions that enable computational access to some aspects of the meaning of classes and relations

- **Facilitate data integration, data access and analysis**



What is an ontology?

- **Ontologies:**

- provide standard identifiers for concepts that represent the phenomena within a domain
- provide a **vocabulary** for describing the classes and relations in ontologies
- provide **textual definitions** of the classes and relations in ontologies
- provide **machine-readable** definitions for computational access to some aspects of the ontology



- **Facilitate data integration**

Annotations are links between ontology terms and data objects

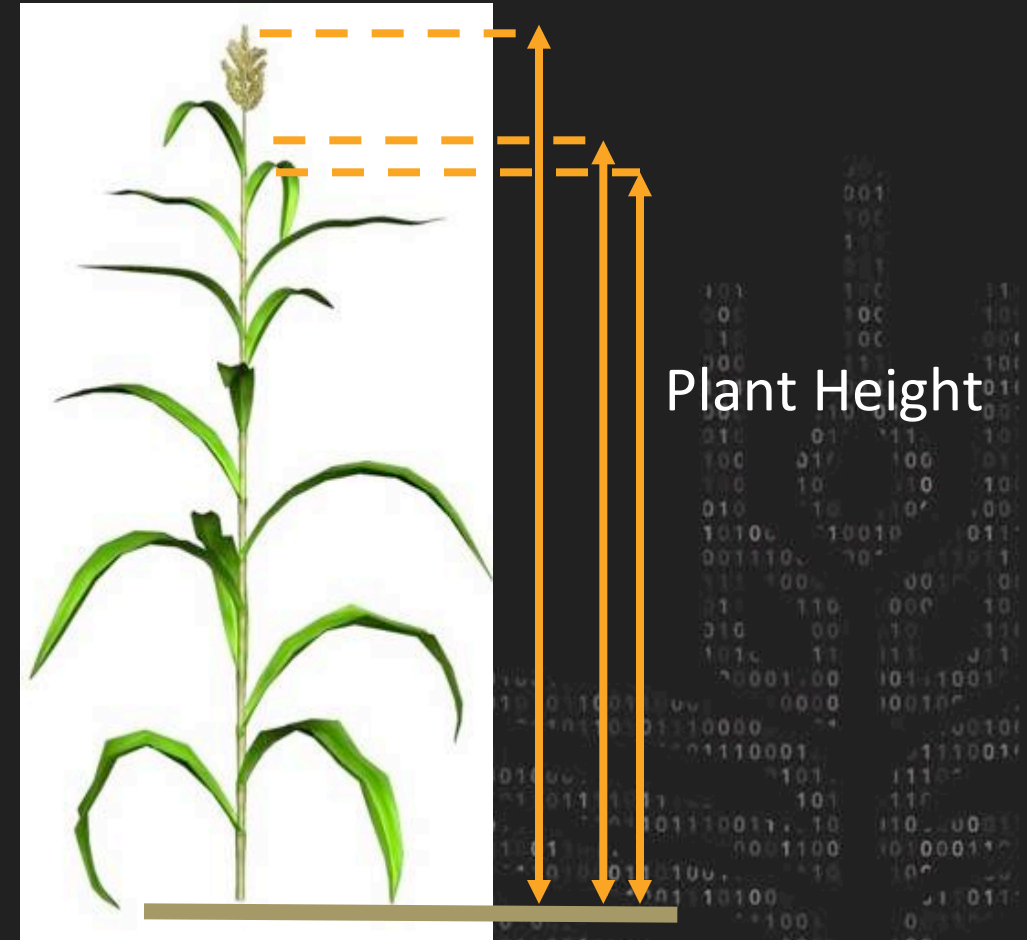
Harmonizing Phenotypic data



Crop Ontology

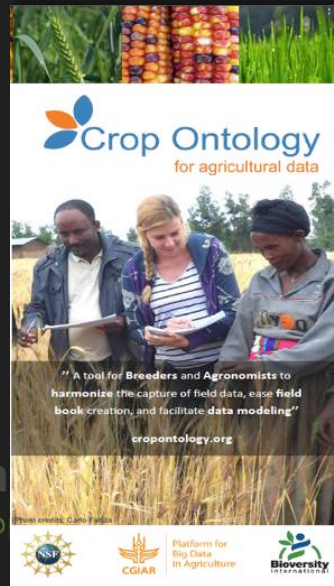
Breaking semantic barriers to data interpretation

- Breeding Management Systems
- Meta Analysis across evaluation sites
- Confusion between **traits and variables**
- **No naming convention for variables and methods** of measurement which are heterogeneous
- Trait & Variable definitions and measurements are not similar between farmers, breeders, agronomists, modelers



=> One trait = 4 traits... From D. Pot, CIRAD

Provides measured traits, parameters and their standard variables for the Breeding fieldbook and for data annotation in the crop databases



Integrated Breeding
Today's tools for tomorrow's crop



Phenotype data in breeding

Germplasm ID	PH	PH2	GCOL	GY
24530	80	1	2	35
85432	120	3	4	48
78452	95	2	4	43
56093	100	2	1	50

The height of the plant

The color of the grain

The grain yield

Annotation must explain:

1/ What is the observation
about ?

=

TRAIT

Entity + Attribute

Phenotype data in breeding

Germplasm ID	PH	PH2	GCOL	GY
24530	80	1	2	35
85432	120	3	4	48
78452	95	2	4	43
56093	100	2	1	50

With a measuring tape

Estimated visually

Calculated
Panicle weight x panicle density

Annotation must explain:

2/ How is the trait observed ?

=

METHOD

Phenotype data in breeding

Germplasm ID	PH	PH2	GCOL	GY
24530	80	1	2	35
85432	120	3	3	48
78452	95	2	3	43
56093	100	2	1	50

cm

1 = short (<90cm)
2 = medium (>90cm and <110cm)
3 = tall (>110cm)

1 = white
2 = cream
3 = yellow

g/m²

Annotation must explain:

3/ How is the trait observation expressed?

=

SCALE

Standard Variable in Crop Ontology

- Method and scales are important to capture for supporting data comparison & interpretation

A **Variable** is combination of

Property (Trait) + **Method** + **Scales/units**

- It annotates the **actual value of the measurement**
- Has a unique name -> Proposed naming convention: **P_M_S**

Trait = Entity+ Quality
(Root) (Length)

Average root length expressed in cm

Average root length scored on a 3 level scale :

1=short (<50cm)

2= medium (50-100cm)

3=long (>100cm)




Crop Ontology Online

- 27 species
- Download in csv, obo, RDF
- API
- Helpdesk
- Adding farmers preferences, sensory traits



Crop Ontology Curation Tool

[Home](#) [About](#) [Feedback](#)



Wheat Ontology

Ontology curators

- Rosemary Shrestha, CIMMYT
- Julian Pietragalla, IBP GCP

Scientists

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

CO_321

[Add New Terms](#) [API](#) [Help](#)

Traits, methods and scales

[DOWNLOAD](#) [SHOW OBSOLETE TERMS](#) [EDIT](#) English

Wheat traits

- Abiotic stress traits [is_a](#)
- Agronomical traits [is_a](#)
- Biotic stress traits [is_a](#)
- Morphological traits [is_a](#)
- Phenological traits [is_a](#)
- Physiological traits [is_a](#)
- Quality traits [is_a](#)

GrnSpk Computation

[Permalink](#) [General](#) 0 Comments

Identifier CO_321:0000258

Formula xxxx

Method class Computation

Method description The number of grains per spike can be measured independently by threshing a known number of randomly selected spikes per plot (10-20 spikes per plot) or can be calculated as: Grains per spike (GSP) = grains m² / spikes m².

Grain number per spike [is_a](#)

GrnSpk Computation [method_of](#)

grain/spike [scale_of](#)

Crop Ontology Curation Tool

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Lentil ontology

- Ontology curators
 - Karthika Rajendran, ICARDA
- Scientists
 - Shiv Kumar Agrawal, breeder, ICARDA

Crop Lead Center

Partners

CGIAR research program

ICARDA
Science for Better Livelihoods in Dry Areas

CGIAR

RESEARCH PROGRAM ON Grain Legumes

CO_339

Add New Terms

API

Help

Agtrials

Annotation Tool

Logout

ElizabethArnaud

Traits, methods and scales

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English

Term information

Name

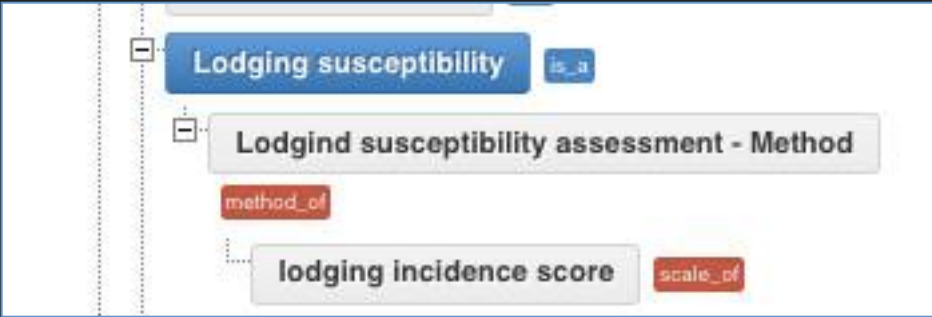
Permalink

General

Comments

Variables

LodgSuscp_Est_1to7



lodging incidence score

Permalink

General

0 Comments

Identifier CO_339:0000092

Category 0 None

Category 3 Low

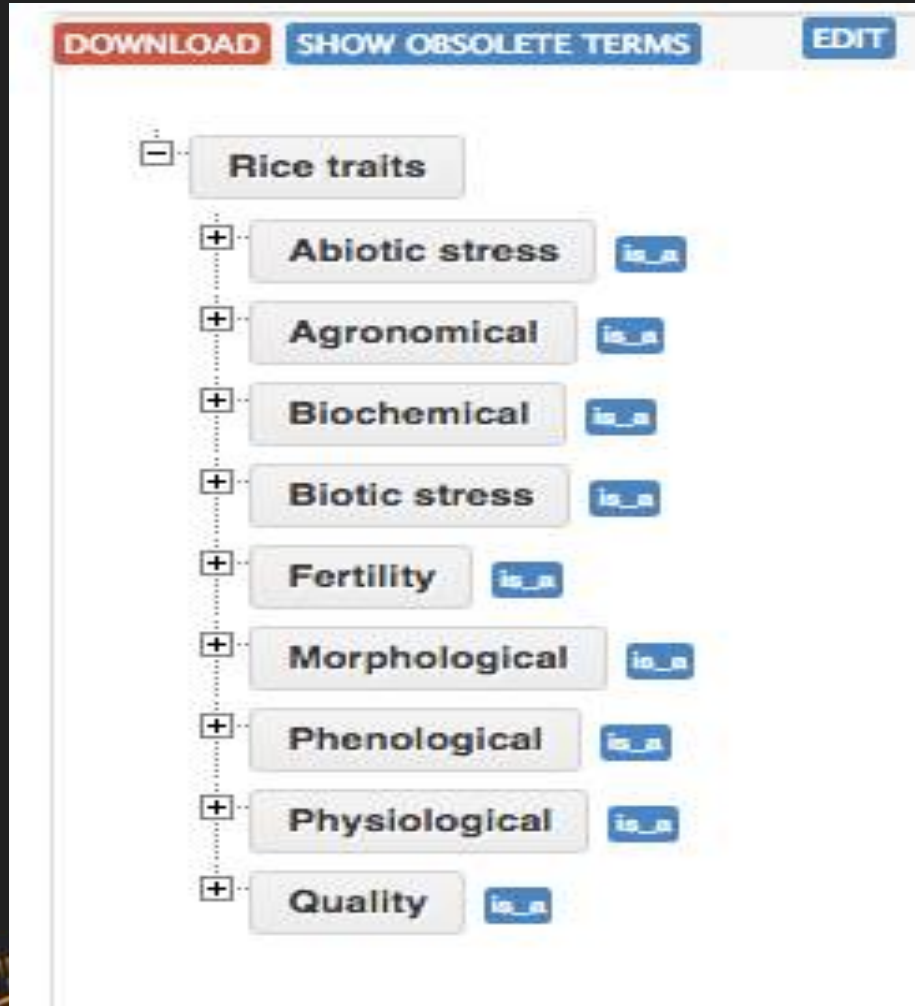
Category 5 Medium

Category 7 High

Scale class Nominal

Scale name lodging incidence score

Trait classes



Classification of methods

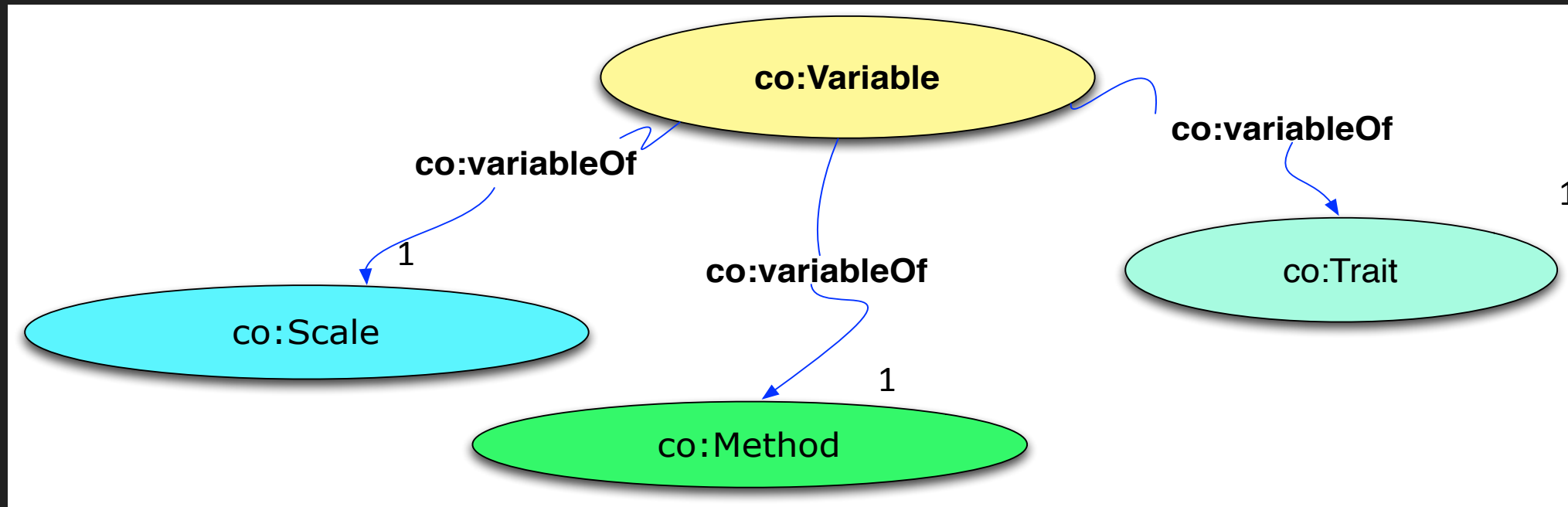
		Method class	Examples
The trait is observed directly	By using a measuring device, a sensor	Measurement	<ul style="list-style-type: none"> - Plant height measuring with a ruler - Fruit weighing on a scale
	By counting entities	Counting	<ul style="list-style-type: none"> - Leaf counting
	By an assessment that only relies on the experience and subjectivity of the observer. The assessment is not supported by a measuring device.	Estimation	<ul style="list-style-type: none"> - Grain colour estimation - Damage on leaves visual estimation - Plant height visual estimation
The trait observation derives from an aggregation of observations (regardless of how they were observed i.e., measured, counted, estimated or computed)		Computation	<ul style="list-style-type: none"> - 1000 grain weight calculation (1000 * measured grain weight / grain count) - Harvest index calculation (Grain yield / Aboveground biomass) - Grain protein content calculation (Grain Nitrogen content * 6.25)

Classification of scales

Method name	Description
Code	This scale class is exceptionally used to express complex traits. Code is a nominal scale that combines the expressions of the different traits composing the complex trait. For example a disease related code might be expressed by a 2 digit expressing intensity and 2 character code expressing the severity. The first 2 digits are the proportion of plants affected by a fungus and the 2 characters refer to the severity, e.g. "75HD" means "75% of the plants are infected and plants are highly damaged". It is recommended to create variables for every component of the code.
Duration	The date class is for time elapsed between two events expressed in a time format, e.g. "days", "hours", "months".
Nominal	Categorical scale that can take one of a limited number of categories. There is no intrinsic ordering to the categories.
Numerical	Numerical scales express the trait with real numbers. The numerical scale defines the unit e.g. centimeter, ton per hectare, branches.
Ordinal	Ordinal scales are composed of ordered and fixed number of categories.
Text	A free text is used to express the trait. Also known as character variable.
Date	The date class is for events expressed in a time format, e.g. "yyyymmdd hh:mm:ss - UTC" or "dd/mm/yy".

All traits, Methods, scales have a definition

Example of an ontology



Improving the re-usability of the data file

The content of the Excel file is not always re-usable because of lack of clear variable name

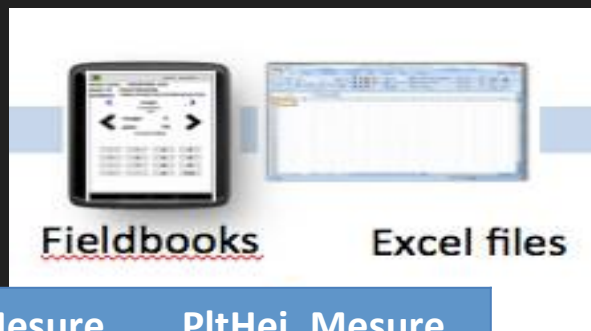
Germplasm ID	PH	PH2	GCOL	GY
24530	80	1	2	35
85432	120	3	3	48
78452	95	2	3	43
56093	100	2	1	50



Fieldbook design system



 **Crop Ontology**
for agricultural data



Germplasm ID	PltHei_Mesure_cm	PltHei_Mesure_category
24530	80	1
85432	120	3
78452	95	2
56093	100	2



Statistical analysis



BREEDING MANAGEMENT SYSTEM



Data file using standard variables

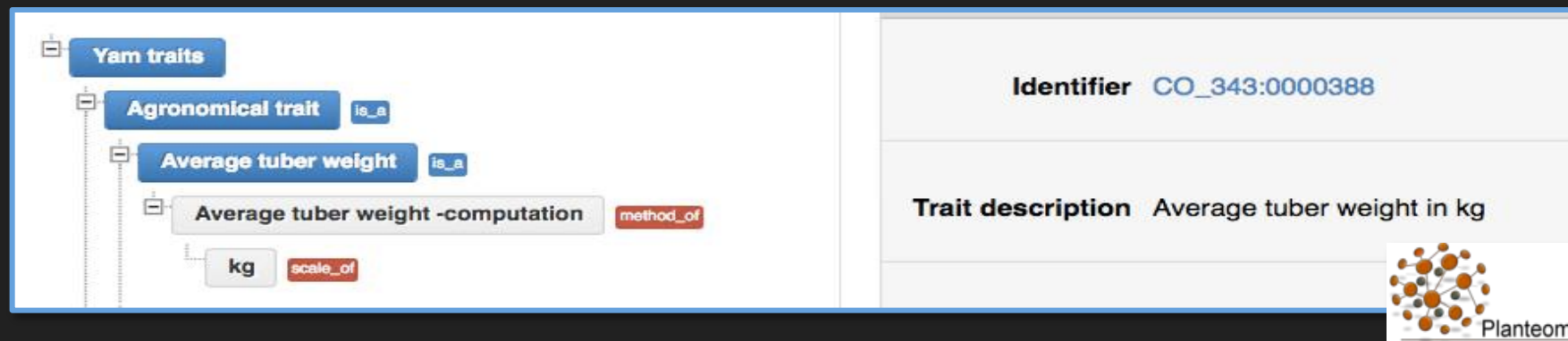
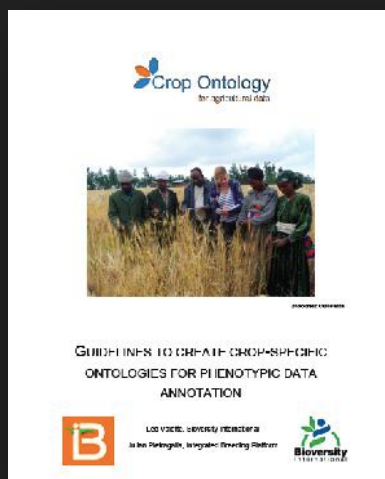


Crop Ontology for Trait Data

www.croponontology.org



27 Plants (*latest Sugar Kelp - algae*)



Good Practice for Trait Data Annotation

Community selects traits and standard variables

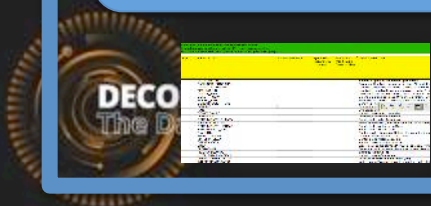
Create Fieldbook with Ontology

Data collect with standard variables

Formatted files in repositories or databases

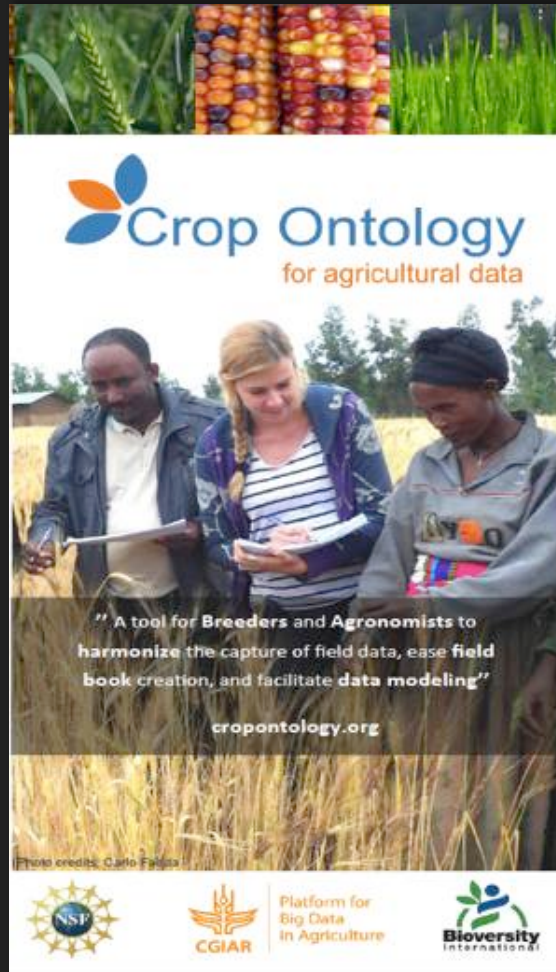
Submission of new traits & variables

Use of the formatted data files



Germplasm ID	PitHel_Mesure_cm	PitHel_Mesure_category
24530	80	1
85432	120	3
78452	95	2
56093	100	2

Crop Traits

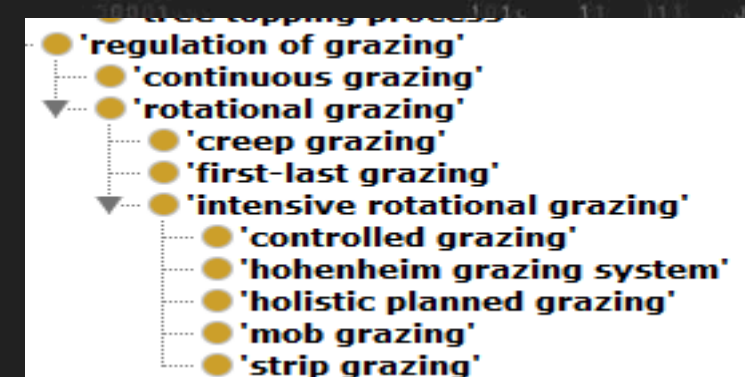


Provides names, definition and semantic relationships for measured traits and agronomic parameters with their standard variables for Agronomic and Breeding fieldbooks, surveys and for data annotation in the databases and repositories

Integrating Farmers preferences with respect to gender



Agronomy Ontology




Crop Ontology Online

- 27 species
- Download in csv, obo, RDF
- API
- Helpdesk
- Adding farmers preferences, sensory traits



Crop Ontology Curation Tool

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Grain number per spike [is_a](#)

GrnSpk Computation [method_of](#)

grain/spike [scale_of](#)

GrnSpk Computation [Permalink](#) [General](#) 0 Comments

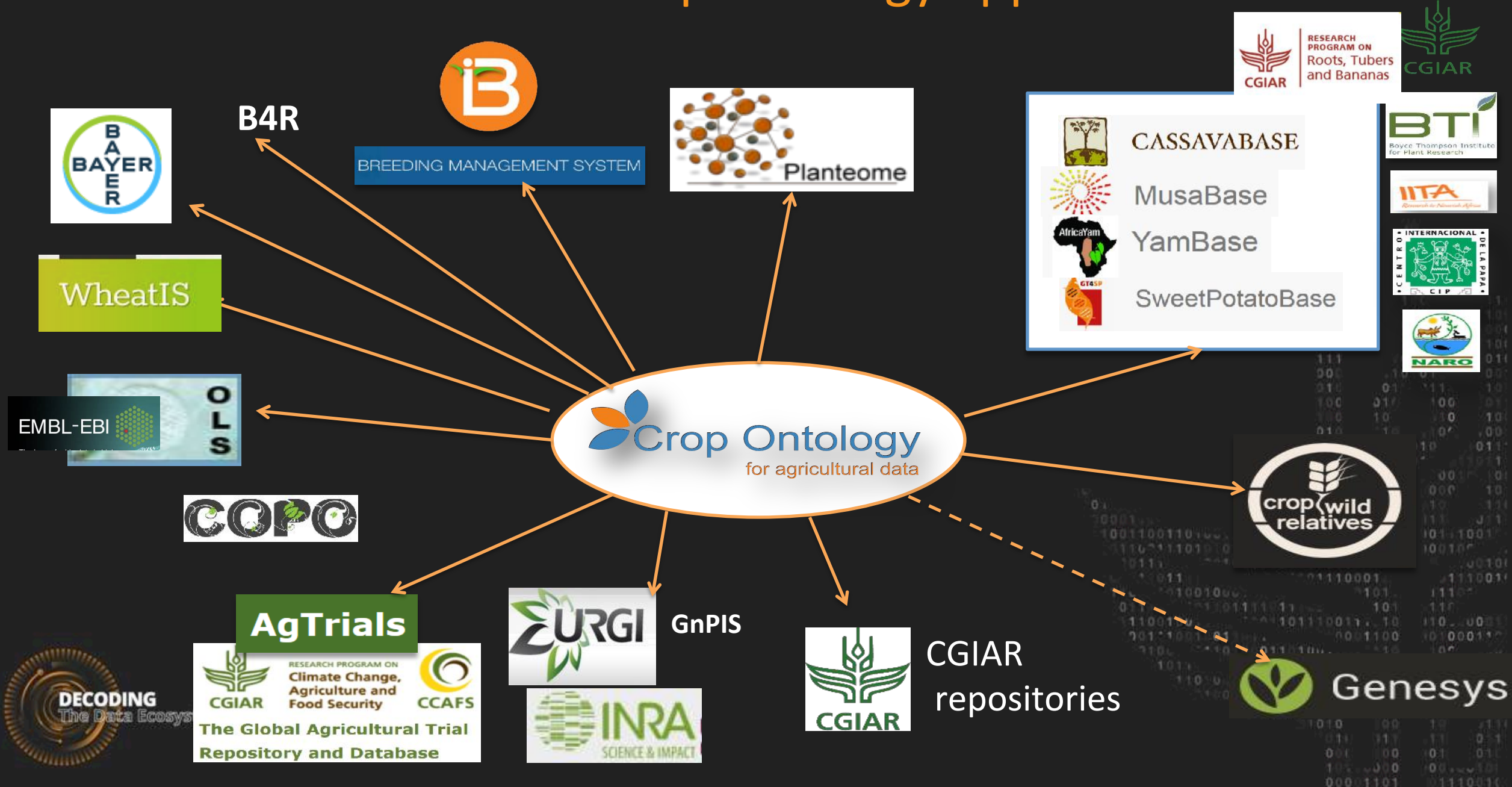
Identifier CO_321:0000258

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Where is Crop Ontology applied?



Crop Ontology Curation Workflow



From Next Gen Databases

Crop Ontology Variable Request Form

Submitter Information

Name: Elizabeth Amant
Email: e.amant@cgiar.org
Breeding Program: Banana cv. Batawara evaluation, Tanzania

Variable Information

Detailed Trait Name: Fruit smashed pulp colour
Crop: Banana
Trait Class: Quality

Default Trait Selection
The color of the smashed pulp of a mature fruit

Method of Measurement

Visual appearance
Measurement Type: Categorical Measurement (e.g. [1,2,3,4,5] or [yellow, green, purple])

Categories

Category	Description
1	dark green
2	dark green very much
3	dark green
4	dark green
5	dark green

Term submission form
submit.rtbbase.org

Sweet Potato
Breeder /
Genebank

Curation

CO Curators

Vilma Huala
Dorcus Gimenet
Afolo Agbona
Rhiannon Crichton

Bryan Ellerbrock
Guillaume Bauchet
Naama Menda

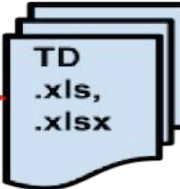


Github issue

CO Website

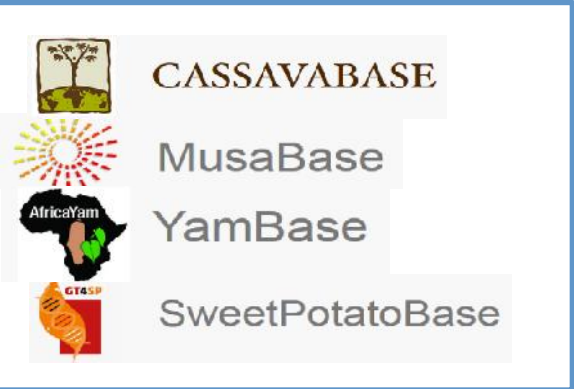


Release



BMS

HIDAP



Getting Involved: How can you contribute and utilize these resources?

- Explore annotations and ontologies for your own research work
- Create a GitHub account to request terms, make comments, or share your own ontology
- Annotate your data, and work with us to submit to our repository



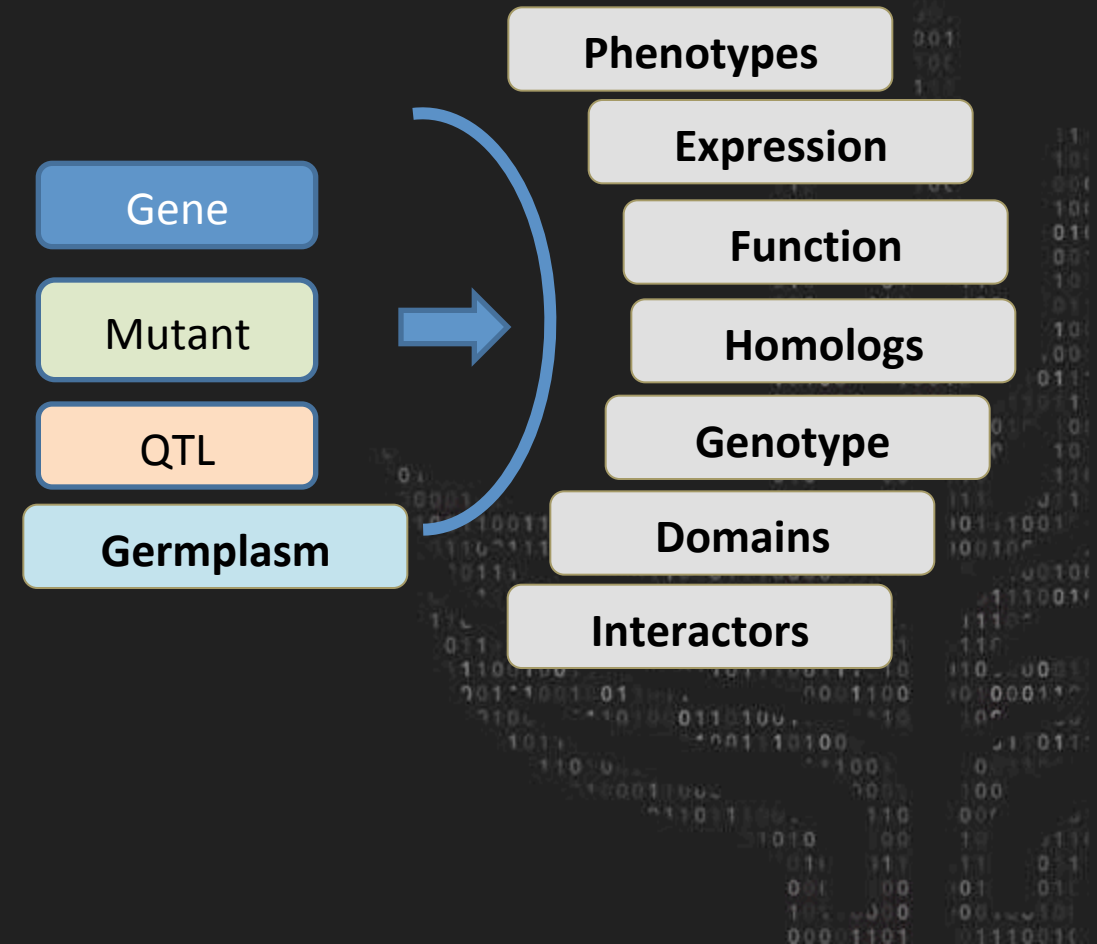
Linking the application Crop Ontology to the reference Plant Ontology of Planteome

From Species-specific to species-agnostic



Ontologies can link to data from multiple species

Examples of fruit **color trait** (TO:0002617) across various species



Species-Specific Ontologies and Data Annotations

Cassava- IITA



Image Source: Wikipedia

163 traits, for example:

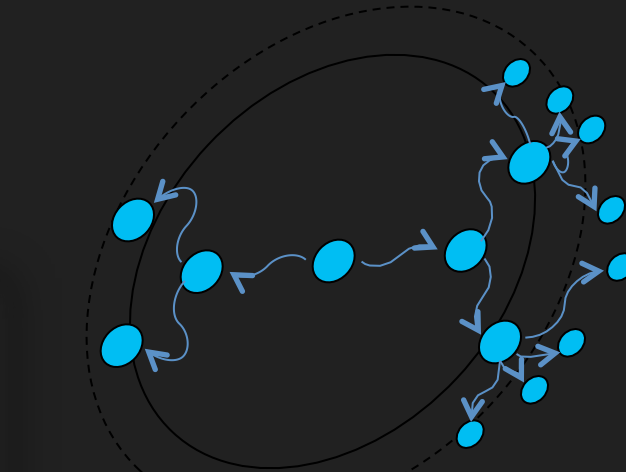
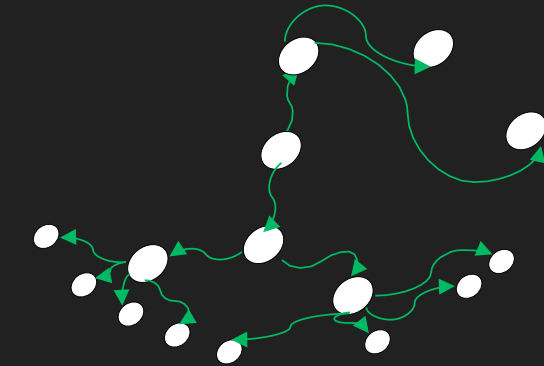
- stem number
- root neck length
- red spider mite severity

Lentil- ICARDA



Image source: Karthika Rajendra

DECODING
The Data Ecosystem



68 traits, for example:

- pod weight
- cooking time
- root length

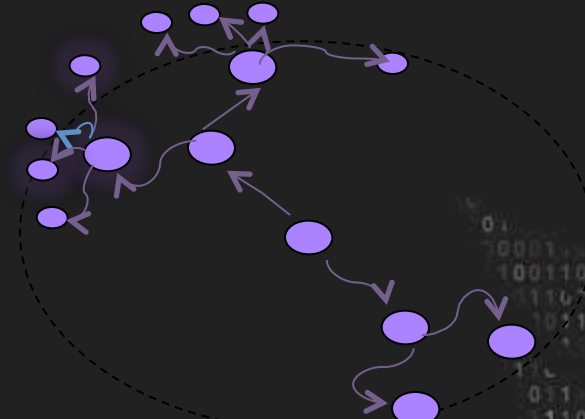
Three examples from CGIAR Centers integrated into Planteome:

How can we make interspecific comparisons across these ontologies?

Rice- IRRI



Image Source: Wikipedia



157 traits, for example:

- caryopsis shape
- amylose content
- lodging incidence

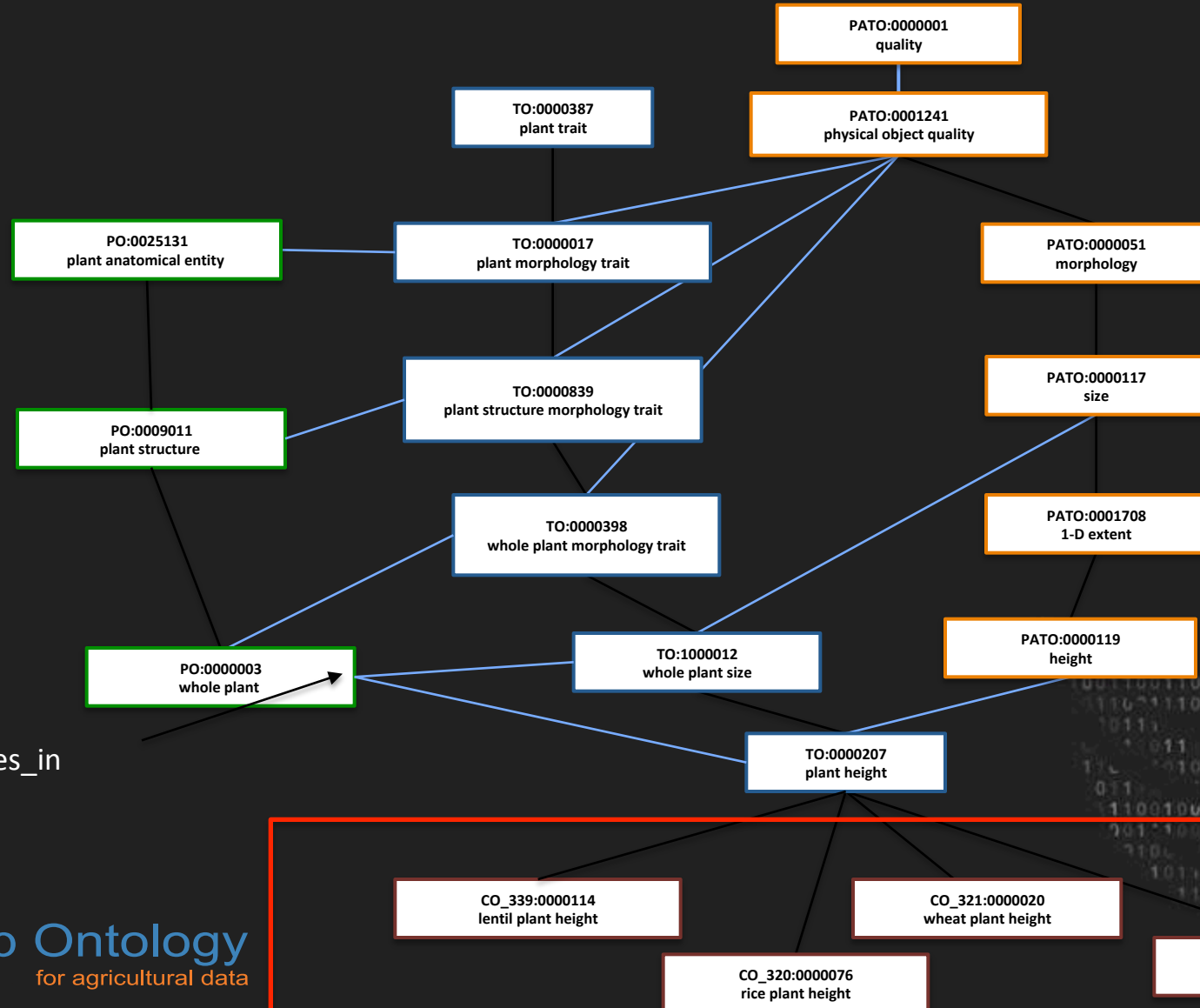
Integration of Species-Specific Ontologies in Planteome Reference Trait Ontology

Entities from Plant
Ontology or Gene
Ontology

Trait qualities from
PATO

is_a

inheres_in





Progress of CO to TO Mapping:

Ten CO crop vocabularies have been mapped to the TO:

	# 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



on the Planteome development browser (<http://dev.planteome.org>)
- will be available on live with the next AmiGO release



ACKNOWLEDGMENTS

Planteome Partners

Oregon State University

Pankaj Jaiswal (Lead PI), Laurel Cooper, Justin L. Elser, Austin Meier, Justin Preece

Sinisa Todorovic, Ryan S. Kitchen

Eugene Zhang, Botong Qu



Lawrence Berkeley National Lab
Christopher Mungall, Seth Carbon



NY Botanical Garden, USA
Dennis Stevenson



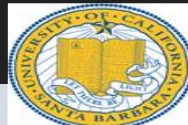
University at Buffalo, NY
Barry Smith



University of Birmingham, UK
Georgios Gkoutos,



Aberystwyth University, UK
John Doonan,



UC Santa Barbara
BS Manjunath (Bisque), Dmitry Fedorov, Kristian Kevilekval

Elizabeth Arnaud, Bioversity:

Marie-Angélique Laporte, Leo Valette

CGIAR:

Rosemary Shrestha (CIMMYT), Karthika Rajendran (ICARDA), Agbona Afolo (IITA), Omar Benites (CIP), Vilma Hualla (CIP), Jeffery Detras (IRRI)
And many others!



Collaborator Labs & Projects

Users and resource databases who have adopted the Planteome Ontologies and contributed data:

CyVerse, Gene Ontology Consortium, Protégé, OBO Foundry, Gramene, Ensembl Plants, USDA-GRIN, Rice Diversity Project, SolGenomics N, MaizeGDB, Rex Nelson, SoyBase, TAIR, Steve Cannon, LegumeIS DivSeek

And many others!



NSF #1340112

Ontology Manager of the Breeding Management System

- UX

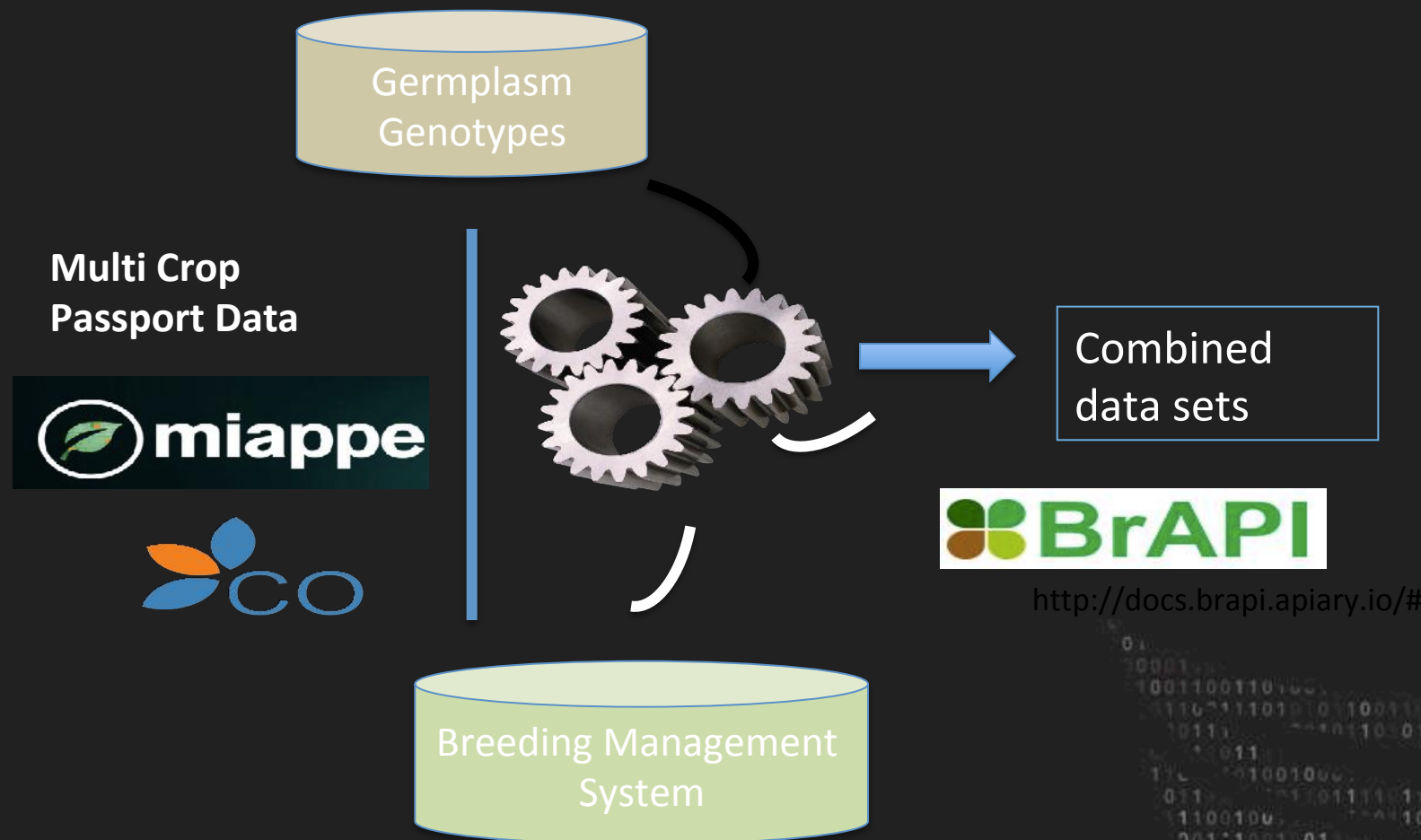
The screenshot displays the 'Ontology Browser' interface for 'IBP SORGHUM'. The sidebar on the left contains navigation links under three main categories: 'BREEDING ACTIVITIES' (Manage Germplasm, Nurseries, Trials, Samples), 'INFORMATION MANAGEMENT' (Import Germplasm, Genotyping Data, Studies, Head to Head Query, **Manage Ontologies**, Import Datasets, Trait Donors Query), and 'STATISTICAL ANALYSIS' and 'PROGRAM ADMINISTRATION'. The main content area has a top navigation bar with 'Variables', 'Properties', 'Methods', and 'Scales' tabs, and an 'Add New' button. Below this is a 'Program Favourites' section with a search bar. The 'Variables' section contains a table with the following data:

Name	Property	Method	Scale
ACCNO	Germplasm id	Assigned	Accession name
AgApp_E_1to5	Plant agronomic appreciation	Plant agronomic appreciation - Estimation	AgApp Score (1-5)
Antho_E_0to2	Plant anthocyanin presence	Plant anthocyanin presence - Estimation	Antho Score (0-2)
AV	Appreciation of variety	Variety Desirability Score	Score (1_5)
BLOCK_ID	BLOCK_ID_PROP	Assigned	Location id
BLOCK_NAME	BLOCK_ID_PROP	Assigned	Location name
BLOCK_NO	Blocking factor	Enumerated	Number
BM_CODE_VTE	Breeding method	Observed	BMETH_CODE
BM_ID_VTE	Breeding method	Observed	Breeding method id
BMETH_VTE	Breeding method	Observed	Breeding method name

BMS 8.4.1



CO variable format used by MIAPPE & Standard Breeding API (BrAPI)



Harmonizing Agronomic Data





Agronomy Ontology and Fieldbook

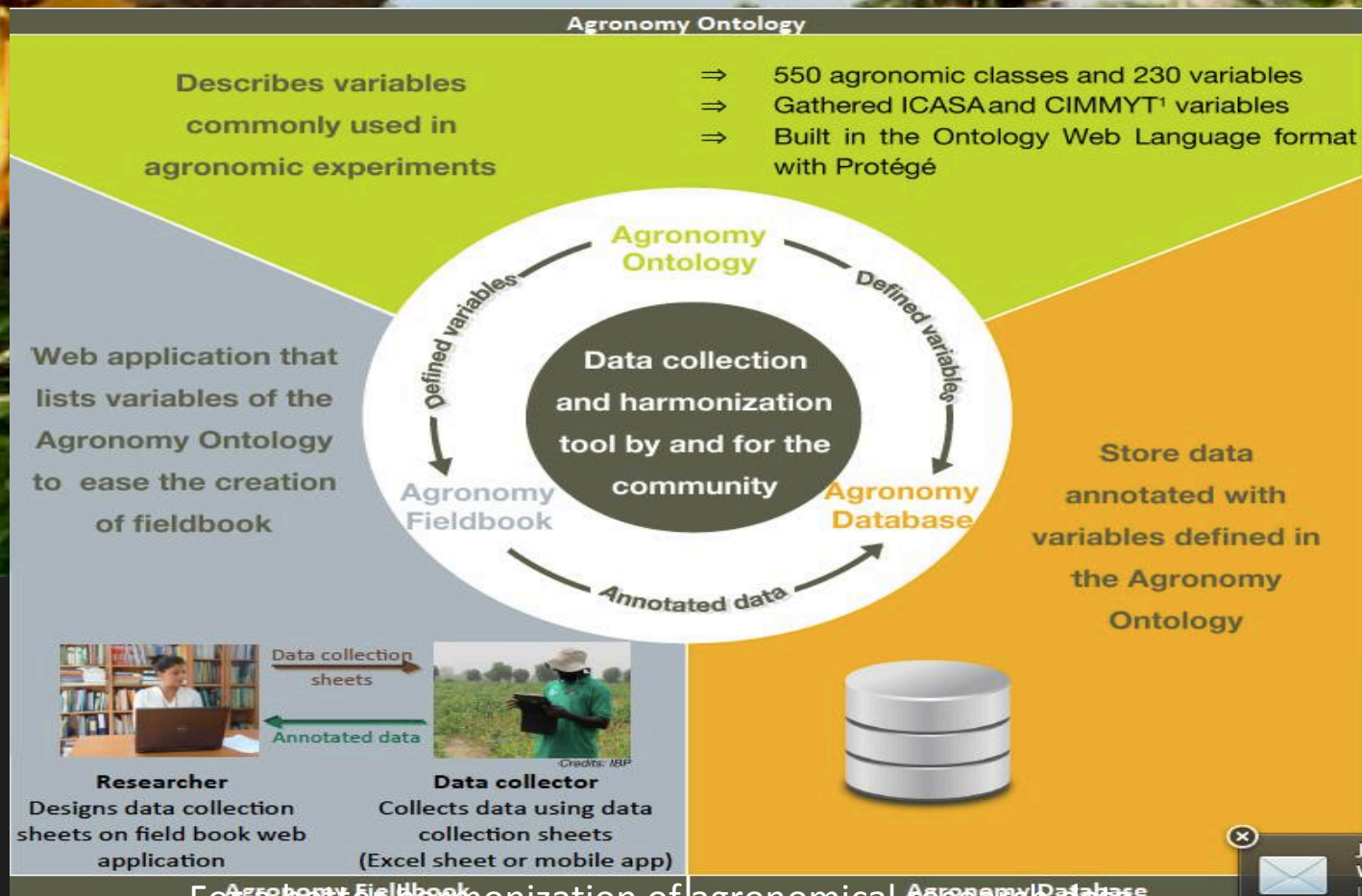


A collaborative project

A Community of Practice of agronomists and data managers is coalescing to contribute to the ontology content, test the agronomy fieldbook within ongoing projects, and provide feedback. Scientists from CIRAD, INRA, Crops for the Future, NARO, CIMMYT, have already showed their interest in participating.

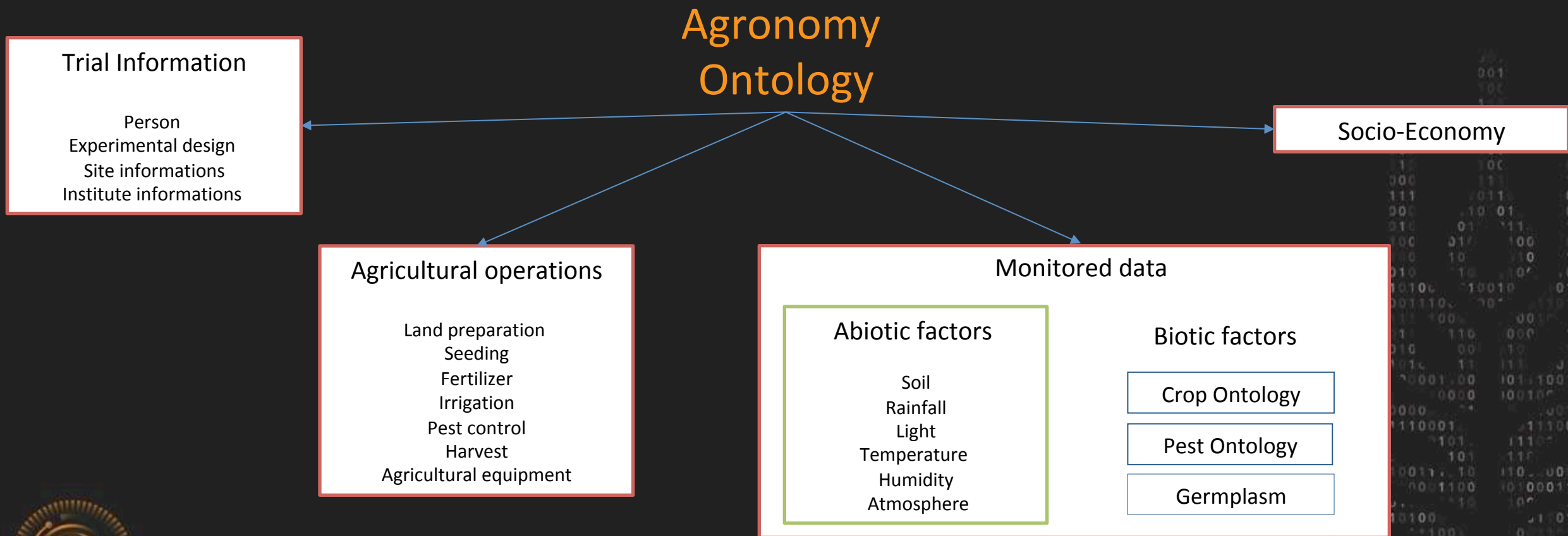


DECODING
The Data Ecosystem



For a better harmonization of agronomical research data

Development of the Agronomy Ontology (AgrO)



AgrO Content



agricultural implements, inputs, agricultural practices
Entity and a Quality (e.g.: field (entity) area (quality))

- 'crop residue management process'
 - 'crop residue burning process'
 - 'crop residue spreading process'
 - no-till
 - 'tillage process'

- 'land levelling process'
 - 'laser land levelling process'
 - 'traditional land levelling process'

- 'tillage process'
 - 'conservation tillage process'
 - mulch-till
 - ridge-till
 - strip-till
 - 'conventional tillage process'
 - 'puddling process'
 - 'reduced tillage process'

- 'plant transplanting process'
- 'planting process'
- 'seeding process'



- 'pest control process'
 - 'biological pest control process'
 - 'organisms augmentation process'
 - 'organisms conservation process'
 - 'organisms importation process'
 - 'chemical pest control process'
 - 'mechanical pest control process'
 - 'mechanical pest destruction process'
 - 'cold treatment'
 - 'diatomaceous earth spreading'
 - 'fire treatment'
 - 'flood treatment'
 - 'heat treatment'
 - 'soil solarization treatment'
 - 'steam treatment'
 - 'tillage process'
 - 'mechanical pest exclusion process'
 - 'mulching process'
 - 'using barrier process'
 - 'mechanical pest removal process'
 - 'hand picking process'
 - 'insect vacuuming process'
 - 'mowing process'
 - 'trapping process'
 - 'water pressure spraying process'

- 'irrigation process'
 - 'localized irrigation process'
 - 'drip irrigation process'
 - 'pitcher irrigation process'
 - 'subsurface drip irrigation process'
 - 'subsurface textile irrigation process'
 - 'sprinkler irrigation process'
 - 'center-pivot irrigation process'
 - 'sub-irrigation process'
 - 'subsurface drip irrigation process'
 - 'subsurface textile irrigation process'
 - 'surface irrigation process'
 - 'bassin irrigation process'
 - 'border irrigation process'
 - 'furrow irrigation process'
 - 'uncontrolled flooding process'

- 'pruning process'
 - 'desuckering process'
 - 'detrashing process'
 - 'limbing process'
 - 'tree topping process'

- 'regulation of grazing'
 - 'continuous grazing'
 - 'rotational grazing'
 - 'creep grazing'
 - 'first-last grazing'
 - 'intensive rotational grazing'
 - 'controlled grazing'
 - 'hohenheim grazing system'
 - 'holistic planned grazing'
 - 'mob grazing'
 - 'strip grazing'

AgrO - a composite ontology in OWL

The screenshot displays the AgrO ontology interface. On the left, a class hierarchy (inferred) is shown, listing various agricultural implements. The 'manual oilseed drill' class is highlighted. The main panel shows the details for this class, including its URI, annotations, and a description. A subClass Of relationship is shown, linking 'manual oilseed drill' to 'seed drill'. A detailed view of the 'seed drill' class is shown, listing its subClasses and instances.

Class hierarchy (inferred)

Class: 'manual oilseed drill'

Class Annotations

Annotations: 'manual oilseed drill'

Annotations

rdfs:label [language: en]
manual oilseed drill

definition [language: en]
A seed drill that consists of a seed box attached to the mainframe of a hand wheel hoe. A fluted roller assembly is provided at bottom of the seed box. Fluted roller is rotated with the help of chain and sprockets from the ground wheel.

database_cross_reference
<http://agricoop.nic.in/dacdivision/Machinery1/chap2a.pdf>

Description: 'manual oilseed drill'

Equivalent To

SubClass Of

'seed drill'

General class axioms

SubClass Of (Anonymous)

'participates'
'has model'
'has brand'
'depends on'

Instances

Target for Key

PATO_0000070

'number of blocks'
'number of crops'
'number of crops previously cultivated'
'number of plots'
'number of pots'
'number of replications'
'number of rows'
'number of treatments'



AgrO Github

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

Quality classes are imported from PATO (Phenotypic Quality Ontology), whereas the unit classes are imported from the Unit Ontology

AgroFIMS – user-tested; ready to field-test in Spring 2019



HIDAP
AgroFIMS

Hello, Guest
○ Not connected
[Login](#)

- Fieldbook
- Single Trial Analysis
- Documentation
- Help
- About



HIDAP AgroFIMS
Agronomy Field Management System

HIDAP AgroFIMS v0.0.17

The Agronomy Field Information Management System (AgroFIMS) has been developed on CGIAR's [HiDAP](#) (Highly-interactive Data Analysis Platform created by CGIAR's International Potato Center, [CIP](#)). AgroFIMS draws fully on ontologies, particularly the Agronomy Ontology and the Crop Ontology. It consists of modules that represent the typical cycle of operations in agronomic trial management, and enables the creation of data collection sheets using the same ontology-based set of variables, terminology, units and protocols. AgroFIMS therefore:

- Standardizes data collection and description for easy aggregation and inter-linking across disparate datasets;
- Allows easy integration with HiDAP breeding data, or any other ontology-based datasets;
- Functions as a data staging repository, allowing data uploads with view/edit permissions;
- Enables data quality checks, statistical analysis of the data collected, and the generation of sophisticated statistics reports;
- Aligns a priori with CGIAR's CG Core metadata schema;
- Enables easy upload to the institutional repositories, and much more.

Funding for AgroFIMS was provided by the Bill and Melinda Gates Foundation's Open Access, Open Data Initiative, and the [CGIAR Big Data Platform](#).



Platform for
Big Data
in Agriculture

> Create fieldbook

Single Trial Analysis

Documentation

About

Account

Help

Account: Med

Irrigation

Mulching and residue

Soil fertility

Weeding

Irrigation details

Number of irrigations

3

Application #1

Start date

2018/11/20

End date

2018/11/21

Irrigation source distance

Unit

Select one...

Irrigation technique

Localized

Irrigation amount

Unit

Select one...

Localized irrigation technique

Select one...

Bubbler irrigation

Drip irrigation

Mist irrigation

Pitcher irrigation

Subsurface drip irrigation

Subsurface textile irrigation

Other

Notes

Irrigation source distance

Unit

Crop measurement

Please, select measurement by click.

Show 25 entries

☐ Select all

Search:

	Crop	Group	Subgroup	Crop measurement	Scale
1	Cassava	General	Timing	Date	yyyy/mm/dd
2	Cassava	Biomass	Harvest	Area harvested	m2
3	Cassava	Biomass	Storage roots	Fresh weight	g
4	Cassava	Biomass	Storage roots	Subsample fresh weight	g
5	Cassava	Biomass	Storage roots	Subsample dry weight	g
6	Cassava	Biomass	Storage roots	Moisture content	%
7	Cassava	Biomass	Storage roots	Dry weight	g
8	Cassava	Biomass	Storage roots	Dry matter yield	kg/ha
9	Cassava	Biomass	Leaves	Fresh weight	g
10	Cassava	Biomass	Leaves	Subsample fresh weight	g
11	Cassava	Biomass	Leaves	Subsample dry weight	g
12	Cassava	Biomass	Leaves	Moisture content	%
13	Cassava	Biomass	Leaves	Dry weight	g
14	Cassava	Biomass	Leaves	Dry matter yield	kg/ha
15	Cassava	Biomass	Stems	Fresh weight	g

ICRISAT Dataverse: Data set annotation with ontologies

Annotation on Dataverse

to 10 of 254 Results

Sort

Phenotypic evaluation data of Pigeonpea (*C.acutifolious*) medium duration advanced lines trial for year 2016-17

Nov 14, 2018 - Phenotypic

Sameer Kumar, CV; Anupama Hingane, 2017, "Phenotypic evaluation data of Pigeonpea (*C.acutifolious*) medium duration advanced lines trial for year 2016-17" [doi:10.21421/D2/YALIZBD](https://doi.org/10.21421/D2/YALIZBD) ICRISAT Dataverse V3 LINE:6·Elf26uVuetmS2bWWuOeAWO==

Keyword

Chickpea (CROP ONTOLOGY) http://www.croponontology.org/terms/CO_338:ROOT/

Plant height (CROP ONTOLOGY) http://www.croponontology.org/terms/CO_338:0000270/

Days to maturity (CROP ONTOLOGY) http://www.croponontology.org/terms/CO_338:0000281/

Days to 50% flowering (CROP ONTOLOGY) http://www.croponontology.org/terms/CO_338:0000279/

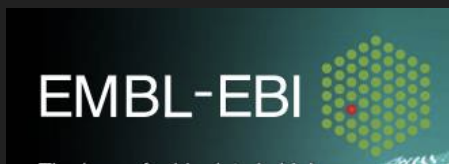
Replication number (CROP ONTOLOGY) http://www.croponontology.org/terms/CO_715:0000246/

Entry number (CROP ONTOLOGY) http://www.croponontology.org/terms/CO_715:0000031/

Seed yield per plot (CROP ONTOLOGY) http://www.croponontology.org/terms/CO_338:0000271/

Seed yield (CROP ONTOLOGY) http://www.croponontology.org/terms/CO_338:0000275/

A	B	C	D	E	F	G	H	I	J	K
Plot No	Replication Number	Entry No	Entry name	Days to 50 percent flowering	Days to maturity	Plant height	Plant count at harvest	Seed yield per plot	Seed yield	Hundred seed weight
401	1	1	ICCV 14301	47	96	39,4	90	457,33	953	35,1
402	1	8	ICCV 14308	47	97	38,4	70	570,13	1188	40
403	1	20	Local Check	48	98	46,6	75	696,00	1450	39
404	1	16	ICCV 14316	47	98	41	75	738,76	1539	45,5
405	1	19	KAK 2	46	96	45,8	102	618,00	1287	38
406	1	14	ICCV 14314	46	95	44,8	91	959,00	1998	39,5



Ontology Look Up Service

European Bioinformatics Institute



Services Research Training



Ontology Lookup Service

Home Ontologies Documentation About

OLS > Search

Grain number per spike



☐ Exact match ☐ Obsolete terms

Filters

Term type

Filter by type

class	16593
individual	547
property	66

Ontologies

Filter by ontology

NCIT	3659
MP	1677
FOODON	948

Search results for *Grain number per spike*

Previous Showing 1 to 10 of 17206 results Next

Grain number per spike CO_321:0000038

http://www.cropontology.org/rdf/CO_321:0000038

Number of grains per spike.

Ontology: Wheat ontology CO_321

Also in: CO_321

Grain number per spike CO_323:0000027

http://www.cropontology.org/rdf/CO_323:0000027

The number of grains per spike.

Ontology: Barley ontology CO_323

Also in: CO_323

grain CO_323:0000029

http://www.cropontology.org/rdf/CO_323:0000029

The number of grains per spike.

Ontology: Barley ontology CO_323



Data Annotation tool for public repositories using the OLS

<https://copo-project.org/>

Apply this description to all items in the description bundle?

Yes



Phenotypic Variables

wheat earliness

Method

Scale

shoot

Method

Scale

✕ PO:shoot axis tegument layer - PO:0025609

Delete

✕ TO:shoot axis node color - TO:1000003

✕ PO:shoot meristematic apical cell - PO:0030009

✕ PO:shoot axis meristematic apical cell - PO:0030010

✕ PO:shoot lateral meristem - PO:0006344

✕ PO:shoot axis tuber - PO:0004543

✕ TO:shoot axis tegument layer - PO:0025609

✕ TO:shoot system development - GO:0048367



Earlham Institute



Oxford e-Research Centre



University of York



EMBL-EBI

EMBL-EBI



Multi-disciplinary data for agriculture research questions

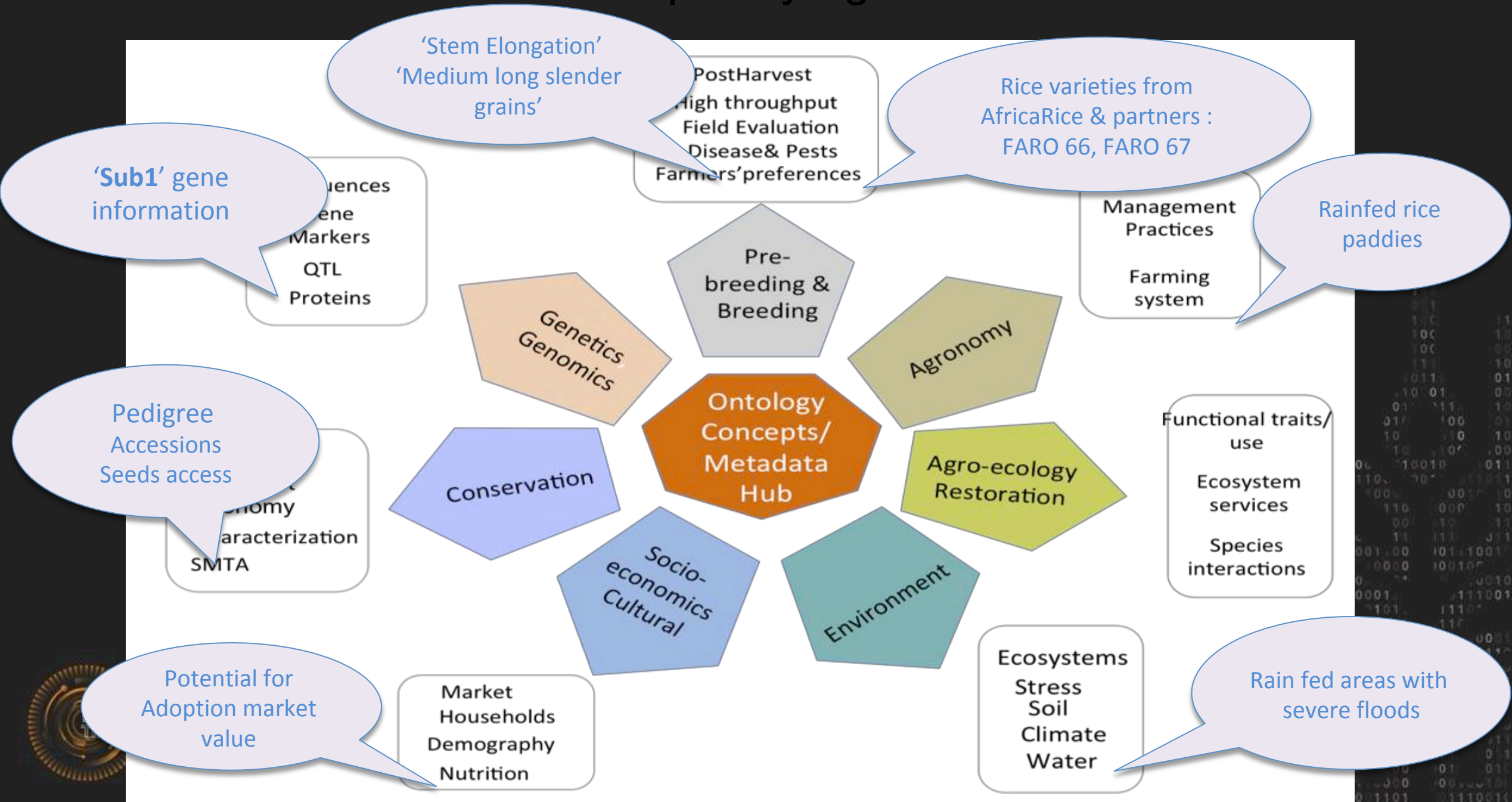
- In Nigeria, Rainfed lowlands = 70% of total rice area.
- Yield losses resulting from flooding may range from 10% to total crop loss.

Question:

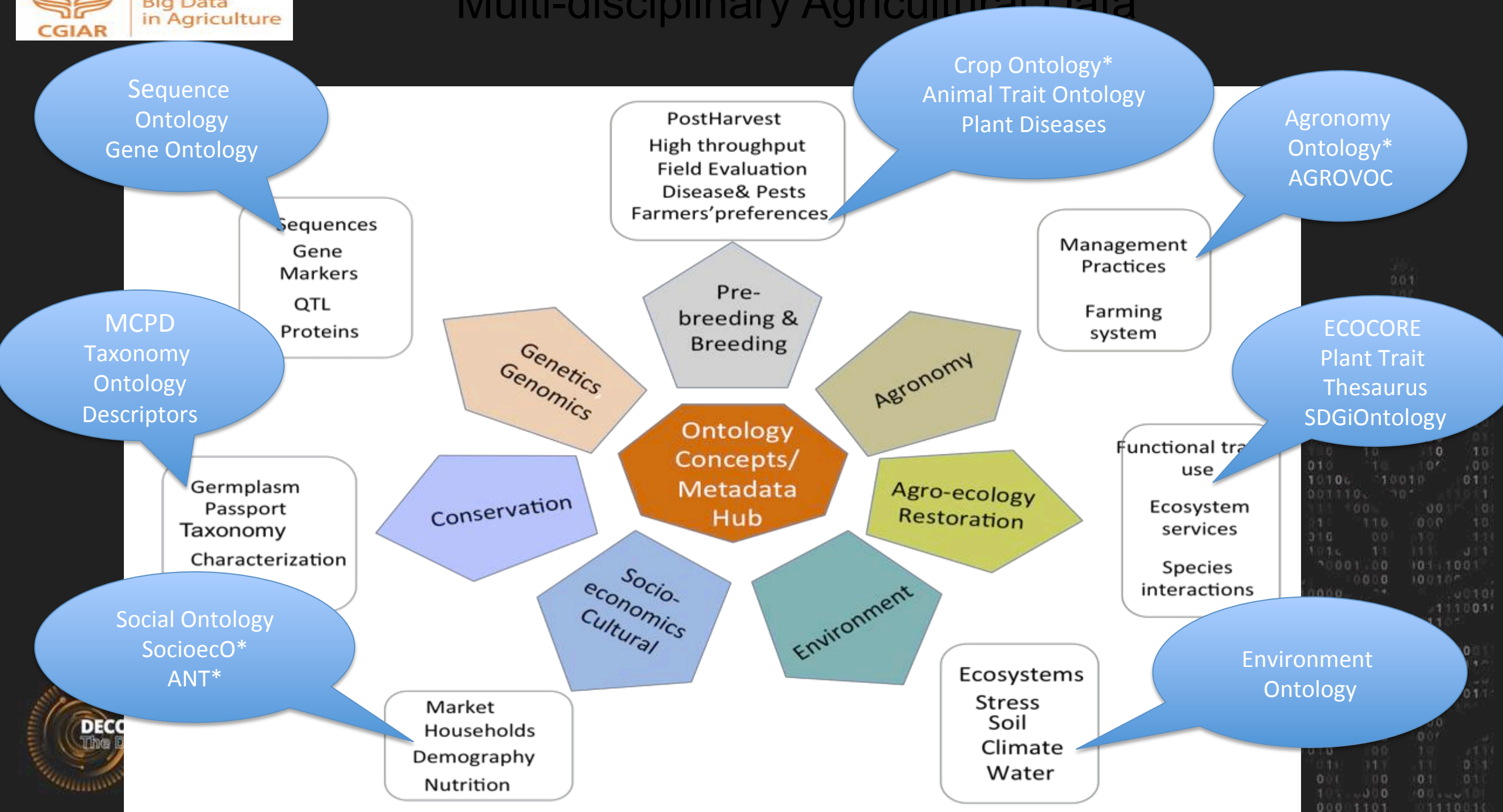
Identify rice varieties that are high-yielding and flood-tolerant that can grow in Nigeria in rain-fed lowlands subject to recurrent devastating flooding?



Multi-disciplinary Agricultural Data

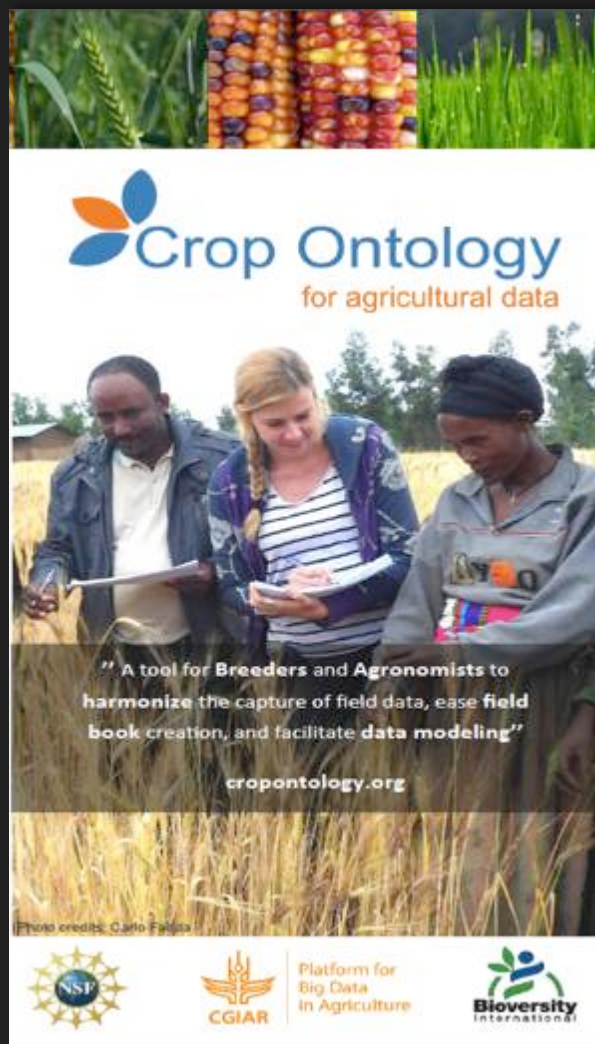


Multi-disciplinary Agricultural Data

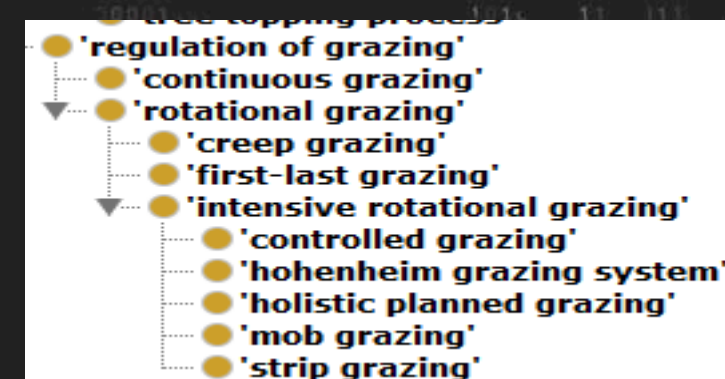


Ontology Community of Practice

Crop Traits



Agronomy Ontology





SOCIO-ECONOMIC ONTOLOGY (SociO)

A socio-economic ontology of controlled vocabularies, classifications, and concordances that allow standardization of key indicators. The key is that in SociO is a 'living' ontology, since the high variety of socio-economic data implies that it will need to evolve continuously.



01

Joint effort from two Community of Practices (CoP)

The SociO ontology has been developing from the collaborative work between the ontologies Data CoP and socio-economic data CoP in the CGIAR the Platform for Big data in Agriculture.

02

The coverage of key socio-economic indicators

The SociO ontology team work together with the working group on 100 questions in standard household surveys in order to get information on key socio-economic indicators that can be useful for research, policymaking, and impact assessment.

03

Linking existing ontologies

The SociO ontology team is working with external partners to re-use existing ontologies such as Basic Formal ontology, Information Artifact ontology, Informed Content Ontology, CGIAR agronomy ontology and others, so that we can easily link to other ontologies in the Linked Open Data cloud.

04

SociO ontology for annotating survey data

The SociO ontology would be used for annotating socio-economic survey data from a survey design stage (i.e. questionnaires) to data sharing stage in the data management life cycle.

Collaboration of the Ontology CoP and the Socio Economic Data CoP
For household surveys



Discussion and Working Groups



Livestock Ontology

Plant Phenotype

Genetics and Genomics

Plant Stress



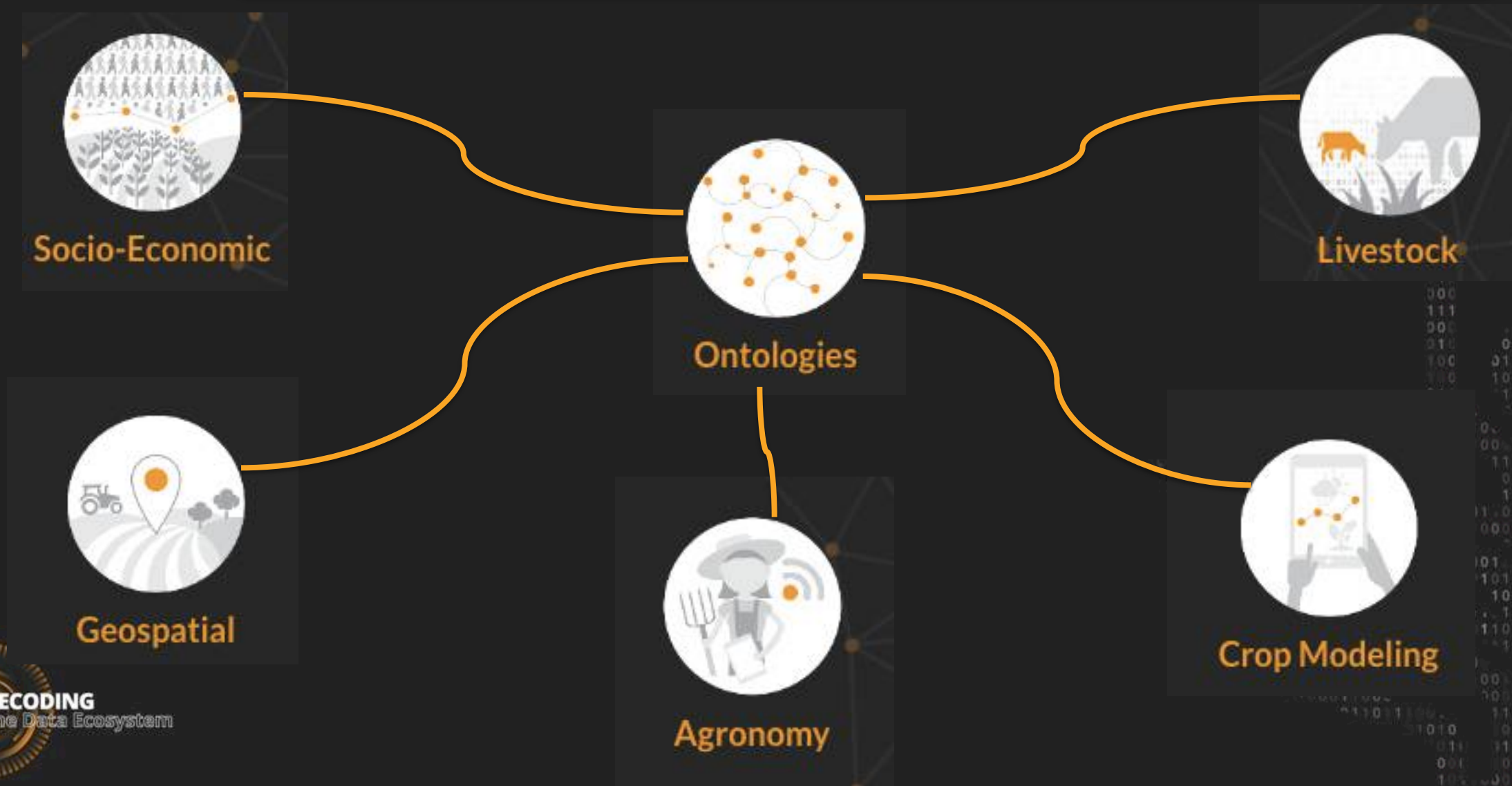
Fish Ontology



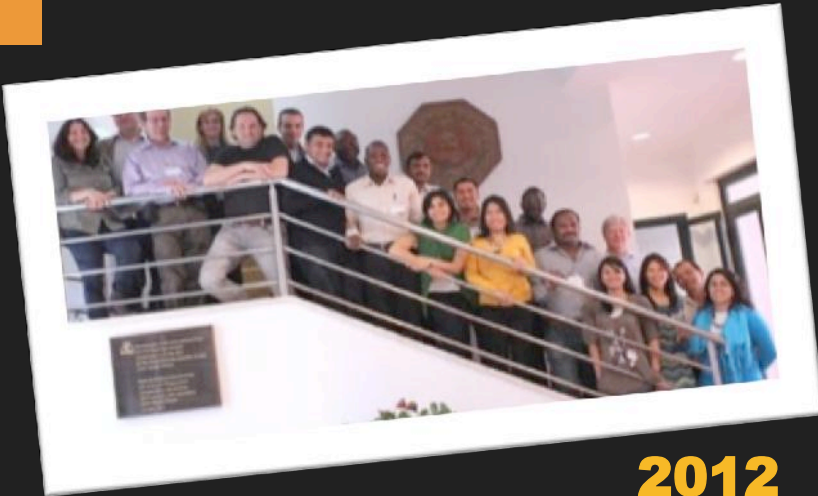
Water Management



Adopt, adapt and validate best practices, guidelines to support the **harmonization** and **interoperability** of data needed by the Big Data Platform and to support the other Communities of Practice.



A Growing Community Of Practice



2012



2014



2016



2018



[More news](#)

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VS

data harmonization at the levels of collection and storage,
and for data interoperability and data discovery following
the FAIR principles.

This space can be used as a discussion area, share and

