Ministerio de Agricultura, Pesca y Alimentación
Ministry of Agriculture, Fishing and Food
SPAIN

Area Frame as ground truth data for agrarian statistics based on EO: case of ESYRCE

DGINS
Directeurs Généraux
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GOBIERNO DE ESPAÑA
MINISTERIO DE AGRICULTURA, PESCA Y ALIMENTACIÓN

ESYRCE

Encuesta de **S**uperficies **y** **R**endimientos de **C**ultivos de **E**spaña
Survey on Crop Areas and Yields in Spain

Area Frame survey focused on agriculture

Original objective
Provide yearly estimations about area and production for different crops:

- CEE 837/90 Council Regulation: statistical information on cereals production
- CEE 959/93 Council Regulation: statistical information on crop products other than cereals
- 2001/109/CE Directive: production potential of plantations of certain species of fruit trees.
- Other National statistical data needs about agricultural land covers and crops yields.

Born in 1990 as a pilot survey in in the autonomous community of Castilla y León, due to its importance in cereal crops.

Over time, it was extended to the rest of the autonomous communities. In 2000 ESYRCE covered the whole country. Since 2001 the information is georeferenced.

Main value: one of the first availabe crop area estimates every year:
Results on crop area by October/November year N.

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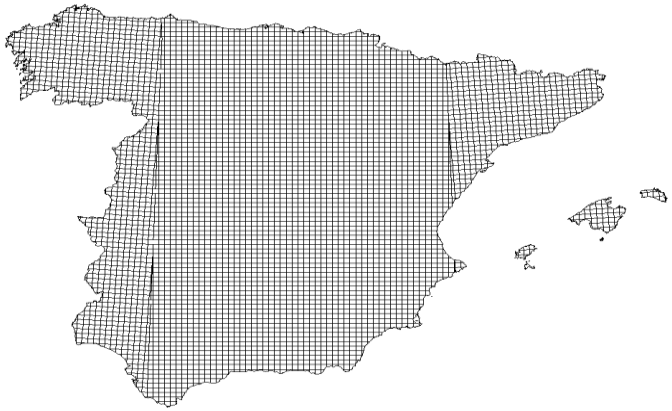
Sample design



Division of the territory in a 10 km x 10 km grid of units (blocks)
Four grids, one per utm zone

Elementary Sample Unit: cell (1km x 1km)
Each block contains 100 cells of 1 km x 1km.

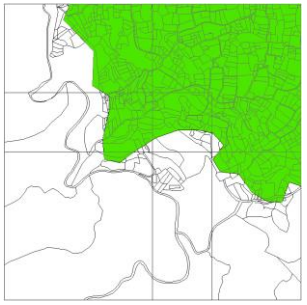
- Cell centre criteria for cell geographic attribution
- No link with the Land Plot Identification System used in the Common Agricultural Policy context

Observation Unit: Cell subdivision
- 700 m x 700 m (49 ha)
- 500 m x 500 m (25 ha)

ESYRCE
Sample design

Stratification of the territory based on IACS cartography (Agricultural Plots Information System) and Corinne Land Cover.

IACS (APIS) Cartography
- Area,
- Perimeter
- Use class
- Irrigation coefficient (only for arable land!!!)
- ….



Corinne Land Cover
- Permanent irrigated land
- Rice fields
- Irrigated fruit trees
- Irrigated vineyards
- Irrigated olive trees
- …

Simplyfied classification of land cover APIS at plot level

Alternative source for irrigated land characterisation

Crop index at elementary population unit level (1 km x 1 km cell)
Intensity of agricultural land use

Four strata depending on the **intensity of agricultural land use**:
- No crop (N)
- Disperse crops: vineyards/olive Trees/almonds (P)
- Non irrigated agricultural land (E): 50% olive trees and 80% arable land
- Irrigated agricultural land (I): 90% arable land and 75% permanent crops

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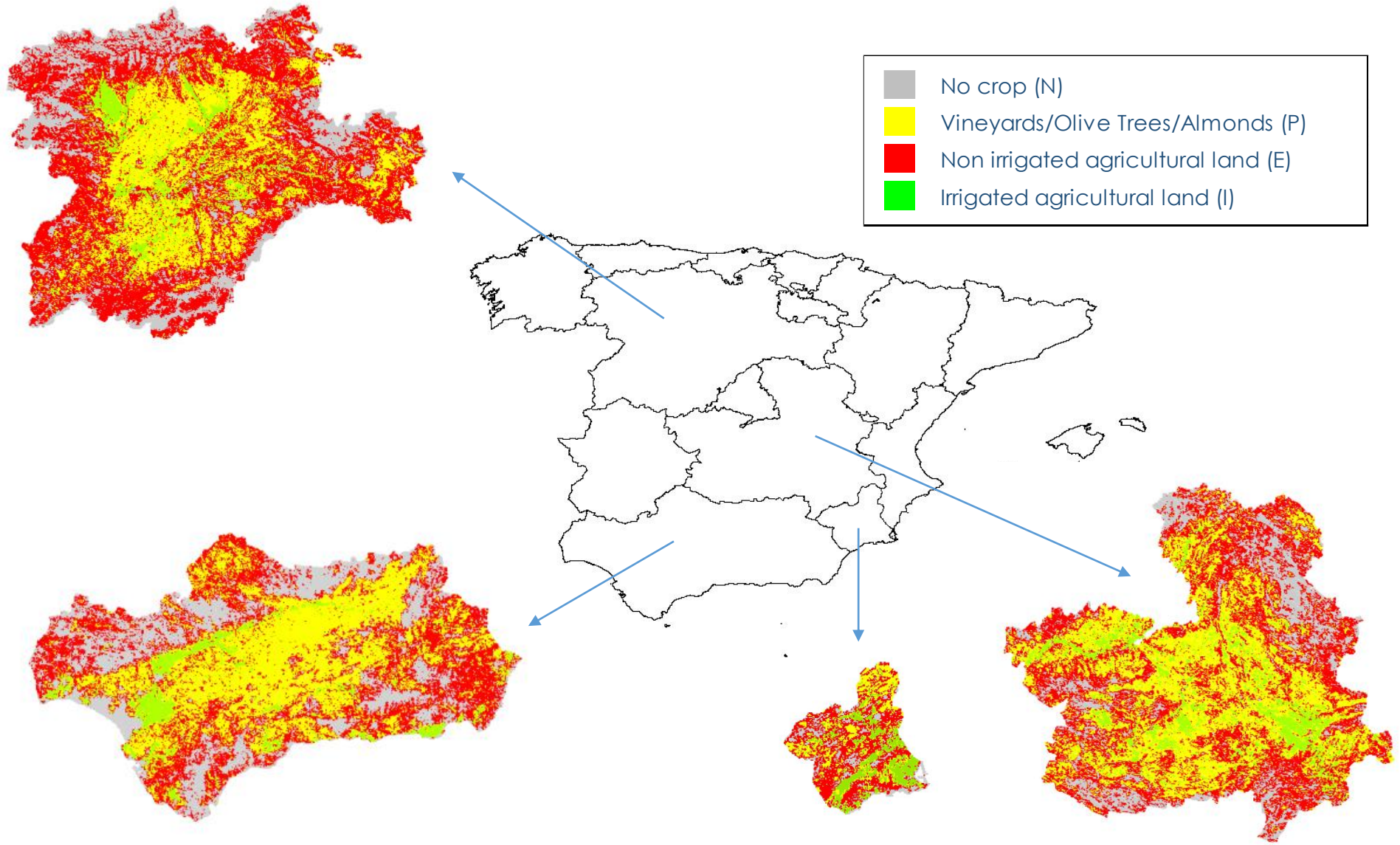
Sample design



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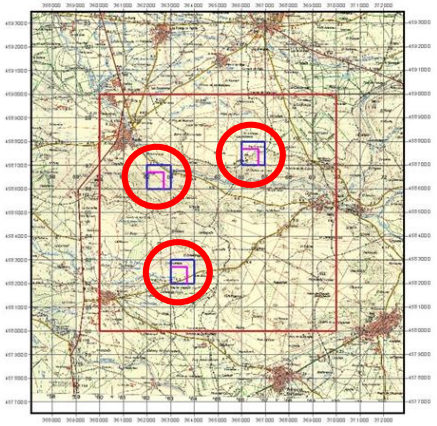
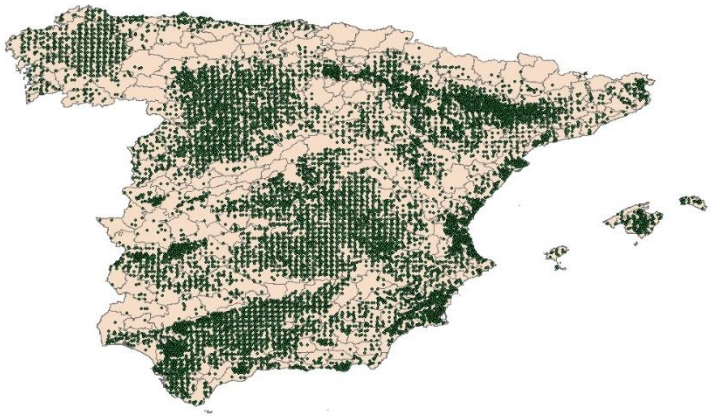
Sample design

Sample: Panel where the same relative positions inside blocks are surveyed.

- General sample: 3% of the territory (MAPA)
- Reinforcement sample: up to 15 % in stratum I (regions)





STRATUM	POPULATION	SAMPLE	sampling rate (%)
Irrigated agricultural land (I)	50,429	4,043	8.02
Non irrigated agricultural land (E)	143,825	5,029	3.50
Disperse crops: vineyards/olive Trees/almonds (P)	199,581	5,975	2.99
No Crop (N)	108,995	3,173	2.91
TOTAL	502,830	18,220	3.62

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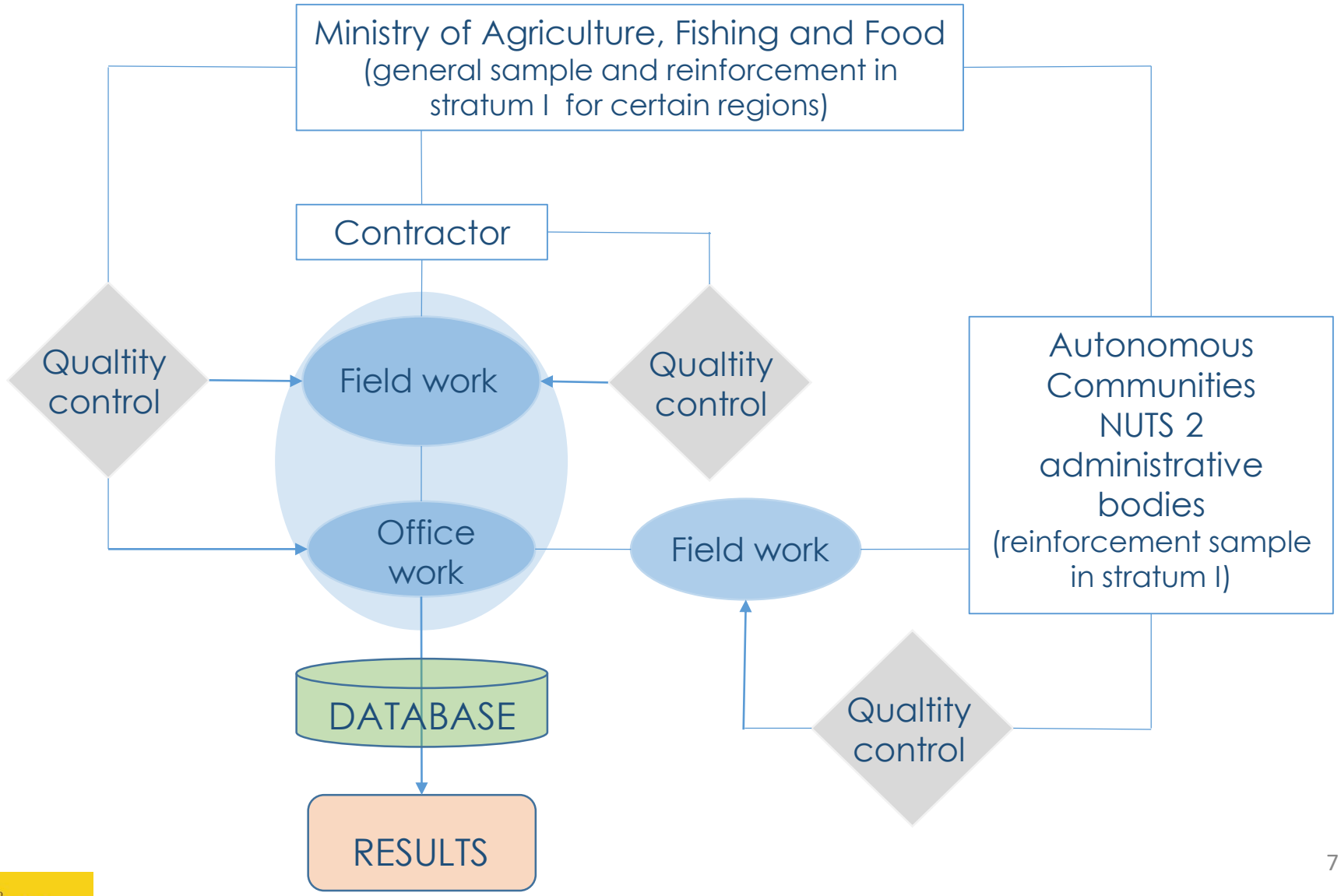
Project organization



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Human team

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General sample and reinforcement in stratum I for certain regions

- 350 field agents (contractor)
- 11 regional field work supervisors (contractor)
- 1 general field work supervisor (contractor)
- 3 office workers (contractor)
- 50 quality control agents (MAPA)
- 1 supervisor of the project (MAPA)

Autonomous Communities (NUTS 2 administrative bodies)
Reinforcement sample in stratum I

- 80 field agents
- 11 regional supervisors

Three campaings (at harvest for (1) Winter/Springs crops, (2) Summer crops and (3) Autumn/Winter crops.

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Variables

- **Plot area** (No link with the Land Plot Identification System dataset used in the Common Agricultural Policy context)

- **Land cover**
  - **Not agrarian**: compatible with **LUCAS**
  - **Agrarian**
    - **Type of crop**
      - Arable land
        - Soil maintenance (soil tillage)
        - Type of sowing
      - Permanent crops
        - Age
        - Density
        - Variety
        - Plantation system
        - Soil maintenance techniques
      - Irrigation Y/N (if Yes, Irrigation system)
      - If Greenhouse: Technification level
    - **Crop yield**
      - Yield estimation method

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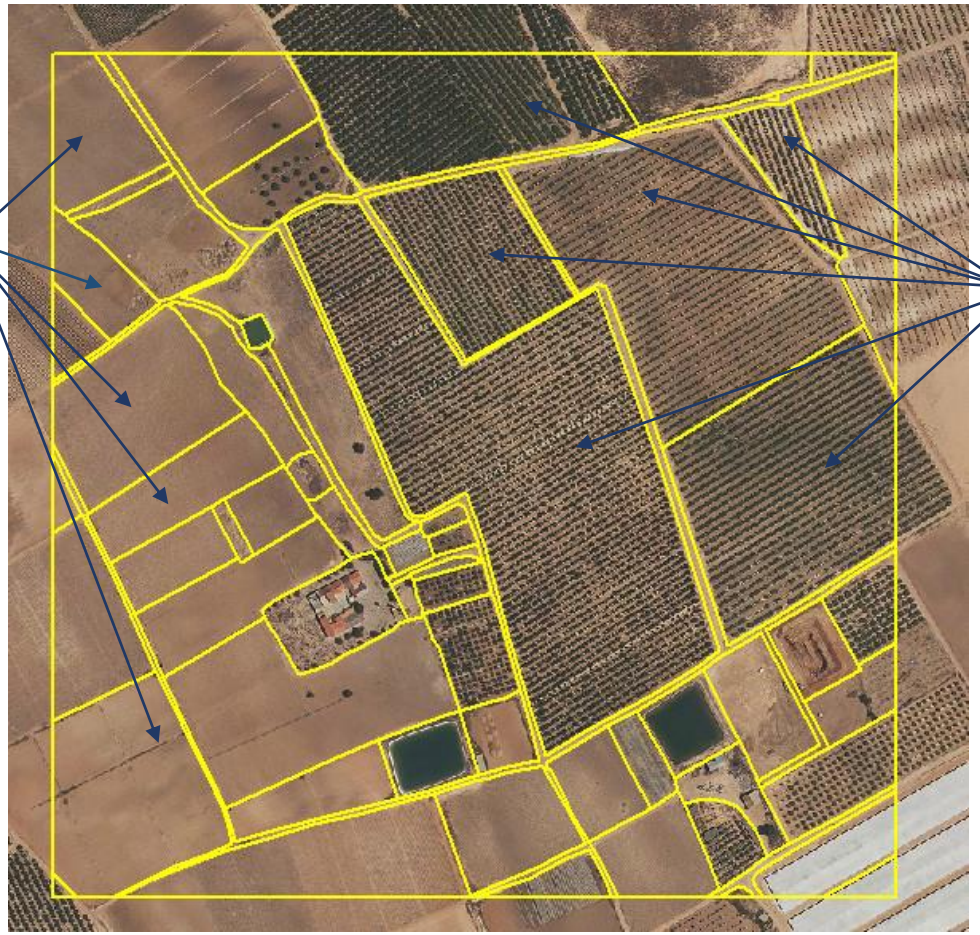
Variables

Arable land:
- Type of crop (C)
- Plot area (N)
- Soil maintenance (C)
- Type of sowing (C)
- Irrigation (C)
- Irrigation system (C)
- Greenhouse (C)
- Greenhouse technification level (C)
- Crop yield (N)
- Yield estimation method (C)



Permanent crops
- Type of crop (C)
- Plot area (N)
- Age (N)
- Density (N)
- Variety (C)
- Plantation system (C)
- Soil maintenance (C)
- Irrigation (C)
- Irrigation system (C)
- Greenhouse (C)
- Greenhouse technification level (C)
- Crop yield (N)
- Yield estimation method (C)

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Database

- Yearly
- Georeferenced at plot level since 2001
- Geographic information: location
- Sampling information (stratum, expansion factor…)
- Cover
- List of crop types
- Plot area
- Yield
  - Field gauging (information not provided by farmers)
  - Yield at parcel level (not averages).
  - Yield at harvest
  - Gauging method
- Complementary information related to crop production methods at plot level

<u>Higly demanded by institutional and academic users</u>

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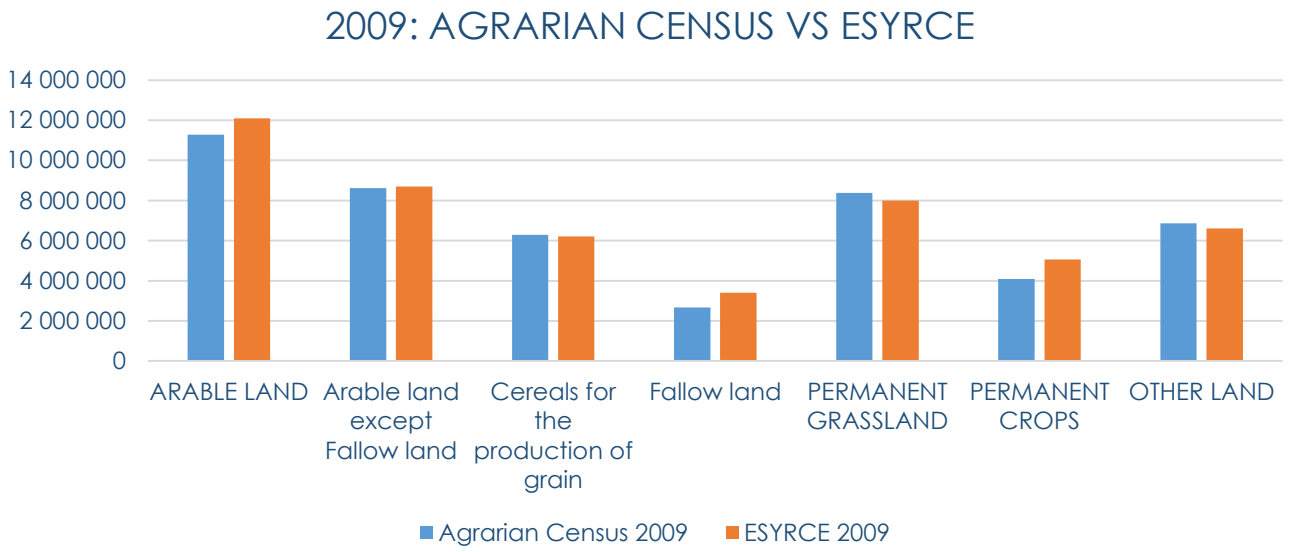
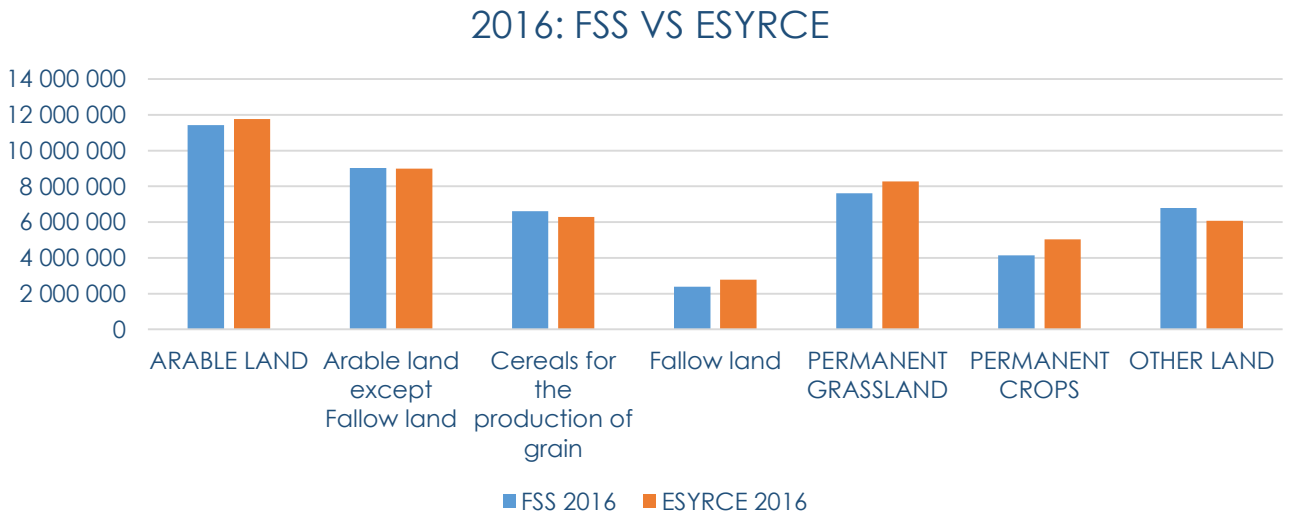
Results





Courtesy of Sophie Bontemps (Université catholique de Louvain). Sen4Stat.

MAPA and Spain involved as pilot in the ESA "Sentinels for Agricultural Statistics" (Sen4Stat) project

Pilot National Statistical Offices (Spain, Senegal, Malawi, Tanzania, Ecuador)

- Objectives: demonstrate and facilitate the integration of Earth Observation (EO) data for national agricultural statistics
- 6 EO potential contributions investigated:
  1) **Cost-efficiency**: EO data for reducing the estimation error without increasing the survey cost / reducing the survey cost without increasing the estimation error
  2) **Granularity**: EO data for disaggregating the national/regional-level estimates to smaller admin. units
  3) **Timeliness**: EO data for providing early estimates and supporting multi-seasonal estimation
  4) **Sample design optimization**: EO data for optimizing the sample size, the segment size and their spatial allocation
  5) **Ground data quality control**: EO data for improving ground survey protocol & applying QC procedure
  6) **SDG's reporting**: EO data for supporting indicators calculation
- Challenges:
  1) Ground data reliability (QC needed), quantity (segments preferred) and completeness (non crop info also needed)
  2) Multiple EO approaches needed to be performant in the different applications
  3) Know-how in EO and IT needed to generate and interpret EO-derived information
- Sen4Stat open-source system (v1) reviewed, including modules for EO processing, in situ datasets QC, visualization, higher-level statistical analyses
- 2021 and 2022: testing the prototypes up to national scale, fitness-to-use assessment with NSOs, capacity building and training plan specific to each country

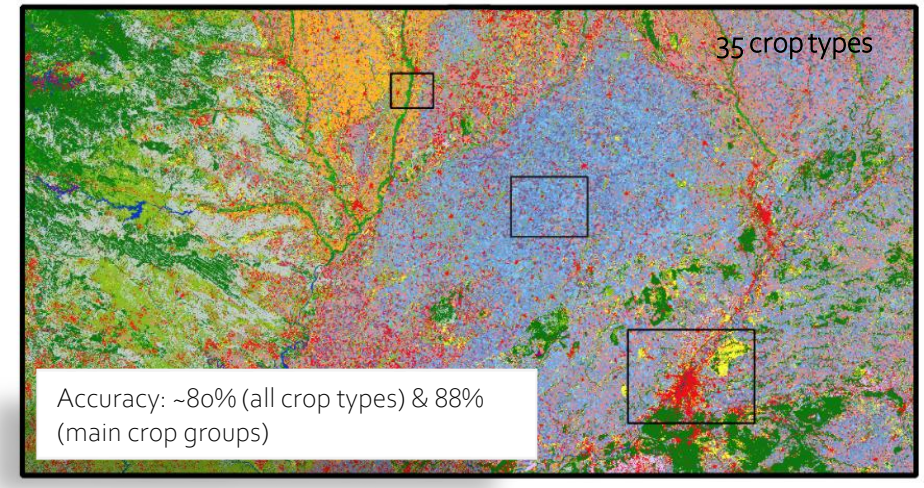
www.esa-sen4stat.org

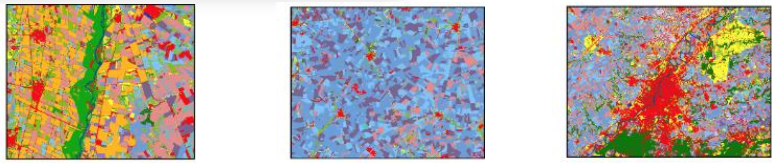
Courtesy of Sophie Bontemps (Université catholique de Louvain). Sen4Stat.

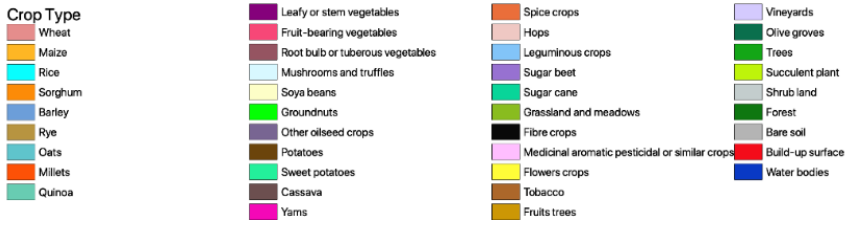
EO data contributing to reduce the confidence interval around the crop acreage estimates and allowing their spatial disaggregation

Sen4Stat
Sentinels for Agricultural Statistics

Test site in Castilla y Leon: barley crop acreage estimates



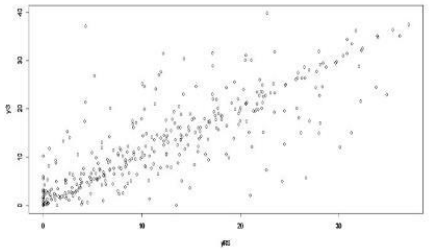




Same level of barley acreage estimation with and without EO data
Lower confidence interval with EO -> higher efficiency
Statistics at municipality-level only possible if using EO data

Data	Barley acreage (Hectares) in the study area. Spain. 2018	Uncertainty: 95% Confidence Interval (Hectares) Limits	Uncertainty: 95% Confidence Interval (Hectares) Amplitude	Uncertainty: Sampling Error (CV%)	Relative efficiency
Ground data only	**236.165,4**	Lw: 215951.7 Up: 256379	40427.24	4.37	------
Ground + EO data	**228.550,1**	Lw: 219699.8 Up: 237400.3	17700.51	1.98	5.2

Barley acreage estimates (R2=0.71)



Municipality		Acreage: Has.	Acreage: Error (CV%)
49020	Belver de los Montes	212.96	29.1
49043	Castroverde	2914.22	8.0
49156	Pinilla de Toro	963.30	10.0
49168	Quintanilla del Monte	466.65	20.3
49219	Toro	615.91	14.0
49235	Vezdemarbán	1358.22	12.6
49250	Villalpando	560.05	39.1
49252	Villamayor de Campos	1056.23	11.1
49260	Villanueva del Campo	784.03	13.2
49263	Villar de Fallaves	844.16	11.0
49267	Villardondiego	516.40	11.5
49270	Villavendimio	656.07	10.4
Total Zamora		10948.2	8.16

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THANK YOU

For more information:
https://www.mapa.gob.es/es/estadistica/temas/estadisticas-agrarias/agricultura/esyrce/

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