National Information System for Agriculture Development

The multisource Remote Sensing activity for the agricultural monitoring and the EU CAP subsidy controls in Italy

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SIN - National Information System for Agricultural Development, is a company owned by AGEA - Agency for Agricultural Subsidy Payments (by Law 231/2005), for managing and developing the **Italian Agricultural Information System** for: agriculture, agribusiness, forestry and fishery sectors.

SIN takes advantage of private ownership, **leading companies** in information technology and territorial data management.

SIN uses **remote sensing services**, satellite and aerial, also provided through the aircrafts by its owned Telaer Ltd., and **innovative sensors/products** for land survey and monitoring.
Main Users and Clients of SIN

Central Public Authorities

AGEA
Agenzia per le erogazioni in agricoltura

MPAAF
Ministero delle politiche agricole, alimentari e forestali

Local subsidy Paying Agencies

- AGEA
- AVEPA (Regione Veneto)
- ARCEA (Regione Calabria)
- ARPEA (Regione Piemonte)
- ARTEA (Regione Toscana)
- OPPAB (Provincia Bolzano)
- APPAG (Provincia Trento)
- AGREA (Regione Emilia Romagna)

Other Public Bodies

- ISMEA
- INEA
- INRAN
- CRA
- UNIRE
- ENCI
- Agenzia del Territorio
- Joint Research Centre
- ....

Local Public Authorities

- Calabria
- Sicilia
- Marche
- Piemonte
- Campania
- Basilicata
- ....
Advanced aerial remote sensing: AGEA TELAER system managed by SIN

TELAER is an integrated aerial remote sensing system assigned to AGEA by law. Telaer covers all Remote Sensing acquisition, processing and management chains for:

- Aerial acquisition and processing;
- Ground segment;
- Satellite processing

The Telaer Infrastructures offer different configurations of sensor missions and cover different areas and target.

AGEA uses Telaer for its institutional activities: updating of agronomic land cover/use of Italy (LPIS-refresh) and agro-subsidy declarations controls and monitoring. In addition, several R&D tasks are performed through Telaer initiatives and outputs.
Territorial data base- the farm register: a certification system for agro-environment management

Farm register: a complete graphic and alphanumeric data base concerning all national agriculture and forestry farms
Agro meteorological services

Agro-climatic operational support to Assistance Centres, meteorological monitoring and related products diffusion and publication

National Agro-meteorological network
31 agro-meteo stations
✓ National network integration (Air force)

Services
✓ Data acquisition/diffusion
✓ Agro-meteorological bulletins realizing
✓ Climatic and climatologic services

Involved Bodies
✓ CRA (centre of Agricultural research)
✓ Military Air force service
✓ ECMWS (European Centre of forecasting)
✓ Regional services
Territorial data base - **national GIS**: a certification system for agro-environment management

Cartographic and thematic layers are on a continuous data base, organized in 3 informative levels

**Remote Sensing imagery**: digital Ortho-photos updated every 3 years for 30% of Italian territory 0,5m ris.; satellite imagery at highest resolution by DG EU JRC; Radar and hyperspectral data;

**Land Data**: Digital Models of terrain and surface Cadastral (320,000 maps, 70 million parcels); maps in scale 1:10,00 of Italy

**Thematic layers**: by RS Interpretation land cover and land use; in situ surveys; 4,5 millions of olive-groves parcels; 220 mil. of olive trees; 4 millions of vineyards; forestry data and layers; unauthorized landfills; fires scar mapping for Forest Guard Services

**GIS SIN-AGEA** is one of the main, detailed and updated data base available in Italy
LPIS “Refresh” project for AGEA

LPIS- Land Parcel Identification System

“Refresh” allows the continuous updating of the entire national Land cover/use necessary for IACS management (Integrated Agricultural Controls System).

LPIS allows the total amount of the subsidy eligibility area calculation and monitoring, detecting and delimiting all the territorial land cover of the nation.

“LPIS Refresh” uses remote sensing multispectral imagery (aerial Tealer and satellite) at very high resolution 0,50 m.

LPIS-Refresh provides the AGEA and the Italian Administration with a thematic map “wall-to-wall” 1:10,000 scale with MMU (minimum mapping units) up to 100 sm, with an updating frequency of 3 years.
AGRIT project: statistics before the harvest

20 years of agronomic statistics in Italy
1,2 million of interpreted points on a grid 500x500m;
more than 100,000 multi-temporal ground surveys every year

Example of Agrit grid point frame in Emilia-R

Yellow: Interpreted points
Red: agronomic current RFV

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Ground surveys for speeding up operations and minimize mistakes; WEB site for ground survey management data collection and verification
The Agriculture policy evolution....
from: Atlas of Italian Regions
De Agostini – 1951
ERP (European Reconstruction Programme)

• *The Atlas final desiderata*...”ploughing and always over fertilize new lands; drain all wetlands; build embankments for all rivers and creeks; build houses, bridges, roads; create everywhere dams and aqueducts and canals”…
EU

First attempt in agriculture management years 80\textsuperscript{th} - 90\textsuperscript{th}

First European agriculture subsidy target:

improve the yield through the subsidies to farm production!
Two methods in parallel- $1^{st}$: ground surveys for agronomic input to be collected

B/W Ortho-photo for tailored in situ verifications and farmer interviews

Topographic maps for guiding the systematic field visits
2nd method: multi-temporal RS data overlaid on cadastral and declarations

- Landsat and Spot for phenological thematic info
- Graphic calculation on archive orthophotos
EU second attempt in agriculture management years mid 90th - 2005

New European agriculture subsidy target:

forget production…. pay farmers for the all actual cultivated lands
(goal: reducing chemicals, fertilizers, pesticides, energy, etc.)
2\textsuperscript{nd} method: Declared farm surfaces to be controlled by RS

All farm parcels
- Pastures
- Arable
- Olive trees

To administrate and control:
- Digitised farmer drawing
- Claim database
- VHR images
- HR satellite image time series

By Loudjani- JRC Mars
Where: Annual samples extraction by risk analysis

Several and different parameters
By EU regulations must be followed, mainly based on:

- Geopolitical distribution
- Fraud risk score in the past
- Frequency in controls
HOW:
on line manual with Spectral signatures library for crop groups and phenology homogeneous detection
Example of good processing and sharing capability for agro-surfaces detection and measure.
Zooming example of final different layers through sat VHR/ancillary data

- Farms (light blue)
- Cadastral (blue)
- Land use (yellow)

- Fodder (clover/alpha-alpha)
- Wheat
- Legumes
- Ploughed
- Farmyard
EU
third attempt in agriculture management
years 2005-2013

Again a new European target:
No more extensive cultivated lands only, but a well maintained agro-environment and eco-sustainable behaviour addressing
- the Cross- Compliance rules
After 2005 CAP reform

Cross compliance for the agro-environment maintenance or amelioration

- More spatial check (slope, riverside, undeclared area …)
- More ‘objects’ to identify (fire, erosion, bush, tree lines, isolated trees …)
- More temporal checks (winter, fixed date, reference period …)

VHR images needed more than HR images

By Loudjani- JRC Mars
Third and current EU policy

*Operational examples*

- Agro-environment protection modeling
- Vulnerability and Risk mapping
- Remote Sensing benefit/costs advantages
- RS Multi sensors for different targets
- The importance of ancillary 3D and morphometric measures
Soil maintenance and protection by erosion
1955-current situation comparison

The correct agro-management and the good agronomic environmental conditions allow:

- soil maintenance,
- erosion mitigation
- sustainability of the agro-practices
Historical analysis airborne 1955 vs. sat VHR 2009 – Sicily, erosion zones

Parcels segmentation; ditches: low erosion level in a clay agro-landscape
Historical analysis airborne 1955
same area sat VHR 2009 – Sicily, erosion zones

wider arable parcels:
high level of erosion, both linear and areal
Historical analysis airborne 1955 vs. sat VHR 2009 – Sicily, erosion zones

1955 situation
Distributed erosion and landslides
Abandoned soil, no parcels
Historical analysis airborne 1955 vs. sat same area sat 2009 – Sicily, erosion zones

Ponds and water courses drainage realized

….Agricultural activity came back, even if with erosion…
Soil erosion vulnerability mapping in agronomic zones

Goal: Good Agricultural Environmental Conditions monitoring

Synthetic map of risk erosion on agricultural areas in Italy by RS data, DSM and existing thematic layers
Crossing flow for erosion vulnerability on agro-environment data used
Map validation: 2006-08 in situ found violations (triangles) per municipality on vulnerability soil erosion zones (orange-red)
SIN-AGEA vulnerability/risk maps, overlaid on sample areas

- Burning stubbles
- Erosion
- Water stagnation

- Olives maintenance

PESARO URBINO

AGRIGENTO

MESINA

SIN

Sistema Informativo Nazionale per lo Sviluppo dell'Agricoltura
Sicily:
small soil movements are detectable, while hidden phenomena are clear detected by RS.
Erosion to landslide: irreversible loss of agricultural soil; GAEC standard 1.1

Woodland slope on landslide

Wheat spectral signature
Messina vegetation encroachment on pastures monitoring

Active creeping detection

2009, July

2009, April
Ground pictures on test areas for standard 2.1 (Sept 11-13th)

Burnt and ploughed

Burnt and not yet ploughed
Siracusa: slight damage on stone walls/terraces: best VHR is needed
Marche: Extended overgrazing on pasture; uncorrected sludge near the stable => rapid field visit necessity
Tuscany, Environmental monitoring and alert near reservoirs and water courses.
Waste deposit, manure? => rapid field visits necessity
Remote Sensing activity benefit/cost positive ratio - Final statistics for DG Agri

<table>
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<th>Total points/parcels investigated</th>
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<td>parcels with partial accordance VHR/Ground (3 interpreters/2 inspectors)</td>
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<td>non conforming points/parcels</td>
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<td>NO</td>
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<td>NO/NR</td>
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SIN  Including “partial impossible survey” the total is 27+39 => 66 => 6%
Multisensor availability by Telaer system

Quickbird 0.6m May

Telaer SAR 0.5m 12 July

Telaer hyper spectral- 700 bands
5 Aug
Telaer Airborne high res Radar for Landscape elements detection and risk layers generation

Agro-environment safeguard and monitoring; maintenance of bio-diversity

Isolated trees

Terraces

Hedgerows and hedgetrees

Olives and vine maintaining

3D radar Telaer flight For agro-envi monitoring
What’s for the future?
The Greening policy after 2013
e.g. Detailed characterization of rural landscapes (Managed through Land Parcel System LPIS)

Landscape features (location, type)
- Hedgerow
- Group of trees
- Isolated trees
- Pond
- Stone walls
- Terraces…

Land use / land cover
- Arable land
- Pasture
- Forest
- Permanent crop
…

Eligibility of land
100% eligible

By Loudjani
High accuracy level of DSM 2m by 0.5m air stereo couples already acquired for LPIS updating.

Automatic extraction of both landscape features and complete parcel sloping, not more in average.
2D DSM on hierarchical water courses at very high iso-hypse density

3D DSM on imagery

Drainage, orthophotos and DSM at 1:10,000
LPIS parcels and water courses: agro Land use immediate visualization and issue
Complete and synoptic agro-environment monitoring: Agro-landscape mapping, pollution and flooding risk detection

Bank presence and its Altitude range by DSM

Landscape elements automatic detection

bank limits
Nat. vegetation Buffer Zone against agricultural run-off pollution
Fishery support: monitoring of marine and inland waters

Indexes for water health status (aquiculture monitoring) fishing vessels correlation by Radar satellite and blue boxes

Radar acquisition

Thermal analysis

Courtesy of e-GEOS and ESA
Next EU agro-management
the 2013-2020 approach: 4\textsuperscript{th} attempt

Next forthcoming European agriculture policy purposes:
• No more monocultures and absence of farm crop variability
• Agro-environment and ecological behaviour stronger addressing
• Young farmers encouraging and funding
• Greening farms mandatory (min of 7\% of natural elements, etc)
• Pollution fighting and climate changes mitigation (CO2 fluxes)
Main international advantages by EU agro-policy

• EU Agronomic production maintenance means: reduce risk of other continents’ colonization (e.g. massive land acquisitions and export addressing…)

• EU agro-environment and greening policies realizing means: offer best practices, tested and operational methods for a forthcoming expanding worldwide application, tuning the already achieved results….