Main challenges identified in conducting checks by monitoring in Spain
ES (FEGA and Aragon)

Valladolid, 10-11/04/2019

Index

1.1

Monitoring in Spain in 2019

MONITORING IN SPAIN IN 2019

12 AREAS LOCATED IN 10 DIFFERENT PAYING AGENCIES. 6 DIFFERENT MONITORING PROJECTS WITH GREAT DIVERSITY OF CROPS, AGRICULTURAL MANAGEMENT AND PARCEL SIZE.

In 2019, in total, 10 Paying Agencies will be conducting checks by monitoring in Spain. 4 PA will carry out independent monitoring projects. Another 4 PA will participate in the project led by FEGA, implemented by Tragsatec. And, finally, 2 more PA will conduct their own projects, also taking part in the FEGA initiative.

PA/ CB	Concerned Region	Scheme / Measure	Phasing in
Andalusia	Andalusia	BPS, VCS cotton	Yes
Aragon	Aragon	SFS	No
Castile and Leon	Castile and Leon	BPS, greening, SFS, YFS, VCS (5 schemes)	Yes
Catalonia	Catalonia	VCS rice	Yes
Murcia	Murcia	VCS rice	No
FEGA	Andalusia, Valencia, Extremadura, Galicia, Madrid, Murcia, Navarre	BPS	Yes
FEGA	Valencia	SFS, greening, VCS nuts	Yes

Overview

- This presentation aims at giving an overview of the **main challenges** observed by some Spanish paying agencies to conduct checks by monitoring in 2019.

- The issues presented namely concern the following:

1. The automatic processing by Sentinel data of an essential requirement of the current CAP legislative framework: **the verification that an agricultural activity (production or maintenance) takes place** in the declared parcels. As we know, this a fundamental and horizontal condition that has to be checked in any scheme, such as the Basic Payment Scheme (BPS) or the Small Farmer Scheme (SFS).

2. **The difficulty to develop specific phenological markers** for monitoring according to the different crop vegetative cycles. This is a complex and arduous task, given the agricultural and climatic diversity of Spain's regions, which comprises a vast array of different crop characteristics.

Outline

- The Paying Agency of Aragon reports on the work carried out for the **detection of abandoned almond tree** parcels, and the so-called ***annual non-compliance risk markers***. A detailed methodology is proposed that combines these risk markers with the request of additional evidence from the farmer (geotagged pictures).
- After that, FEGA-Tragsatec proposes a procedure to deal with the **monitoring of abandonment**, which is based on the combination of ***risk markers*** and ***vegetation activity markers.***
- FEGA - Tragsatec also presents a **comprehensive proposal of methodology**, which has been developed to monitor agricultural activity in schemes like the BPS or the SFS.

1.2

Rationale and concept of non-compliance risk markers.

Rationale and concept of non-compliance risk markers

Scenarios developed on permanent crop and permanent grassland

- In scenarios developed on permanent crop and permanent grassland covers, **annual agricultural tasks and phenological events are not easily detected**. This difficulty lies in the fact that maintenance activities carried out during the agricultural campaign do not usually leave evidence on the land that could be detected by Sentinel data. For example, grazing on Mediterranean grassland or pruning permanent crops.
- Nonetheless, these activities' footprint can be manifested through **the preservation of the agricultural character** of the land cover in the following years.
- On the contrary, the absence or lack of those activities can bring about a **gradual abandonment of the agricultural land** that will also be evidenced over time.

Rationale and concept of non-compliance risk markers

Scenarios developed on permanent crop and permanent grassland

- The JRC has stated that the pre-condition to have a high-quality LPIS allows for **certain eligibility criteria to be checked during the LPIS update process**, adding that *"For example, many permanent grasslands or permanent crops do not offer striking evidence of the practices occurring therein, but the absence of maintenance could, over some years, trigger a land cover change that will be picked up by a non-Sentinel monitoring system (**such as LPIS update cycle)" .***

- The JRS has also explained that the pluriannual monitoring of permanent crops and permanent grassland is based on the **annual application of the benefit of doubt** to yellow light parcels, where **the absence of annual non-compliance markers has been proven**. As a result, these parcels become green and eligible in that specific campaign, although they have to start the following campaign with a yellow light again. **The recovery of undue payments** in parcels detected as ineligible **during the LPIS update completes this approach.**

Rationale and concept of non-compliance risk markers

Scenarios developed on permanent crop and permanent grassland

- In order to check the absence of annual non-compliance markers **two verifications** should be annually conducted:

1. that **an important change in the land cover has not occurred**. For example, situations such as the plowing of an environmental grassland or the effect of construction and building-up activities (phenomena that can be detected annually)
2. analyze the temporal profile of the parcel to confirm that **the parcel's land cover remains**.

Main shortcoming of pluriannual markers

- The application of the benefit of doubt to a large number of parcels with yellow light would entail an **increase in administrative burden**. The LPIS update and management of undue payments' recovery could become unmanageable for the Paying Agency, as the latter is a very painstaking task in itself.

Rationale and concept of non-compliance risk markers

Annual non-compliance risk markers. Complementary proposal for monitoring permanent crops and permanent pasture.

- Another type of complementary risk markers is suggested to find a solution to the explained constrain. These are called **non-compliance risk markers**.
- Non-compliance risk markers would belong to an intermediate category used to **identify parcels with a higher risk** of not having carried out an agricultural activity or maintenance activity on them.
- Once these parcels have been identified, the paying agency could demand **additional evidence of completion** (geotagged photos, mowing invoices, etc.) from the beneficiaries who declared them.
- The key element of the proposal lies in **being able to find a direct or indirect parameter** that relates the monitored characteristic (for instance, abandonment) with some historical Sentinel or LPIS data.

Rationale and concept of non-compliance risk markers

Annual non-compliance risk markers. Complementary proposal for monitoring permanent crops and permanent pasture.

- Parcels showing the **highest values of that parameter** would be considered **risky**, and the beneficiaries who declare them would have to supply **additional evidence.**
- An advantage of the proposed procedure is that the threshold of **the risk parameter that triggers the follow-up action (georeferenced photo) could be calibrated**. For instance, if the number of beneficiaries identified with risk parcels is excessive, the threshold could be set at higher values. As management and processing of geotagged photos improve, this threshold may be set at lower risk values.
- **In summary**, annual non-compliance risk markers are a **complement to the pluriannual markers** based on the LPIS update. Non-compliance risk markers are aimed at reducing the number of parcels with yellow light turned into green (yellow the following year) by giving farmers the benefit of doubt, avoiding some recovery of undue payments linked to the LPIS cycle update.

2

Pluriannual monitoring of permanent crops in Aragon.

Introduction

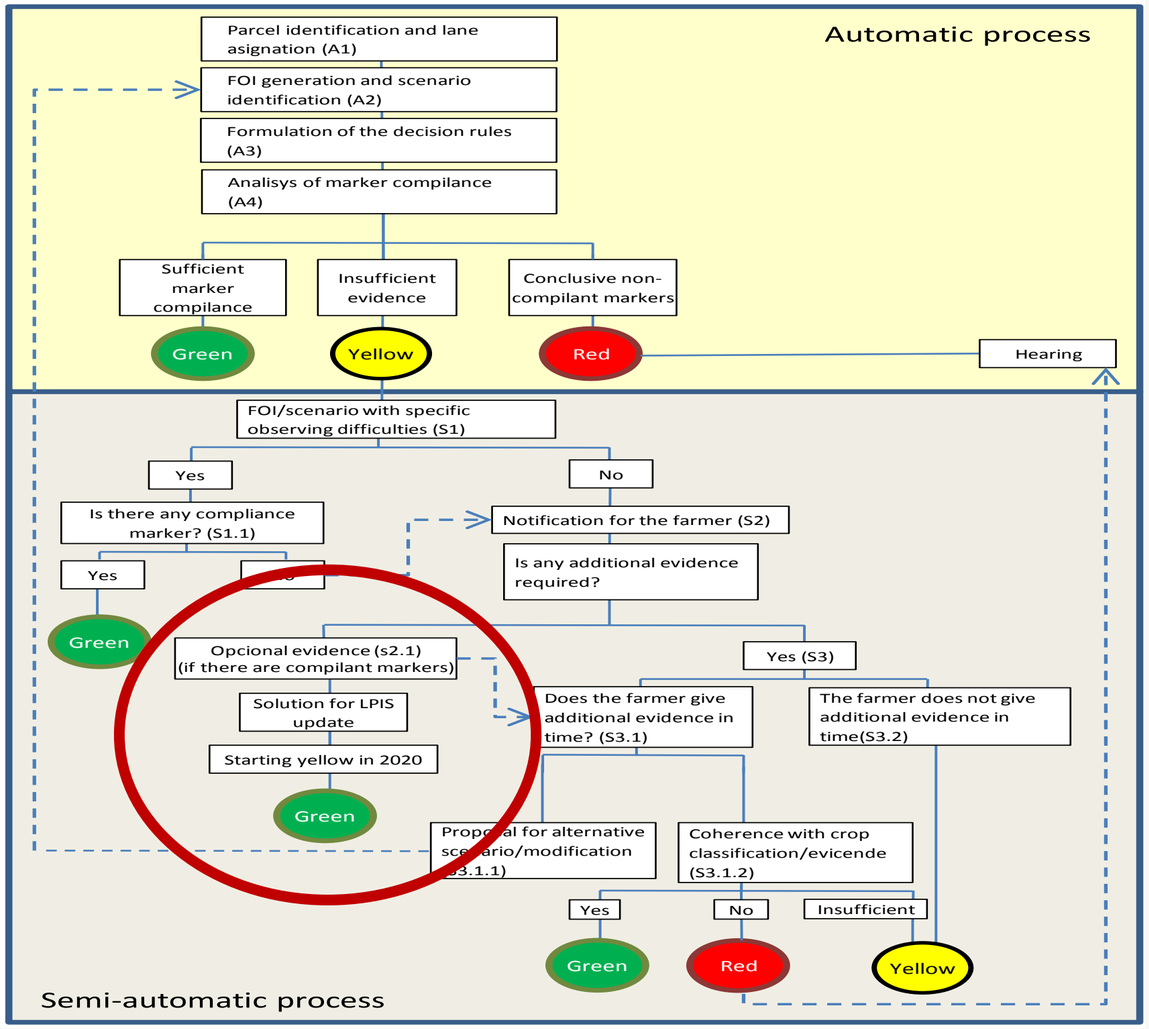
1. In the context of monitoring, the possibility to apply the benefit of doubt in permanent crops exists.

2. The benefit of doubt consists in reviewing those crops within the LPIS updating process. They become subject to eventual rectroactive payments.

3. This has been included in the regional monitoring diagram.

4. However, the aplication of retroactivity of payments could cause an additional work load for us in the future.

Regional monitoring diagram.



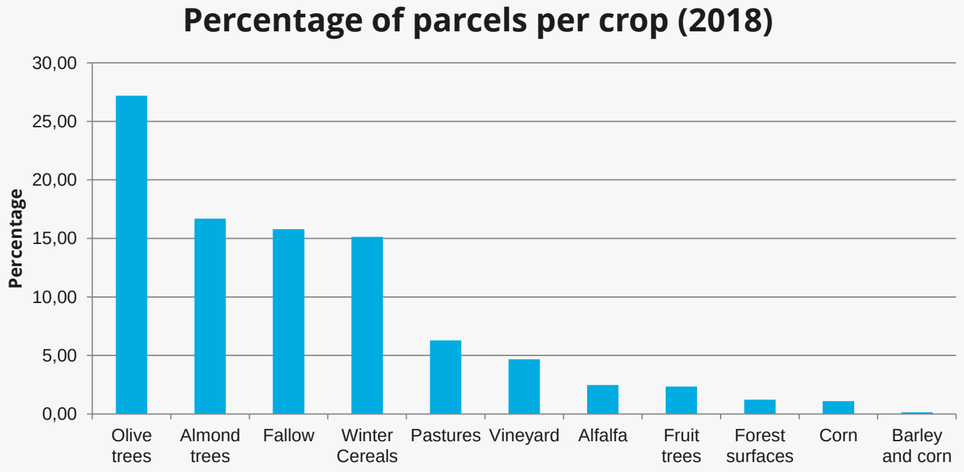
Small Farmers Scheme in Aragon

1. In Aragon (Spain) the small farmers scheme will be controled by monitoring.

2. In the scheme, olive and almond groves are almost 44% of the declared parcels.

3. Because of the permanent crops importance in the scheme which we will be monitoring, special attention is needed.

4. The purpose of this is to prevent undue payments and also retroactivity in future years.



2.1

Research project on abandoned almond groves

Background

1. The region conducted a research project to optimize the sample selection by means of risk criteria.

2. It was found that most abandoned almond groves had not been ploughed.

3. The absence of tillage is a symptomatic sign of agrarian inactivity in the parcel, not taking into consideration other abandonment signs such as the failure to prune.

Almond grove abandoned

In this photo, you can see an almond grove abandoned.
It shows the presence of vegetal cover with multiannual plants.

Background

1. The region conducted a research project to optimize the sample selection by means of risk criteria.

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3. The absence of tillage is a symptomatic sign of agrarian inactivity in the parcel, not taking into consideration other abandonment signs such as the failure to prune.

Almond grove with agrarian activity

In this other photo, you can see an almond grove with agrarian activity. It shows the field has been tilled.

Methodology

1. Once the relationship between abandonment and lack of ploughing was known, the NDVI evolution was analyzed in a sample of abandoned parcels and in other parcels with agrarian activity.

2. The work carried out is an analysis of field inspections in 2017 and 2018. It consisted in the comparison of NDVI and BSI signals, on one hand in almond groves with agrarian activity and, on the other, without activity.

3. Afterwards, a risk marker was done by means of a classification tree.

Data sources

Images:

1. Images of Sentinel 2 at level 2A from August 2016 to the present have been used. The NDVI and BSI has been calculated for each scene.
2. Later a cloud mask has been applied to remove pixels under clouds and their shadows.

Parcels:

1. A layer has been generated by dissolving adjacent almond tree parcels belonging to the same farmer. After we applied an inverse 10 m buffer to each geometry.

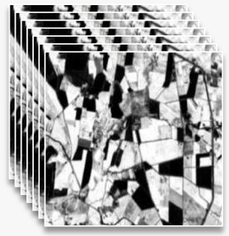
Inspections:

1. The parcels inspected have been divided in 2 categories:

   -Parcels with confirmed activity / Parcels with detected unactivity.

Signals:

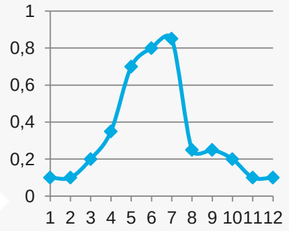
1. The index average of each parcel has been calculated for every scene. Once we did this, the maximum value was calculated biweekly. This information was transferred for inspection to know its signal.



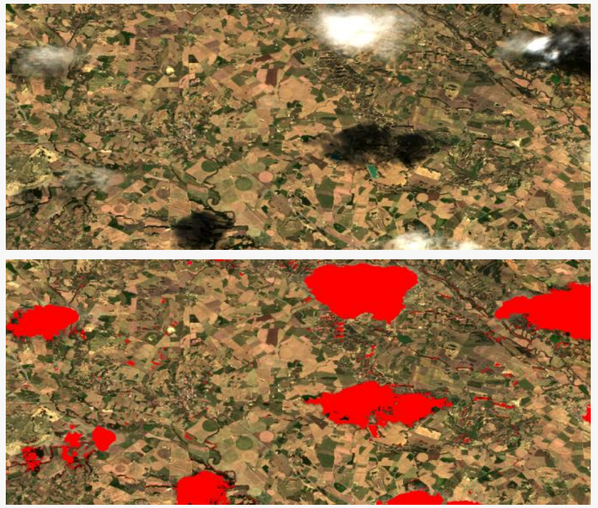
Parcel identification

Signal

rec_codigo bigint	c_rec character varying	prd_codigo bigint	nd04_1704 double precision	nd04_1705 double precision	nd04_1706 double precision	nd04_1707 double precision	nd04_1708 double precision
10	22.	4	130.1625	1712.21875	2206.18125	872.84375	227.6375
1	22.	4	.13432835821	.51575456053	592039800995	857379767828	903814262023
69	22.	101	.19727891156	.98979591837	.2789115646	5.7074829932	.62585034014
143	44.	20	.75084175084	5.2962962963	.49158249158	.92255892256	.41414141414
38	22.	24	8.1568627451	.27450980392	.27450980392	.50980392157	.50980392157
9898805	22.	105	038461538462	48717948717	.03846153846	051282051282	833333333333
48	22.	67	.71532846715	.35766423358	.37226277372	.07299270073	0.6496350365
6	44.	33	67741935484	61290322581	77419354839	54838709677	90322580645



Cloud mask:



Inverse buffer:

Results

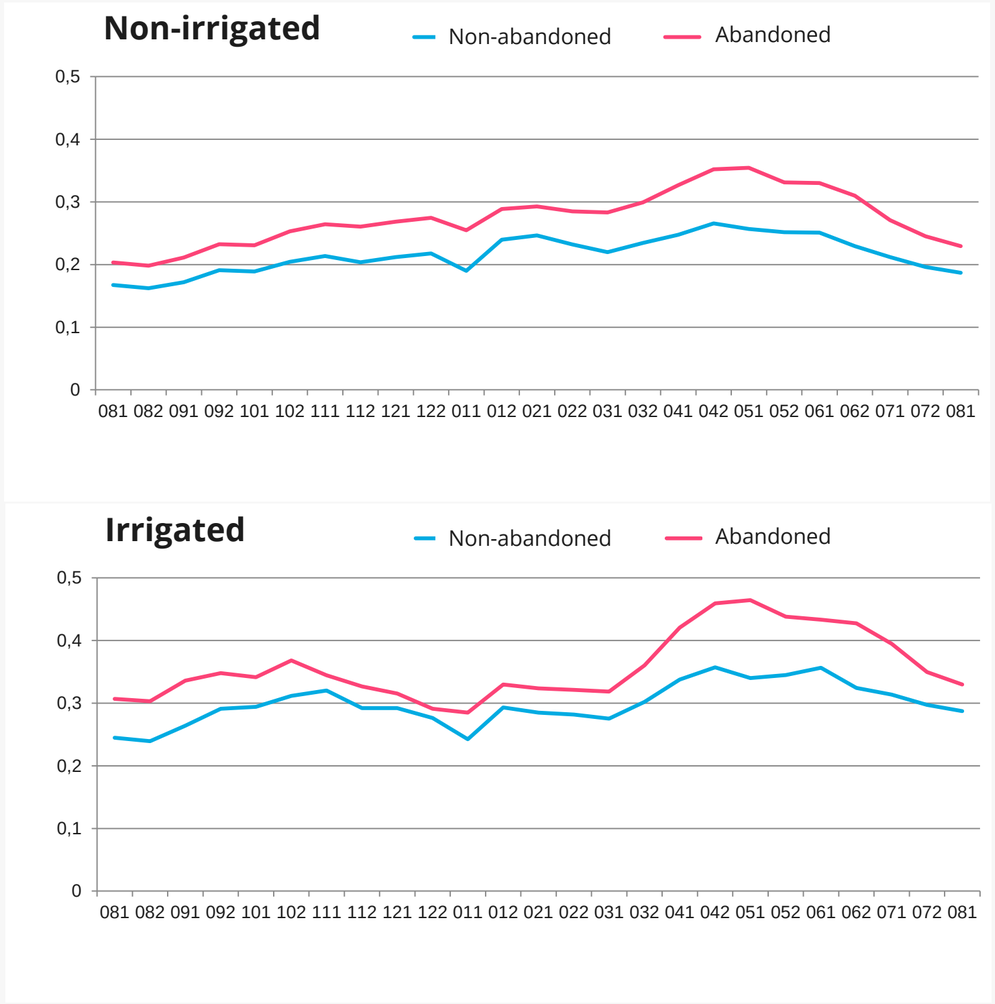
1. We have analyzed almost 21,000 almond grove inspections of which 700 were abandoned.

2. The sample has 3.39% of abandoned fields.

3. The NDVI average value in abandoned fields is higher than in those where the inspector confirmed agrarian activity.

4. The differences are significant in both irrigated and non-irrigated areas.

NDVI evolution



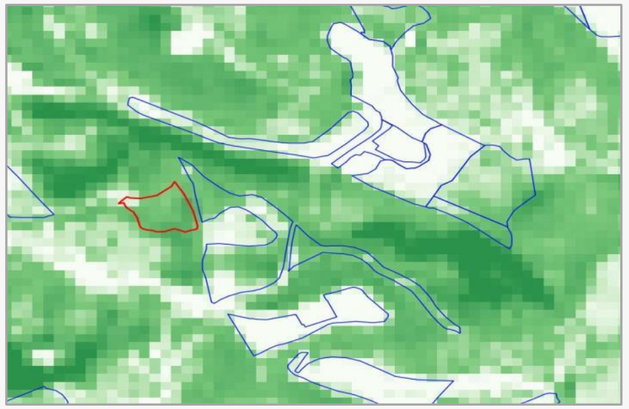
Aerial photo 2015

Image sequence

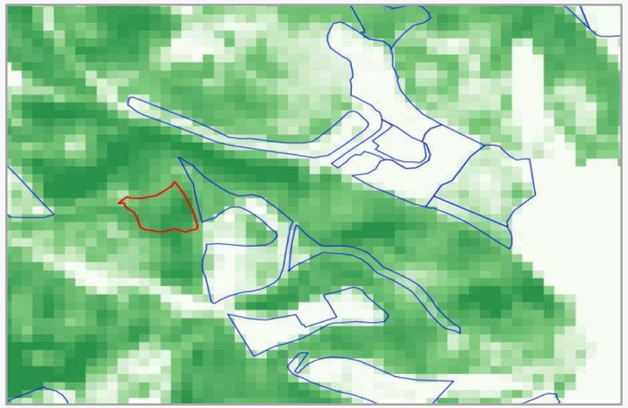
Blue colour: non-abandoned almond groves
Red colour: abandoned almond groves

Background:
Dark tone: high NDVI values
Light tone: low NDVI values

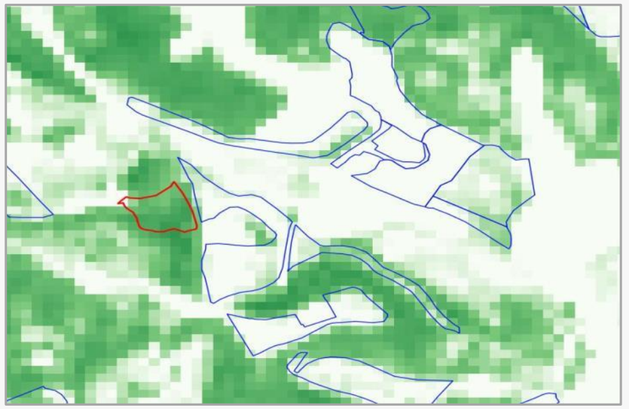
This sequence shows the NDVI evolution in an abandoned almond grove and in other almond groves with confirmed activity.



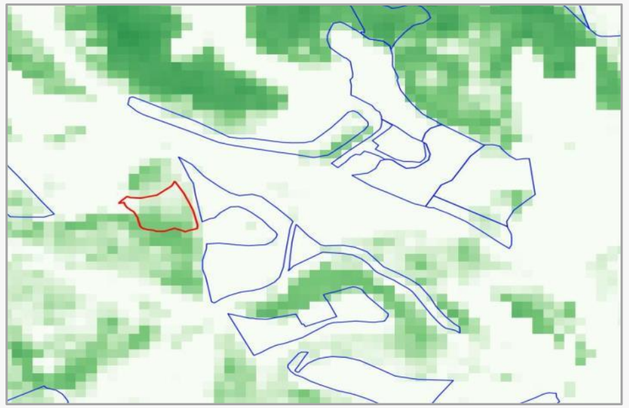
NDVI 2018-04-14



NDVI 2018-05-19



NDVI 2018-06-28



NDVI 2018-08-17

1. We can see that the abandoned field has a higher value every spring because it has not been tilled.

2. The same thing has occurred over the years as the aerial photo shows.

Aerial photo 2018

Comparison

1. The previous sequence can be summarized in both following pictures:

2. The first clearly shows agricultural activity, in it the vegetal cover has been removed.

3. This has not happend in the second which is an abandoned field.

Almond grove with agrarian activity

Almond grove without agrarian activity

2.2

Annual non-compliance risk markers in permanent crops

Risk markers proposal

1.Abandonment probability has been estimated using a decision tree and using the yearly data.

2.The first column in the table below shows a set of abandonment probability thresholds.

3. E.g. The 0.7 threshold has 10% of inspected parcels and half of the abandonment cases detected.

4.However, currently we are working to improve the marker accuracy for an eventual utilization.

Table. Thresholds

Threshold	Number of abandoned parcels	Number of parcels in the threshold (yellow)	Percentage of parcels in the threshold (% yellow over total)	Percentage of abandoned parcels in the threshold (% red in yellow)
0,1	710	20.927	100,00	3,39
0,2	710	20.927	100,00	3,39
0,3	637	14,456	69,08	4,41
0,4	533	8,408	40,18	6,34
0,5	421	4.426	21,15	9,51
0,6	386	3.639	17,39	10,61
0,7	**295**	**2,076**	**9,92**	**14,21**
0,8	194	1041	4,97	18,64
0,9	51	151	0,72	33,77

Tree QUEST

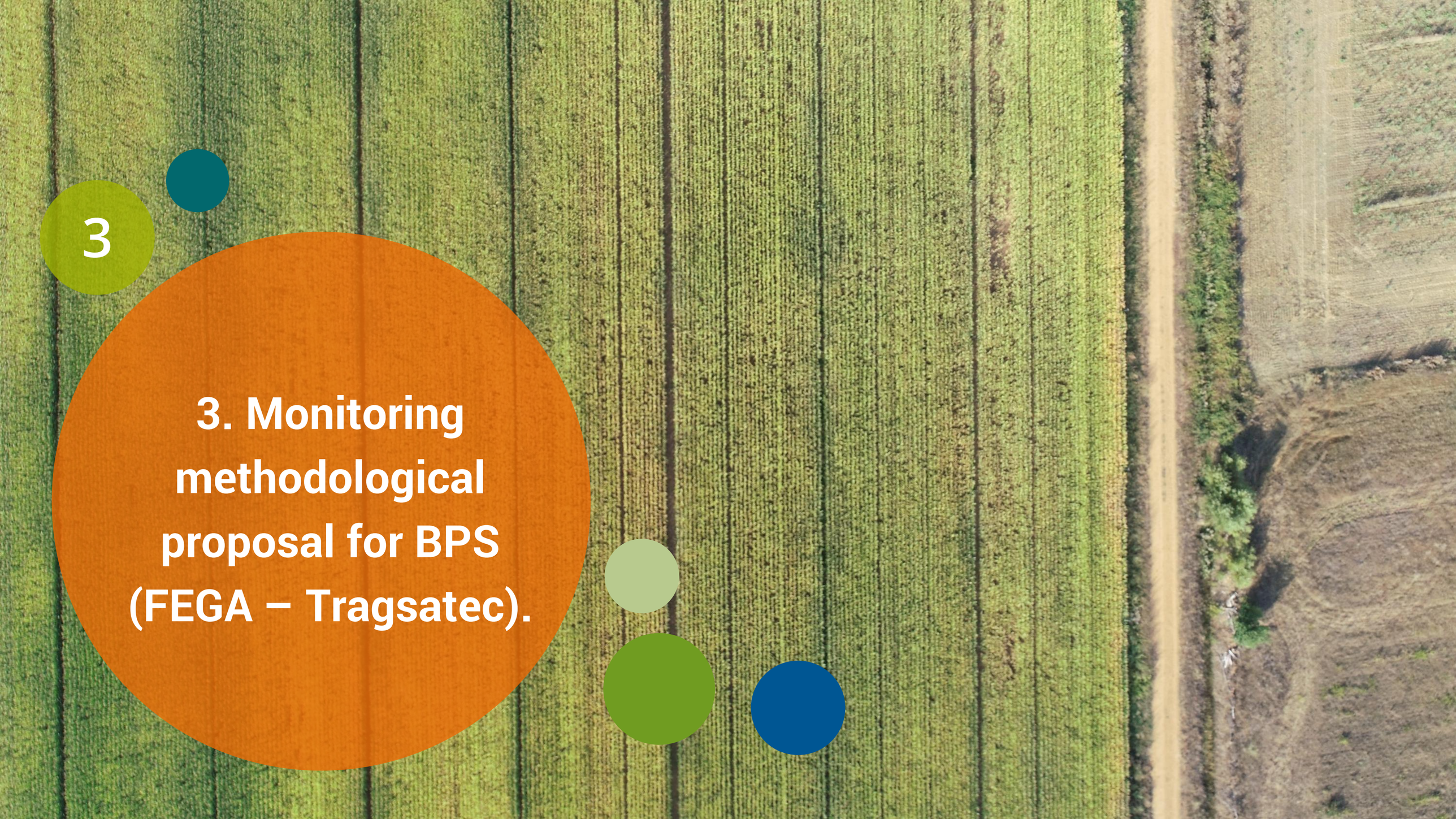
Final considerations

1. The proposed risk markers are only indicative, they are not non-compliance markers.

2. They can be used with other elements, for example the financial risk associated with each parcel.

3. Their objective is to select a set of parcels with high risk of being abandoned. In these cases we can ask for additional evidence from the farmer.

4. The potential use is to prevent undue payments. Therefore, we can limit the parcels for review within the LPIS updating process. Applying it only to those with less non-compliance risk.



3

3. Monitoring methodological proposal for BPS (FEGA – Tragsatec).

The verification of agricultural activity - The monitoring of abandonment

- In the different *proofs of concept* carried out in a pilot project using different indexes, it was demonstrated the difficulty to identify abandonment parcels solely from Sentinel data. It was also concluded the importance to have additional information indicating the risk of abandonment, both in arable land and permanent crops.

- As a possible solution to the difficulties found to monitor abandon parcels, an attribute of "risk of abandonment" has been designed by photointerpretation of the two most recent LPIS orthophotos (last six years).

Identification of non-eligible features

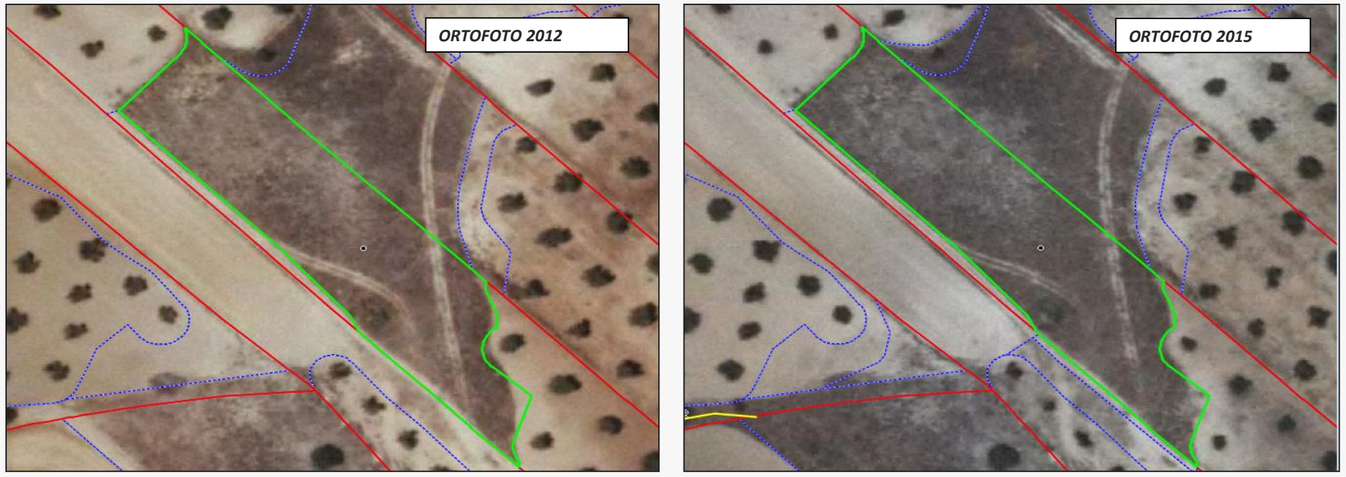
Indicative risk marker of abandonment

Non-eligible features will be identified by means of LPIS classes (unproductive and forestry) except in the case of abandonment. However, every 3 years, within the LPIS update cycle, a review of the LPIS orthophoto will be performed and if necessary the recovery of undue payments will take place.

For abandonment, in arable land and permanent crops, a photo-interpretation of the two most recent LPIS ortho-photos. For permanent grasslands, it is not available. The categorization of the parcels is the following:

- **High risk**: The parcel seems to be abandoned in both ortho-photos.
- **Medium risk**: The parcel seems to be abandoned in the most recent ortho-photo.
- **No risk**: The parcel does not show a trace of abandonment.

This indicator marker of abandonment will be available at the beginning of the monitoring process



Parcel flagged as abandoned


3.1
Monitoring of the agricultural activity carried out in arable land and permanent crop parcels

Main challenges for the verification of agricultural activity

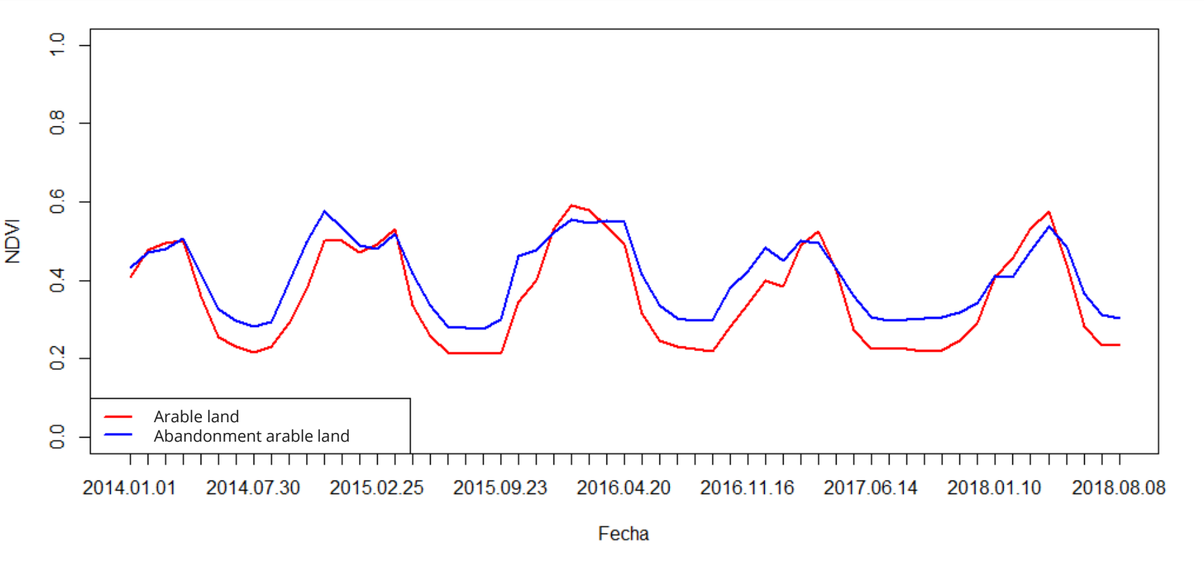
The main challenge is to find a procedure to determine agricultural activity & abandonment.

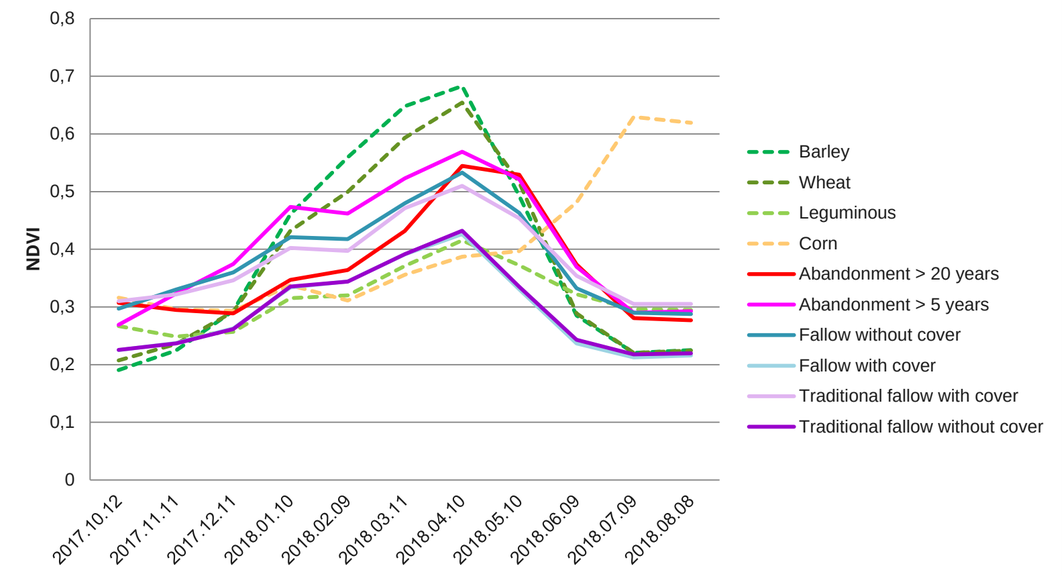
- ✓ The RS signals/markers observe vegetation activity (land cover), not land use (agricultural activity)
- ✓ The agro-climatic diversity and the enormous quantity and variety of products declared and crop management in Spain make the development of “specific markers” a complex and arduous task.
- ✓ The spatial resolution of Sentinel2 (10 meters) is a constriction for the monitoring of permanent crops.
- ✓ The specific case of permanent grasslands, where the challenge is to find signs/markers that show a substantial change in the land cover of the parcel that over time could lead to a gradual change of the land use and, eventually, to a non-compliance for abandonment (ineligible feature).

Monitoring of the agricultural activity in arable land parcels

Lack of maintenance / Abandonment

- Se1&2 are great instruments for the monitoring of seasonal crop cycle and ploughing of annual crops. Nevertheless, the problem is that the vegetative cycle observed in winter crops (rainfed), fallow land and abandoned parcels are very similar, even though they correspond to different agricultural activities.
- Even after gathering data from the last 5 years, it was not possible to find spectral patterns to identify abandonment in arable land due to the great variability in land covers and agricultural managements.
- At the moment, the classification is a key element to analyze the whole population in order to detect the subtle patterns that result in confusions.
- ML classification is also useful for greening payment.





Lack of maintenance/Abandonment

Lack of maintenance / Abandonment

Seasonal crop cycle and ploughing are the observed activity in arable land using Sentinel.

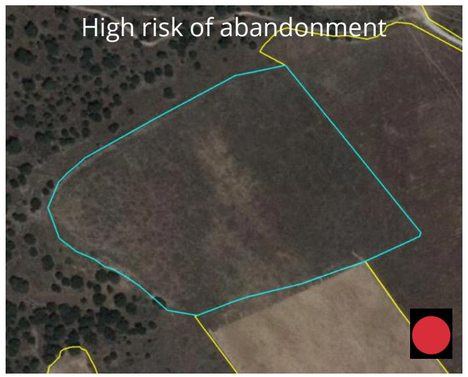
Risk of abandonment (orthophoto 2015)

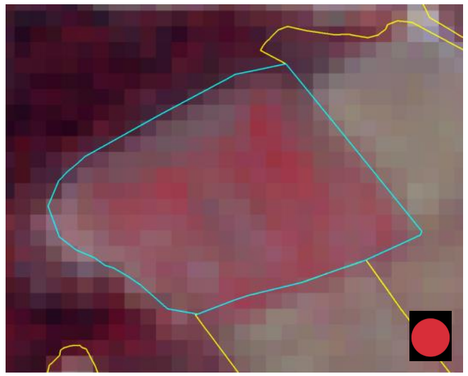
Vegetation activity

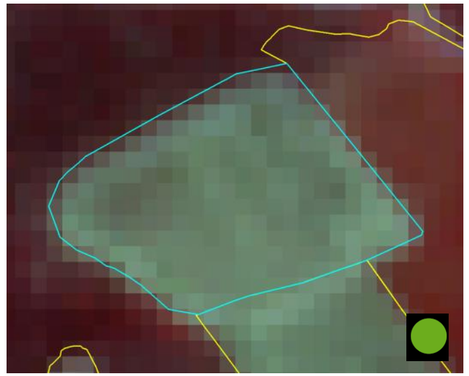
S2 of 18/12/2017 | S2 of 28/03/2018 | S2 of 16/06/2018

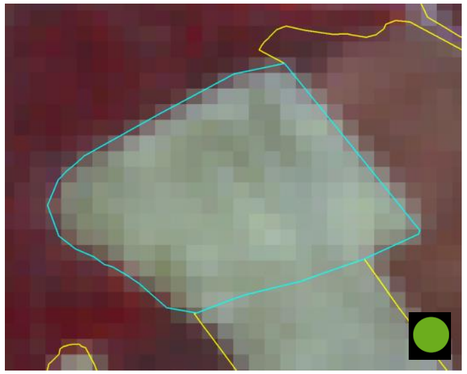
Confirmed non-abandonment by using the VHR CwRS image (WV of 27/04/2018)

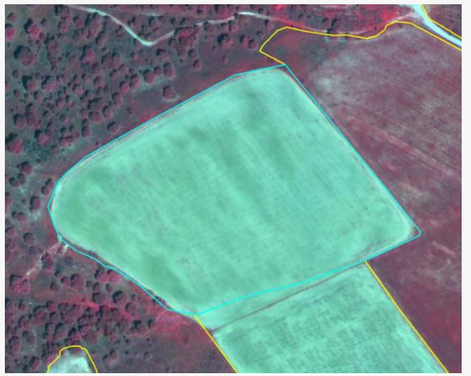
Example of monitoring procedure for a fallow declaration (CwRS site- ESCN 2018)



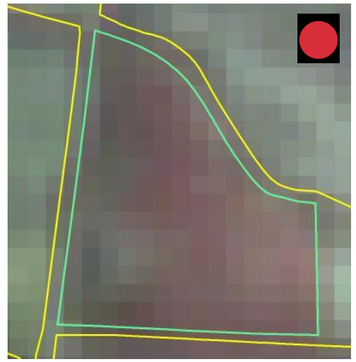


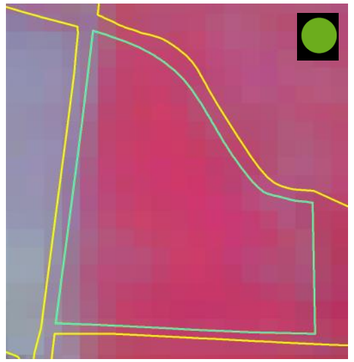


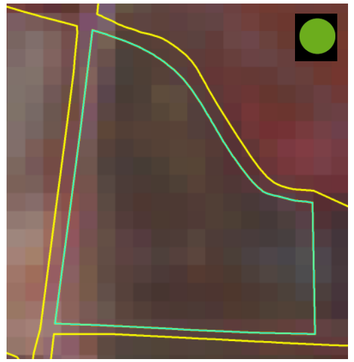


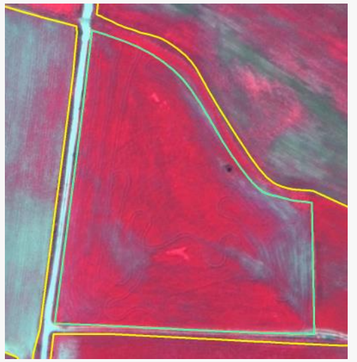


Example of monitoring procedure for a barley declaration (ESCN 2018)







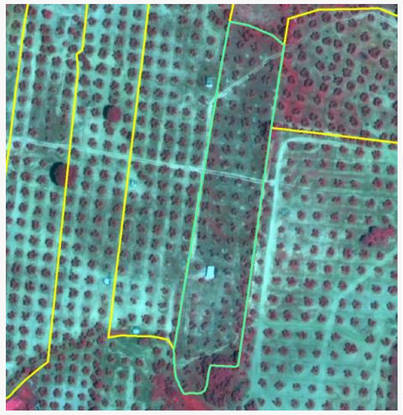


Monitoring of the agricultural activity carried out in permanent crops parcels

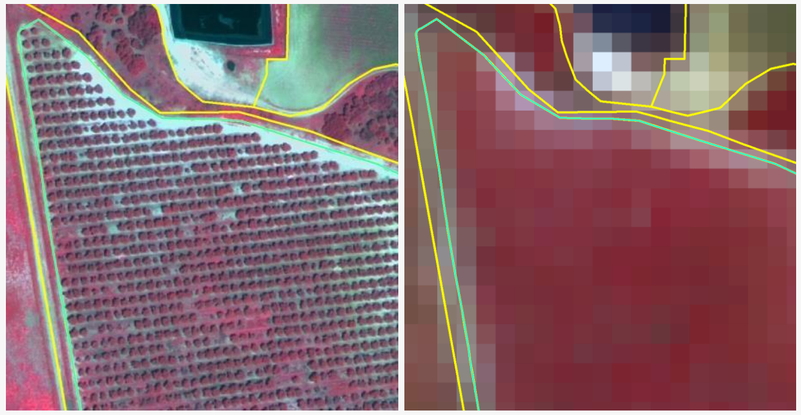
Monitoring of the agricultural activity carried out in permanent crops parcels. Pluriannual markers based on the LPIS update

- A permanent crop is abandoned when the necessary maintenance activities (e.g. pruning, dead branches removal,…) are not carried out for years.
- The spectral response observed over permanents crops is conditioned by multiple factors: the relationship between the canopy and the soil, the plantation pattern, the cover management between rows, among others.
- The new indicator of non-compliance risk marker will be updated annually by monitoring:
  - ✓ In a first step, the indicator risk will be modulated by a marker of compliance of agricultural activity for ploughed parcels, based in NDVI seasonal values.
  - ✓ In a second step, a classification is performed to confirm the use compared to the rest of the declared parcels

Some different olive groves, in production and abandoned, observed on WV vs Se2 date 27/04/2018. (ESCN 2018):



Not ploughed olive grove



Irrigated olive grove

Abandonment olive grove

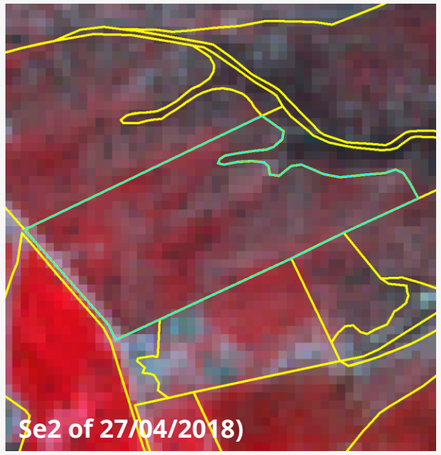
3.2

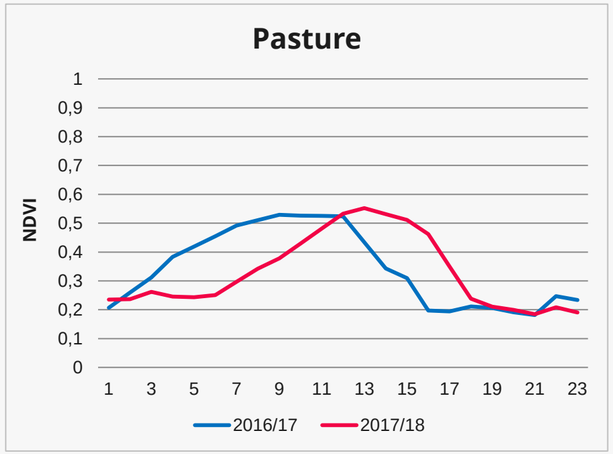
Monitoring of the agricultural activity in grassland parcels.

Monitoring of the agricultural activity carried out in permanent grassland parcels

Pluriannual markers based on the LPIS update

- In the case of pastures, shrub and woody pastures the indicator risk of abandonment, ortho LPIS based, is not available.
- The challenge is the potential identification, through signs/markers of Sentinel, the gradual change in the land cover of parcels and, eventually, to a non-compliance for abandonment (ineligible feature). For instance, the developing of encroachment that may make the permanent grassland parcel ineligible.
- A pluriannual Sentinel marker will have to be developed in order to divide the population in two categories:
  - ✓ with risk →substantial change in the GSAA vegetation activity compared to previous years.
  - ✓ without risk → similar vegetation activity in the GSAA than in previous years. In this case, neither the admissibility nor the LPIS use is questioned. The assigned LPIS use is maintained.
- A classification will be made to verify that grassland is not changed to a ineligible use, like forestry…





Inaccessible grassland

3.3

Monitoring methodological proposal for BPS scheme

Basic payment scheme

Summary of methodology proposed

1. Determine and updating the level of risk in the parcel/FOI:

- For arable lands and permanent crops: Combination of an indicative risk marker of abandonment (non-compliance), orthophoto based, available at the beginning of the campaign, with the analysis of Se2 data to update the risk
- For permanent grasslands: Parcel/FOI phenological curve of the current year will be compared with the previous year in order to check maintenance.

2. Analyze the state and behavior of the vegetation in each parcel/FOI:

The moment of occurrence of agricultural events varies depending on the crop, the management and the local conditions. It has been decided to use a ML classification because it is easily adapted to different agroclimatic conditions and scenarios without human manual settings.

Additionally, Tukey IQR method will be used for determining outliers in the signals for each date and product. A high number of outliers in a parcel/FOI implies that the crop is not developing in the right way.

Basic payment scheme

Summary of methodology proposed

The generation of traffic lights combines all the elements considered (GSAA, Risk of abandonment, ML results and Tukey IQR) in logical rules. When the behavior is very similar to the expected performance in a well-developed crop, the traffic light will be green. When the behavior suggests that there is non-agricultural vegetation (shrubs or trees) the traffic light will be red. Otherwise traffic light will be yellow.

The complete analysis runs periodically on a platform.

This methodology approach is yearly based, but also, every 3 years, within the LPIS update cycle, a review of the LPIS orthophoto will take place in order to detect and recover undue payments.

Monitoring methodological proposal

AGRICULTURAL ACTIVITY MARKER FOR BPS

LPIS Land use

Arable lands

Permanent crops

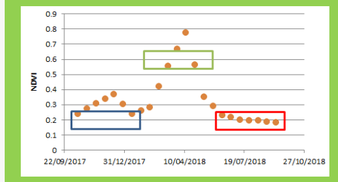
Permanent Grasslands:
- pastures
- shrub pasture
- woody pastures

Indicative risk of abandonment marker (Orthophoto based)

- ✓ High risk (HR)
- ✓ Medium risk (MR)
- ✓ No risk (NR)

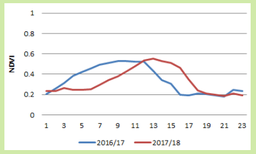
Generic vegetation activity marker (NDVI based)

Update abandonment risk



- ✓ HR
- ✓ MR
- ✓ NR

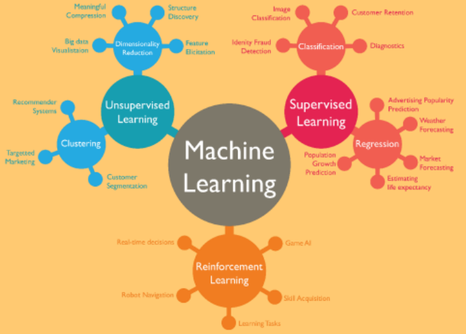
Pluriannual comparison of phenological curves (on going)



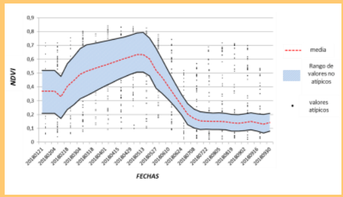
- ✓ Risk
- ✓ No risk

Specific vegetation activity marker (GSAA, LPIS, Sentinel 1&2)

- ✓ Classification



- ✓ Outliers by product (Tukey IQR)



Traffic light rules f (GSAA, abandonment risk, Classification, Probability and Tukey)

Annual monitoring for arable lands

Pluriannual monitoring for permanent crops and grasslands

(LPIS upadate cycle)

Thank you!

Charo Escudero reb@tragsa.es
Samuel Esteban sesteban@aragon.es
Fernando Feliu ffeliube@fega.es