

## Use Case implementation - Ecological Focus Area (EFA)

### Quick user guide

#### Introduction

Farmers with arable areas exceeding 15 ha must ensure that at least 5% of such areas are 'Ecological Focus Areas' (EFA) dedicated to ecologically beneficial elements. Three specific practices have been proposed as separate use cases within the Sen4CAP project:

1. Land lying fallow,
2. Catch crops,
3. Nitrogen fixing crops.

#### Sen4CAP Earth Observation product supporting the EFA use case

The specific product that has been developed to support the analysis of farmers' declaration compliancy is the **"L4C - Agricultural practices monitoring product"**.

The aim of the product is to provide the information about crop harvesting (or clearance) events and about the presence of catch-crops, nitrogen fixing crops and fallow practices.

The main challenge in developing a methodology in this domain is dealing with diverse EFA national implementations, which vary significantly amongst countries. The variations concern the definition of crops (crop groups) and activities (e.g. harvesting, mulching, sowing etc.) that are eligible for each practice, and the definition of the seasonal duration rules for the application of each practice.

In an ideal case, the products answer the question whether the declared practice has been correctly applied on a particular agricultural parcel within the required time period.

#### Agriculture Practice Definition

During the initial phase of the project, the Paying Agencies of all pilot countries have been asked to provide the most detailed information about national rules related to the selected practices. A dedicated form has been prepared that consists of several sections covering different aspects of each practice (basic characteristics, how they are declared, how they are referenced to the agricultural parcel, what temporal rules are applied, and which are the eligible crops).

The detailed description and explanation of temporal rules for each particular practice can be found in Annex A.

The example of such a form is presented below (Catch crops, Netherlands):

**Title/abbreviation** Catchcrops

**Basic characteristics**

The crops are only eligible in case they are used as green manure or as a soil coverage

**Declaration**

- IND\_EA, EFA declared on the parcel, J of N
- EAOPPERVLAKTE, area of the EFA main crop, weighing factor included
- GRONDBEDEKTING2EAOPP, area of the EFA catch crop, weighing factor included
- GRONDBEDEKTING2 (txt, 10), crop code of the catch crop in case of EFA
- Omschr\_gewas\_2 (txt, 256), description of the catch crop in case of EFA
- GRNDBDK2\_CAT, (txt, 3), category in case of a catch crop EFA

**some more explanation**

This means that if 'EAoppervlakte' >0, on this parcel a summer catch crop (= main crop) might be declared. Only possible in case the crop is displayed in the column 'catch crop main crop, nematode catch crop' in the table: 'list of EFA crops and elements'

**EFA coverage per parcel** full

Temporal rules	Category	requirement how long in the field	ultimate date of sowing catch crop or harvest main crop (cat 3)
catch crop as a main crop (summer crop)	categorie 1, general	must be in the field between 15 may and 15 july and for at least 10 weeks	
	categorie 2 (nematode catch crop)	must be in the field between 15 may and 15 july and for at least 10 weeks	
catch crop after main crop	categorie 1, general	10 weeks after the harvest of the main crop	30.IX
	categorie 1 after flax (2736 and 666) or hemp (944)	no requirement	30.IX
	categorie 2 (nematode catch crop)	no requirement	30.IX
	categorie 3 (sowing of grass in (under) the main crop)	10 weeks after the harvest of the main crop	30.IX

**Eligible crops**

cat 1	crop	crop code	single crop for crop diversification
	Kapudjners (en grauwe erwten)	241	Pisum (Erwt)
	Erwten, groene/gele, groen	244	Pisum (Erwt)
	Lupinen, niet bittere-	663	Lupinus
	Lijnzaad niet van vezelvl	666	Linum (Vlas)

### Satellite data signals

The developed methodology relies on the analysis of dense temporal profiles over the parcels for which agricultural practices have been declared.

The generation of temporal profiles is based on optical (Sentinel 2A, Landsat 8) and SAR (Sentinel 1A/1B) imagery. NDVI is used as the optical-based signal, at a spatial resolution of 10 m. The SAR-based signals include backscatter temporal profiles (ascending and descending orbits for dual VV and VH polarization) and coherence temporal profiles (for VV polarization) at 20 m spatial resolution.

### Control approach

Analyses were carried out to identify which markers related to particular practices could be derived from the above described satellite data signals. It was confirmed that the markers provide an initial assessment of the degree of compliancy of an agricultural parcel with a particular agricultural practice, rather than a final answer on its compliancy or non-compliancy. The outcomes of these thorough considerations are summarised below.

The selected markers can inform about the following conditions:

- the presence of low / high vegetation / bare soil;
- the growth of vegetation;
- the loss of vegetation (in the form of harvest, clearance);
- the changing or stable status of the parcel conditions within 6-day periods.

The selected markers may not provide information (or only in limited extent) about:

- the particular crop type/species grown on the parcel within the declared practice;
- the crop sowing date (only indirectly based on further vegetation development);
- the difference between the crop harvest and clearance of crop vegetation;
- the particular harvest date (only the week of the harvest can be identified);
- the use of the crop after the harvest or clearance (e.g. crop production or use as green manure);
- the sub-parcel management or mixed management.

The detailed definition and description of all markers can be found in Annex B.

Based on the above conclusions, it is proposed to use the product as an indicator of the degree of compliancy/non-compliancy (based on the check of selected parameters of each practice). Due to the complex definitions of individual practices that often go behind the assessment of the status and development of crop vegetation on the parcel, it has to be discussed with the Paying Agencies to which extent the full compliancy decision could - or could not - be derived solely from the satellite data analysis.

To reach a decision on the degree of compliancy of a parcel to a particular agricultural practice, all markers are compared with a pre-defined set of conditions related to the declared agricultural practices. The results of this analysis are integrated into single indicator - the compliancy index (C\_INDEX). The compliancy index is based on:

- results of the time-series analysis for the harvest (e.g. harvest week, presence of main-crop vegetation)
- tailored analysis of EFA markers values

The compliancy index may have the following values:

"NA" = Parcel declaration available, but no assessment conducted

"STRONG" = Parcel assessed, shows strong indication of compliancy

"MODERATE" = Parcel assessed, shows moderate indication of compliancy

"WEAK" = Parcel assessed, shows weak indication of compliancy

"POOR" = Parcel assessed, shows poor indication of compliancy

The detailed description and explanation of the control approach for each particular practice can be found in Annex A.

## Results

The resulting L4C Agricultural practices monitoring product consists of:

- An ESRI shapefile and a CSV file containing the parcels that were monitored and describing the assessed markers, week of harvest, and degree of compliancy to regulations. The files are delivered with a README document to describe the content of each data column.
- For each declared parcel, a graphics file which contains a *xy*-plot of the satellite data indicator values vs. the image acquisition date, the week of detected harvest or clearance (if detected), and if relevant, the start and end dates during which compliancy of the parcel with their declared agriculture practice is checked.

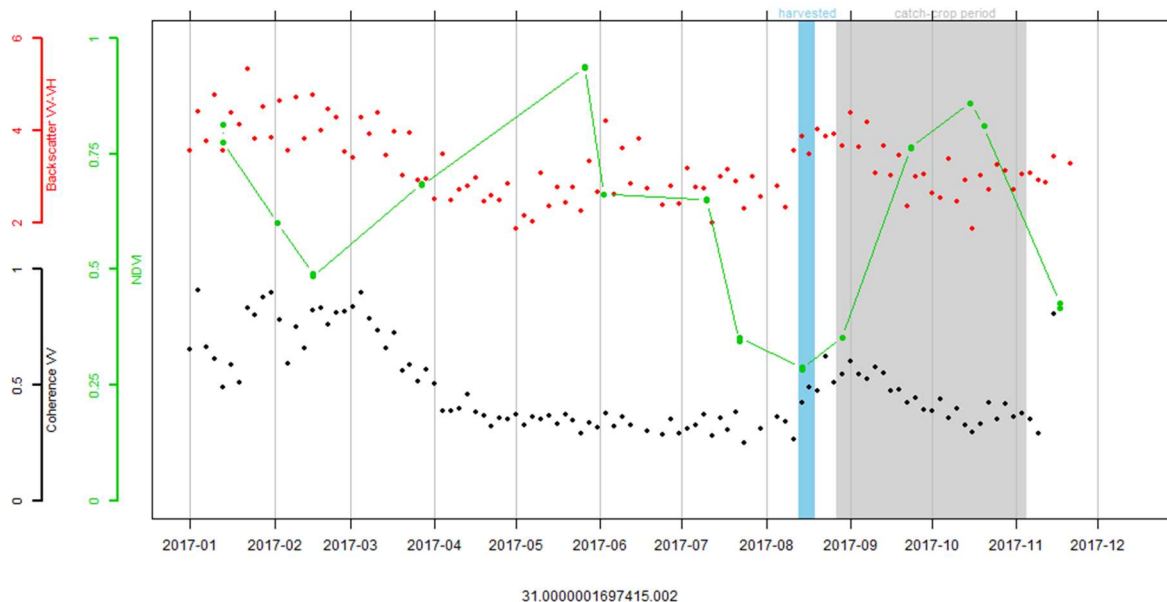
## CSV or Shapefile attribute table

The columns of the file include:

- Data representing the input for the analysis - parcel ID, declared agriculture practice and its type, expected start of harvest period (H-start) and expected end (H-end), expected start of the compliancy period for the practice (P-start) (it may be derived from relative definition) and expected end of the period (P-end);
- Results of the analysis - a number of markers indicating harvest (M1 – M5), the week of the year when harvested or cleared conditions are observed, number of markers indicating compliancy of the parcel with the practice (M6 – M10), the compliancy index (C\_INDEX).

## Graphics File

The example of such a graphic is presented below (parcel with declared catch crop, Netherlands)



## **Annex A: Description of temporal EFA rules and control approach for pilot countries for 2018**

### **CZECHIA**

#### **CATCH CROPS**

##### **Temporal rules:**

Summer Catch Crops (SCC) must be sown before 31 July and must not be harvested before 24 September. During this period, crop coverage must not be mechanically or chemically removed or limited in growth.

Winter Catch Crops (WCC) must be sown before 6 September and must not be harvested before 31 October. During this period, crop coverage must not be mechanically or chemically removed or limited in growth.

Sowing of legume/grass crop in/under the main crop. This type of catch-crop (green cover) must be on the field between 1 August and 24 September.

##### **Control approach:**

If vegetation is present after the harvest of the main crop for the required period and no harvest/clearance is detected, it shows a strong indication of compliancy.

#### **NITROGEN FIXING CROPS**

##### **Temporal rules:**

The parcel shall be covered by the crops or by herbal residuals at least between 1 June and 15 July of the given calendar year.

##### **Control approach:**

If vegetation is present and harvest/clearance is not detected on the parcel during the required period, it shows a strong indication of compliancy.

#### **FALLOW LAND**

##### **Temporal rules:**

Green fallow shall be present from 1 June of the first year of declaration to 15 July of the final year of declaration. During the declared period, any kind of agricultural production is forbidden on the parcel (the crops must not be harvested & removed or grazed). The farmer is obliged to cut or mulch the crop between 1 June and 31 August.

##### **Control approach:**

If vegetation is present and harvest/clearance is detected on the parcel before 15 July, it shows weak indication of compliancy.

## ITALY

### **NITROGEN FIXING CROPS**

#### **Temporal rules:**

Adequate to the respective phenology, along the year.

#### **Control approach:**

If vegetation is present and harvest/clearance is detected on the parcel, it shows a strong indication of compliancy.

### **FALLOW LAND**

#### **Temporal rules:**

Fallow land must be for 6 months from 1 January to 30 June. After 31 March cutting/mulching is expected to prevent fire.

#### **Control approach:**

If vegetation is present and harvest/clearance is detected on the parcel before 30 June, it shows weak indication of compliancy.

## LITHUANIA

### CATCH CROPS

#### Temporal rules:

Fast-growing crop (IS) must be sown during period from 1 April to 30 June and cannot be mowed or grazed till 15 October. Fast-growing are usually sown in/under the main crop. After harvesting of main-crop, the IS plants must be sprouted and visible from 1 September until 15 October (or until winter plants are sown).

Catchcrop (PO) must be sown between 30 June and 15 August, it cannot be mowed or grazed, and it must be sprouted and visible from 1 September to 15 October. PO can be kept shorter than indicated if it is continuously maintained for at least 8 weeks. The farmer informs the Agency about the exact date of sowing.

#### Control approach:

If vegetation is present for the period after the expected harvest of the main crop until 15 October, and no harvest/clearance is detected during this time, it shows a strong indication of compliancy (TYPE = IS).

If vegetation is present for the period 1 September to 15 October and no harvest/clearance is detected during this time, it shows a strong indication of compliancy to obligations (TYPE = PO).

### FALLOW LAND

#### Temporal rules:

Black Fallow (PDJ) needs to be cultivated at least 9 months (January-September), it is periodically ploughed, at least once every 2 months (no weeds or other plants). After that, until 1 November the parcel shall be sown.

Green Fallow (PDŽ) shall not be grazed or mowed (no agricultural activity at all). The green fallow shall be inserted into the soil until 15th of September.

#### Control approach:

### NITROGEN FIXING CROPS

#### Temporal rules:

Nitrogen-fixing crops are grown in the main vegetation season.

After harvesting of the nitrogen-fixing crops, there are 2 options:

- leaving the field covered with nitrogen-fixing crop residues until 15th December (no ploughing is done till 15th December) OR
- after the harvest, a new winter crop needs to be sown, no later than on the 1st of November

#### Control approach:

## NETHERLANDS

### CATCH CROPS

#### Temporal rules:

Catch Crop as Main Crop - Must be growing in the field between 15 May and 15 July.

Catch Crop after Main Crop Category 1 - Shall be growing in the field for 8 weeks. Ultimate date of sowing catch crop is 15th of October.

Catch Crop after Main Crop Category 2 - Shall be growing in the field for 8 weeks. Ultimate date of sowing catch crop is 15th of October.

Catch Crop after Main Crop Category 3 - Sowing of grass in (under) the main crop. Shall be growing in the field for 8 weeks. Ultimate date of harvest of main crop is 15th of October.

#### Control approach:

Catch Crop as Main Crop Category 1 or Category 2 - If vegetation is present within the compliancy dates and harvest/clearance is detected on the parcel, it shows strong indication of compliancy (TYPE = MainCrop\_1 or MainCrop\_2).

Catch Crop as after Main Crop Category 1 - If vegetation is present after the harvest of the main crop for at least a 10 week period, it shows strong indication of compliancy (TYPE = CatchCrop\_1).

Catch Crop as after Main Crop Category 2 - If vegetation is present after the harvest of the main crop, it shows strong indication of compliancy (TYPE = CatchCrop\_2).

Catch Crop as after Main Crop Category 3 - If vegetation is present after the harvest of the main crop for at least a 10 week period, it shows strong indication of compliancy to obli(TYPE = CatchCrop\_3).



## **ROMANIA**

### **CATCH CROPS**

#### **Temporal rules:**

After the harvest of the main-crop, catch crop must be sown between 1 August-1 October and stay at least 8 weeks in the field before incorporating it in the soil.

#### **Control approach:**

If vegetation is present after the harvest of the main crop for at least a 8 week period, it shows strong indication of compliancy.

### **NITROGEN FIXING CROPS**

#### **Temporal rules:**

The nitrogen fixing crop is needed to be in the field at least in the growing period of vegetation.

#### **Control approach:**

If vegetation is present and harvest/clearance is not detected on the parcel in the months preceding expected harvest of the nitrogen fixing crop type, it shows a strong indication of compliancy.

## **SPAIN**

### **FALLOW LAND**

#### **Temporal rules:**

Fallow land must stay without grazing or harvesting during 6 months, till the end June. In this period, any kind of agricultural production is forbidden on the parcel, crops must not be harvested, grazed or removed, tilling tasks are allowed (mandatory once a year), applying cattle manure or mulch is allowed, crops to be buried as green manure are also allowed.

#### **Control approach:**

If vegetation is present and harvest/clearance is detected on the parcel, it shows poor indication of compliancy.

### **NITROGEN FIXING CROPS**

#### **Temporal rules:**

Crops must reach at least blooming state (sowing density and the rest of tilling tasks have to be suitable and according to local agricultural habits).

#### **Control approach:**

If vegetation is present and harvest/clearance is detected on the parcel, it shows a strong indication of compliancy.

## **Annex B: Description of markers**

### Marker 1

Presence of vegetation based on NDVI (TRUE = Yes, FALSE= No, NR = Not relevant, NA = Data not available)

### Marker 2

Loss of vegetation based on NDVI (TRUE = Yes, FALSE= No, NR = Not relevant, NA = Data not available)

### Marker 3

Loss of vegetation based on SAR backscatter (TRUE = Yes, FALSE= No, NR = Not relevant, NA = Data not available)

### Marker 4

Presence of vegetation based on SAR backscatter (TRUE = Yes, FALSE= No, NR = Not relevant, NA = Data not available)

### Marker 5

Stable low/no vegetation based on SAR coherence (TRUE = Yes, FALSE= No, NR = Not relevant, NA = Data not available)

### Marker 6

Presence of vegetation based on NDVI within the EFA period (TRUE = Yes, FALSE= No, NR = Not relevant, NA = Data not available)

### Marker 7

Growth of vegetation based on NDVI within the EFA period (TRUE = Yes, FALSE= No, NR = Not relevant, NA = Data not available)

### Marker 8

No loss of vegetation based on NDVI within the EFA period (TRUE = Yes, FALSE= No, NR = Not relevant, NA = Data not available)

### Marker 9

No loss of vegetation based on SAR backscatter within the EFA period (TRUE = Yes, FALSE= No, NR = Not relevant, NA = Data not available)

### Marker 10

No loss of vegetation based on SAR coherence within the EFA period (TRUE = Yes, FALSE= No, NR = Not relevant, NA = Data not available)