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Technical guidance for the On-The-Spot checks of Crop Diversification

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Abstract:

Compliance with crop diversification rules of the Common Agriculture Policy legislation is one of the three main elements conditioning the 'greening payment' of European farmers. Addressing national administrations in charge of CAP direct payments' management, this technical guidance document provides the essential concepts and technical procedures that are considered best practices to perform the On-The-Spot check of crop diversification requirements.

1 Overview

1.1 Background

This document provides the technical guidance for the performance of the On-The Spot Checks (OTSC) of the crop diversification (CD) requirements as foreseen in Article 44 of Regulation (EU) No 1307/2013 and in Article 40 of Regulation (EU) No 639/2014. It complements the guideline for On-the-Spot Checks and area measurement provided by DG AGRI (document DSCG/2014/32). It also takes into account articles of the chapter III of TITLE III of the Commission Implementing Regulation (EU) No 809/2014.

1.2 Terms and definitions

"Agricultural area" (Article 4(1)(e) of Regulation (EU) No 1307/2013): means any area taken up by arable land, permanent grassland and permanent pasture, or permanent crops.

"Arable land" (Article 4(1)(f) of Regulation (EU) No 1307/2013): means land cultivated for crop production or areas available for crop production but lying fallow, including areas set aside in accordance with Articles 22, 23 and 24 of Regulation (EC) No 1257/1999, with Article 39 of Regulation (EC) No 1698/2005 and with Article 28 of Regulation (EU) No 1305/2013, irrespective of whether or not that land is under greenhouses or under fixed or mobile cover.

"Crop": means any of the following (Article 44(4) of Regulation (EU) No 1307/2013):

- (a) a culture of any of the different genera defined in the botanical classification of crops;
- (b) a culture of any of the species in the case of Brassicaceae, Solanaceae, and Cucurbitaceae;
- (c) land lying fallow;
- (d) grasses or other herbaceous forage.

Winter crop and spring crop shall be considered to be distinct crops even if they belong to the same genus.

"Measured area": in the frame of the check of CD, the measured area of a considered parcel is obtained either by delineation of this parcel through CAPI or GNSS measurement on the field or by confirmation of the recorded area of a reference parcel when fully matching.

"Permanent crops" (Article 4(1)(g) of Regulation (EU) No 1307/2013): means non-rotational crops other than permanent grassland and permanent pasture that occupy the land for five years or more and yield repeated harvests, including nurseries and short rotation coppice.

"Permanent grassland and permanent pasture" (together referred to as "permanent grassland") (Article 4(1)(h) of Regulation (EU) No 1307/2013): means land used to grow grasses or other herbaceous forage naturally (self-seeded) or through cultivation (sown) and that has not been included in the crop rotation of the holding for five years or more; it may include other species such as shrubs and/or trees which can be grazed provided that the grasses and other herbaceous forage remain predominant as well as, where Member States so decide, land which can be grazed and which forms part of established local practices where grasses and other herbaceous forage are traditionally not predominant in grazing areas.


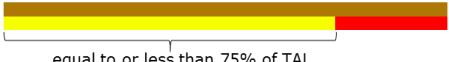
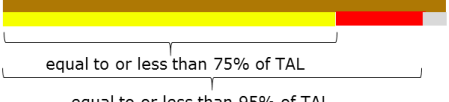
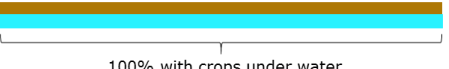
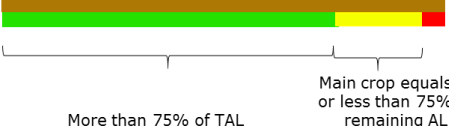
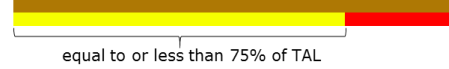
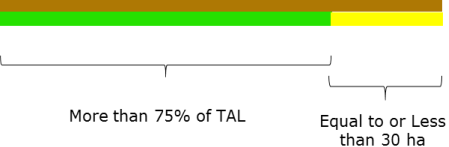
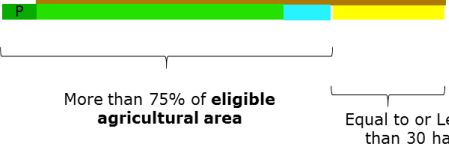
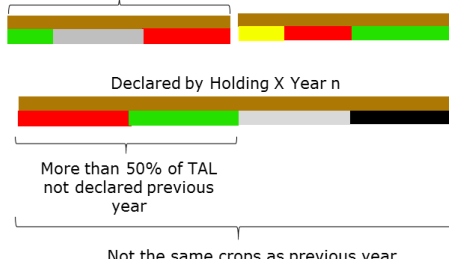
"Reference area": area of the reference parcel that represents its default value of potentially eligible hectares under a particular aid scheme or support measure. It is recovered from the geometric area, possibly after application of an eligibility rate.

1.3 Abbreviations

AL	Arable Land
BPS	Basic Payment Scheme
CD	Crop Diversification
CAPI	Computer Assisted Photo Interpretation
CG	Crop Group
CR	Crop
CTT	Combined Technical Tolerance
CwRS	Control with Remote Sensing
GNSS	Global Navigation Satellite System
GHF:	Grasses and other Herbaceous Coverage
GSD	Ground Sample Distance
HHR	High High Resolution
HR	High Resolution
IACS	Integrated Administration and Control System
LC	Land Cover
LLF	Land Laying Fallow
LPIS	Land Parcel Identification System
LU	Land Use
LUCAS	Land Use/Cover Area frame Statistical Survey
NDVI	Normalised Difference Vegetation Index
OAL	Other Arable land (= TAL – (LLF+CW+GHF))
OTSC	On-The-Spot Check
PC:	Permanent Crop
PG	Permanent Grassland
RFV	Rapid Field Visit
RMSExy	Two-Directional Root Mean Square Error
RP	Reference Parcel
RPAS	Remotely Piloted Aircraft Systems (see UAV)
SAPS	Single Area Payment Scheme
SAR	Synthetic Aperture Radar
TAL	Total Arable Land
TOL	Total Agricultural Land
TR	Crop Diversification Threshold
TT	Technical Tolerance
UAV	Unmanned Aerial Vehicle (See RPAS)
VCS	Voluntary Coupled Support
VHR	Very High Resolution
CW:	Crop under Water

1.4 Summary of legal binding conditions

The provisions and requirements in relation to CD are laid down in Article 44 of Regulation (EU) No 1307/2013. It outlines the scope of the holdings that are exempted or subject to CD, depending on the types of agriculture land they manage, the size of arable land and its particular use, the geographic location of the holdings, and the historical data from the aid applications. Article 44 also provides the requirements for CD that the holdings that are subject to this “greening” measure must respect. The main categories of holdings exempted or subject to CD and the relevant requirements they need to comply with are summarized in the Figure 1 given below.

General rules	Less than 10 ha of Total Arable Land (TAL)	 Less than 10 ha of TAL	No crop diversification required
	Between 10 ha and 30 ha of TAL	 equal to or less than 75% of TAL	<ul style="list-style-type: none"> At least 2 crops Main crop equals to or less than 75% of TAL
	More than 30 ha of TAL	 equal to or less than 75% of TAL equal to or less than 95% of TAL	<ul style="list-style-type: none"> At least 3 crops Main crop equals to or less than 75% of TAL Two main crops equal to or less than 95% of TAL
	AL entirely cultivated with crops under water	 100% with crops under water	No crop diversification required
	Grasses or other herbaceous forage or land laying fallow occupy more than 75% of the arable land	 More than 75% of TAL Main crop equals to or less than 75% of remaining AL	<ul style="list-style-type: none"> Main crop equals to or less than 75% of the remaining AL <u>except</u> where this remaining area is covered by grasses or other herbaceous forage or land lying fallow
	all holding land north of 62nd parallel AND more than 10 ha of Total Arable Land (TAL)	 equal to or less than 75% of TAL	<ul style="list-style-type: none"> At least two different crops Both not covering individually more than 75% of this remaining arable land, <u>unless</u> the main crop is grasses or other herbaceous forage, or land lying fallow
Exemptions	Grasses and other herbaceous forage and land laying fallow occupy more than 75% of the arable land AND the remaining arable land do not exceed 30 ha	 More than 75% of TAL Equal to or Less than 30 ha	No crop diversification required
	PG, grasses and other herbaceous forage or crops under water occupy more than 75% of the eligible agricultural area AND the remaining arable land do not exceed 30 ha	 More than 75% of eligible agricultural area Equal to or Less than 30 ha	No crop diversification required
	more than 50 % of the areas of AL not declared by the farmer in the previous year AND all arable land is being cultivated with a different crop compared to that of the previous calendar year	<p>Not declared by holding X Year n-1 Declared by holding X Year n-1</p>  Declared by Holding X Year n More than 50% of TAL not declared previous year Not the same crops as previous year	No crop diversification required





 Arable Land
    Crops
  Grasses, other herbaceous forage, fallow land
  Permanent grassland
  Crop under water

Figure 1: Summary of CD exemption or requirements foreseen by the article 44 of Regulation (EU) No 1307/2013

In addition, Article 40 of Regulation (EU) No 639/2014 gives specific provisions on how to calculate the shares of different crops for CD. It tackles issues such as: proper timing of the OTS check, calculation of the crop share in case of mix cropping, as well as the way to account the eligible landscape features that are traditionally part of good agriculture cropping or utilisation practices, or being subject to cross-compliance.

Finally, one can note that some of the data collected during the CD, such as land laying fallow or area with nitrogen-fixing crop can be directly used for the calculation of the EFA requirement.

However, the scope of this guidance is not to identify and detail the possible synergies between the different checks to be performed. It is the responsibility of the Member States to establish the possible synergies depending on their specific conditions and organise data captions to make their OTSC general methodology more efficient.

1.5 Scope and description of the use case

The OTSC related to CD (and to the “greening” as a whole), have some specificities compared to Basic Payment scheme (BPS) or Single Area Payment Scheme (SAPS) OTSC. Within the context of BPS/SAPS, the purpose of the OTSC consists in checking the reality on the spot against the agricultural land and correspondent area the farmer declared in his/her aid application. However, for the greening, OTSC consists in controlling the compliance of the reality on the spot with the “greening” rules.

So, the purpose of the OTSC on CD is first to check to which total arable land area threshold legally specified a considered holding belongs to. Then, whether the holding possibly satisfies one of the foreseen conditions for CD requirements exemption. Finally, if CD requirements apply, to check if the holding complies with the requested minimum number of crops and crop shares.

Figure 2 provides a general summary of the full decision rules process for dossier categorisation according to the different CD legal requirements.

The first, and main series of codes, concerns the decisions on dossier categorisation following what has been found on the ground against the ‘CD requirements’. Thus, a dossier (holding) will be classified as either ‘CD exemption verified’ (E), or ‘not compliant’ (N) with CD requirements or compliant with CD requirements and thus ‘accepted’ as OK (O). Apart from the final verdict on the compliance of the holding with CD requirements, it is important to establish also the area of the main crop and, where applicable the area of the other main crop in case the holding is found non-compliant.

A second set of codes is listed in figure 2 to report on the consistency on what the farmer has declared compared to what has been found on the spot. For each observation in the workflow, a code is assigned to report on the fact that what is observed is in agreement (A) or not (D) with what the farmer declared. The possible detected level of disagreement may be used by Administrations to place such holding in the risk sample for greening.

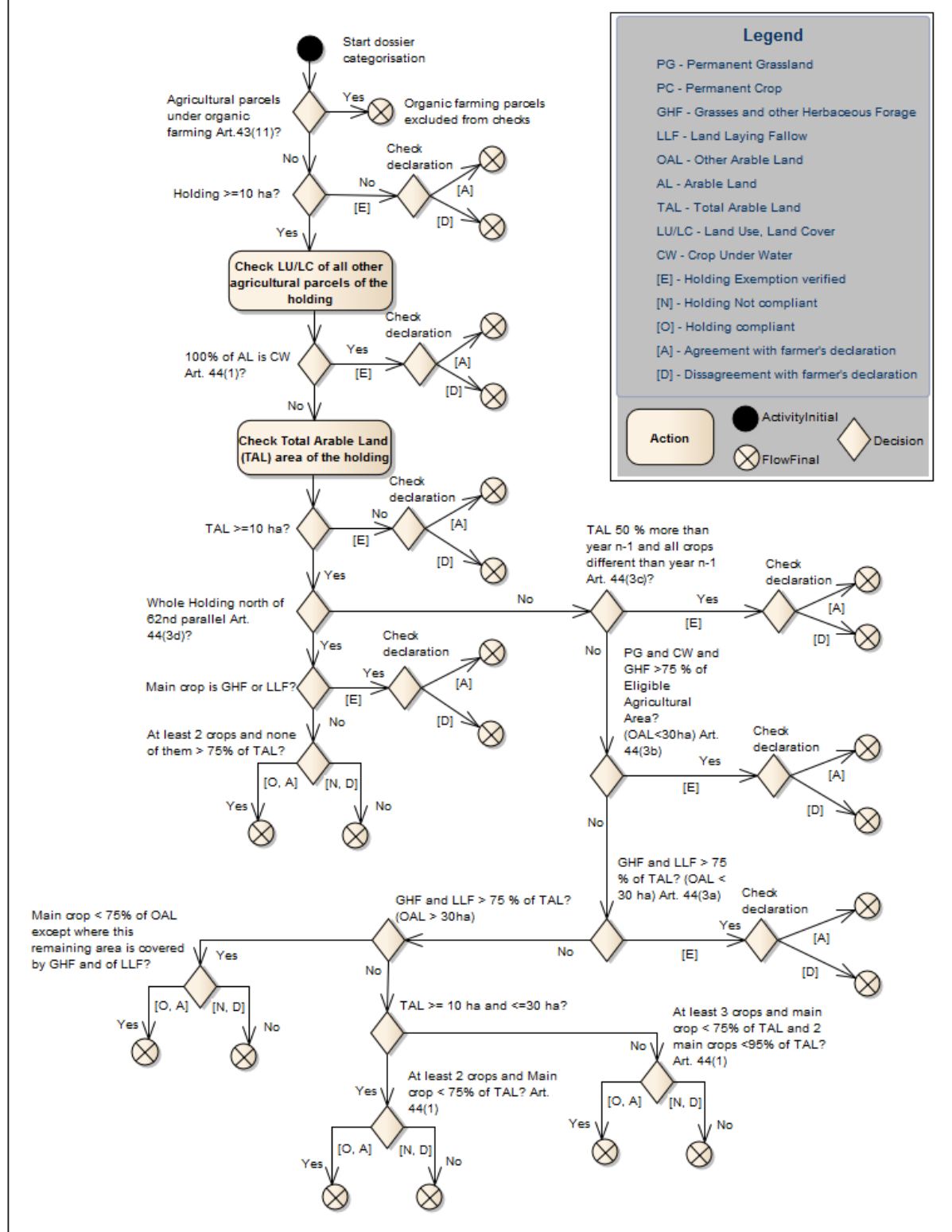


Figure 2: Full decision rules process for dossier categorisation according to different CD legal requirements

While appearing as complex in figure 2, in fact the OTSC CD process can be summarised as two main activities:

- Activity 1: Identification of the Land Use/Cover of all agricultural parcels of the holding;
- Activity 2: Determination of areas to verify the compliance with total arable land thresholds and requested crop shares.

These two actions will interact in different main sequential phases:

- Phase 1: Detection and area determination of the total land of the holding. Its purpose is to verify the compliance with the threshold limit of 10 ha, applicable for arable land, for exemption (total area of the holding is considered larger or equal to the arable land of the holding).
- Phase 2: If no exemption from phase 1, detection and area determination of the total arable land of the holding. Its purpose is to verify the compliance with again the same threshold limit of 10 ha for exemption.
- Phase 3: If no exemption from phase 2, detection and area measurement of the different crops (their type, and share), present in the arable land observed and found in the previous phase to verify the compliance (or non-compliance) with the different requested crop shares or exemptions applicable in the Member State.
- Phase 4: This final phase will consist in categorising the considered holding as: exempted from CD requirements, or compliant with CD requirements. For the latter case, the area of non-compliance (compared to the requested threshold) has to be quantified. For each dossier, all steps and actions that led to the final dossier categorisation will have to be recorded and documented.

2 OTSC of the dossier for crop diversification

Essentially, to perform the OTSC of CD two types of data have to be captured: areas and crop types.

Capturing areas or "area measurement" here expresses the set of activities for determination of the actual area of the observed feature of interest, either by confirmation of the polygon of the fully corresponding reference parcel, or delineation of the features through CAPI or GNSS of the field.

For the determination of Total Arable Land and the calculation of the respective crop shares, a detection of the crop type for each crop parcel would be necessary. For such purpose, activities possible are either classical on-the-spot checks or interpretation of a set of ortho images (control with remote sensing)

2.1 Specific considerations with respect to data capture

The assessment of the total arable land is based on the land declared by the farmer and in compliance with the eligible agriculture area registered in the LPIS (according to 2.1.2 of DSCG/2014/33). It is important to guarantee that the definition of the arable land and the methods for its inventory during the OTSC are consistent with the correspondent information stored in the LPIS.

Using imagery, the detection and area assessment of different types of arable land and crops (with their associated landscape features), are based on the use of two important biophysical characteristics of the vegetation (land cover) - plant physiognomy (visual appearance) and plant phenology (periodic life cycle) (see fig. 3).

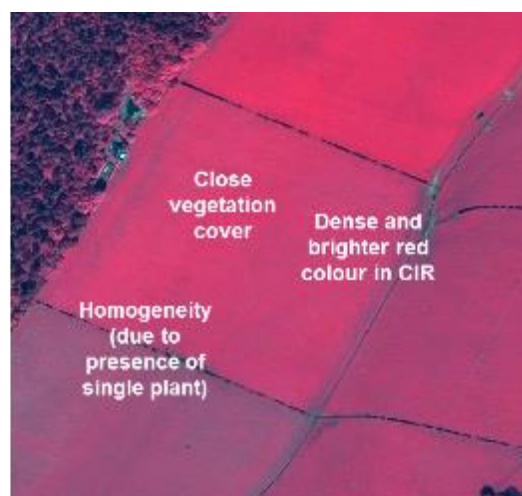


Figure 3. Differences in the physiognomic and phenological characteristics observed on VHR ortho imagery between permanent grassland that is self-seed (left image) and perennial managed grass used for forage (right image)

However, within the different types of crop to identify, some may have characteristics that make them more difficult to discriminate. This is specifically the case for grassland and herbaceous areas. In order to make proper assessment of the CD requirements, the land covered with perennial grasses and herbaceous forage (such as mixtures which includes alfalfa), should be properly detected and accounted. Also, land laying fallow has certain characteristics that can be attributed to “cropped area” (such as ploughing, or green cover), while other can be typical for natural grassland (such as the spontaneous re-growth of vegetation).

In such cases the use of the information from the LPIS on the location and extent of the permanent grassland – provided by the distinction of agricultural area/land cover in arable land, permanent grassland and permanent crops (either recorded alphanumerically or through delineation in a separate layer in LPIS) - is essential. The use of archive imagery will also be of importance to help discriminating these types of cover (more information and examples can be found in WikiCAP).

Depending on the reference parcel system used, the declared arable land of a farmer, can be either located in few well compacted agriculture parcels matching the reference parcels (agriculture parcels, farmers blocks, or cadastral parcels), or “spread” in many individual disjoint agriculture parcels located within the reference parcels together with agriculture parcels of other farmers (physical block, topographic blocks, or also cadastral parcels).

In the first situation, in many cases, the area covered by a specific crop will be deducible from reference parcel recorded area and actual area measurements will be limited;

In the second situation, the actual measurement of crop areas will be necessary for almost all parcels.

It is reminded also that, in case a crop is already harvested at the date of OTSC, existence of its residues can be used to evidence its past presence. To do so, Rapid Field Visit will be necessary.

Also, landscape features considered as eligible in accordance with Article 9 of Regulation (EU) No 640/2014 need to be accounted as part of the arable land area. Farmers have the flexibility to choose to include the bordering landscape features between two crops in one or the other crop area or to distribute it between. As the way in which farmers share the common landscape features will not be discernible by visual observation, a systematic consultation of aid application data for all those cases will be needed.

Finally, attention should also be paid on the fact that, while an agricultural parcels below a minimum size (below or equals to 0.3 ha) may not be accounted for in the frame of BPS/SAPS calculation, these parcels will however have to be accounted for in the calculation of CD. Considering their small size, field visit maybe necessary to come to a conclusion on their area and crop content.

2.2 Data source

In order to check the share of different crops there is a need to gather and use different data sources and tools.

The first information that needs to be gathered is the list of crops cultivated in the given country/region in accordance with Article 44(4) of Regulation (EU) No 1307/2013. This list should be compiled and shared among all direct payments process actors.

Crop data catalogue

In order to be able to identify each particular crop either on the field but mainly to help and train the CAPI operators, it is advised to collect any relevant qualitative and quantitative information about the botany, the physiognomy and phenology of the each crop type. This can include:

- The obtaining of detailed crop calendars per geographic region.
Such information are often collected and maintained by specialised agronomic institutes present in the EU Member States;

- The gathering and geo location of field data, at the beginning of the OTSC campaign, to use as reference crop parcels for interpretation (field pictures, spectrometric measurement ...);
- The production of reference photointerpretation catalogues consisting in remote sensing data, preferably multi-temporal (image snapshots), combined with ground truth data - for the elaboration of photointerpretation keys.
- Also information from surveys such as LUCAS (Land use and land cover Survey) may prove to be useful as they provide information in standardized and harmonized way at pan-European level.

Farmer declaration

Farmer declaration will be key source for reference information not only to assess the eligibility or exemption of the holding with respect to CD, but also will greatly facilitate the work of crop identification when using ortho imagery. This will be further enhanced with the entry into force of the provisions of Geospatial aid-application (GSSA).

Information from LPIS

As stated already, LPIS provides the essential information on the location of the agriculture land cover and maximum number of potential eligible hectares (under particular scheme or measure) available on every piece of well-identified agriculture land. Furthermore, LPIS is expected to provide information of the occurrence and area extent of 3 main types of agricultural land cover for each reference parcel (i.e. arable land, permanent crops and permanent grassland). Thus, LPIS would allow verification of the arable land declared by the farmer against the reference, as well as will facilitate the discrimination between the permanent grassland and the perennial grasses and other herbaceous forage being part of the arable land.

Use of imagery

Different sources of ortho imagery can be used in order to check declared areas and/or declared crop. There are in general two main types of image capture technology that can be used for the checking of CD – optical and Radar (SAR). Both technologies can be used separately, however since in the frame of CwRS data provided by the Commission are mainly optical data, SAR is currently considered as complementary data source.

With respect to area measurements

All imagery should have spatial resolution compliant at least with scale of 1:5.000 or larger. This translates into a required positional accuracy of maximum 1.25 m RMSE_{xy} and a GSD/pixel size at least 70cm or smaller and optimally 50 cm or smaller (i.e. Very High Resolution imagery - VHR). Although High Resolution imagery (HR) cannot be qualified for area measurement, it can be used to confirm boundary between different crops, not present on the VHR at the time of VHR acquisition.

The objective is to clearly identify and quantify the different defined crops. Chosen imagery should also allow to identify landscape features that may be included or not in the “cropped area”. The knowledge of the local conditions will dictate whether panchromatic, multispectral or even SAR imagery is most suitable and it is essential to adhere to that choice.

The source of VHR ortho imagery can be diverse (e.g. satellite sensors, aerial camera, UAV/FPAS (drones) camera)

It is also remembered here the crucial importance of the image pre-processing and ortho rectification steps. See dedicated articles in WikiCAP.

With respect to crop identification

Optical sensors are used for crop identification because many remote sensing devices operate in the green, red, and near infrared regions of the electromagnetic spectrum. In these ‘spectral bands’, vegetation can be discriminated according to its levels of radiation absorption and reflectance. There are quite numerous methods and tools for crop classification available worldwide. Use of multi-spectral HR satellite data for crop verification was extensively used in the CwRS before the decoupling of EU CAP. In addition, crop identification can be further enhanced by the use of multi-

temporal imagery, which allows crop diagnosis by taking into account changes in reflectance as a function of plant phenology (stage of growth). More information on the optical and SAR imagery and the use of spectral information from the optical sensors can be found in the Appendix at the end of this guidance (and in WikiCAP).

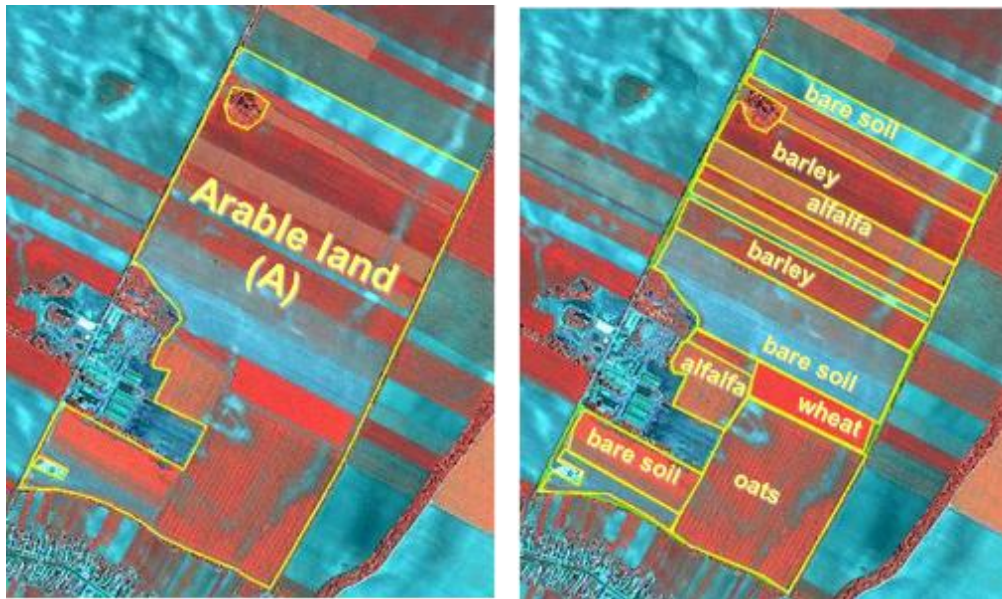


Figure 4. Agriculture parcel with arable land (left image). Same parcel with all crop delineated (right image)

With respect to detection of fallow land

Detection of land laying fallow can be partially based on the assumption that arable land left uncultivated or unmaintained, gradually starts to develop characteristics typical for natural vegetation (Di Gregorio and Jansen, 2000). The apparent transition from cultivated to natural vegetated land is mostly a change of the structure and physiognomy of the vegetation - different life forms might sporadically appear in the existing or newly established vertical strata (Di Gregorio and Jansen, 2000). Due to the lack of agricultural activity- harvesting, weed removal, grazing, mowing, shrub grubbing - the last year remnants of different vegetation, such as stubbles, crop residues, branches, and other, gradually increase. As a result such agriculture land has a higher probability that its surface is covered by closed-open (or more to less dense) layer of dry vegetation with a ratio that is relatively stable during the given year (Tasdemir et al., 2012). During the growing season, the intrinsic mix between the dry and freshly emerged vegetation will result in heterogeneous cover with higher variance in the reflectance as observed from remote sensing.

These two characteristics - closed cover and presence dry vegetation during the whole cultivation year- are well represented by the bio-physical products F_{soil} and F_{brown} respectively, and they can be key parameters used in the detection of the land lying fallow. Such parameters can be derived by some of the current HR satellite used in the CwRS campaign. Specific research needs to be done to elaborate more detailed guidance that can be used at operational level, as such bio-physical parameters are available at resolution allowing identification of land lying fallow, but might not be sufficiently detailed to ensure correct area measurement. Thus, this spatial HR data should be used only in combination with VHR data.

In order to classify a given land as arable land not currently cultivated and left as fallow, historical data should to be consulted. This can be the information available in and provided by the LPIS, as well as the historical archive image data that can further reveal the status of that land in the past.

Use of VHR + HR different dates (help of classified image or no)

Experience from previous pilot projects and studies showed that the spectral resolution of the VHR imagery, usually acquired in early spring, was often sufficient for discrimination of winter crops, forage crops, and natural permanent grassland. However, the distinction ability of the image depends on the

acquisition time. Additional VHR and HR imagery would be needed in certain cases. Such additional imagery is required in any case for spring crops which are not usually well emerged before late spring. Thus, the classical approach from the past, when couple payments (specific crops, like for the voluntary coupled schemes) had to be controlled, will be fully applicable for the CD. It will usually consist in using one to two VHR images for detailed delineation of the total arable land and possible winter crops, with supplementary HR imagery during summer and early winter to detect the spring crops. Number of HR images needed will depend on the type of crops at MS level, the declared crops and local crop calendars. Further studies need to be conducted to assess whether the currently used HR imagery has sufficient spatial resolution to allow the delineation of the crops, which boundaries were not visible on the VHR data.

Use of VHR imagery + Systematic Rapid Field Visits

Depending on their manpower availability and also depending on the holding typologies, the complexity of schemes and measures to be checked, some administrations may opt for this CwRS method. In such case, VHR ortho imagery is acquired in order to perform the measurements. Then for what concern all other diagnostics regarding Land Use/ Land Cover, a Rapid Field Visit will be systematically done for all parcels under OTSC.

Additional source of images

The provision of satellite imagery by the Commission currently foresees three types of profiles for optical sensors.

- VHR images: GSD <0.70m panchromatic, GSD <3m multi spectral and at least 4 bands
- HR images: GSD <5m pan sharpened, GSD <25m multi spectral and at least 3 bands
- HHR images: GSD <3m pan sharpened, GSD <10m multi spectral and at least 4 bands

It is possible to acquire aerial photography. It can be used equally as the VHR satellite, and often it can have a better spatial resolution. However it is the responsibility of the Member State Administration to purchase them i.e. is neither coordinated nor funded by the Commission. The main advantage of aerial photography is that it allows covering much larger areas (e.g. large administrative units such as full provinces) in a limited period of time. In addition, the possible request of (natural or infrared) colour imagery may permit an easier identification of land covers, thus significantly reducing follow-up rapid field visits for crop identification. However, acquiring aerial photography has also some proper constraints such as restrictions over military zones and air traffic lanes. Cloud cover is not as restricting for aerial photography as for satellite imagery, due to the flexibility of flight planning and options to fly at lower altitudes, but meteorological conditions are in any case affecting the radiometric quality of the photos.

The recent years have seen the rapid development and growing availability of drones (UAV/RPAS) devices. They have potential to supplement data collection. They have the advantage to be quick and easy to deploy with the possibility (depending on the size of the device) to load various types of camera (visible, IR, thermal). It is also possible to produce in a very cost effective way VHR 3D imagery. The current disadvantages is that small and cheap devices still operate on limited areas (restricted by the "line-of-sight" rule) and limited time flights. In addition, while progressing rapidly, the legal conditions of use are still to be defined and harmonised in Europe.

Drones can be used by the inspectors in the classical OTSC or during Rapid Field Visits, as complementary source of up-to-date information, as they can fast an overview snapshot of large fields that are difficult to be controlled using GNSS and field photographs.

2.3 OTSC inspection workflow for CD

General provisions

This section describes the different steps of the OTSC. It applies regardless of the control method (i.e. classical OTSC or CwRS).

As a rule and similarly to OTSC for BPS/SAPS, it is recommended to avoid measuring when it is not necessary (e.g. in case information is already provided by the LPIS or CD has already proved to be met). However, the surface covered by arable land is generally not equal to surface occupied by the crops. Attention need to be paid to accommodate correctly the eligible landscape element that are

part of the traditional agronomic practices and to account for any specific dimensions (e.g. width) as defined by particular EU Member State.

Each time it is possible, measurement should be limited to the outer perimeter of contiguous parcels of the same diversification group, to not increase artificially the perimeter and thus the tolerance.

It is not mandatory to measure all the crops areas for reaching a conclusion on the CD requirements. Depending on the conditions, measuring either only the main crop or only the less represented crops could be sufficient.

If the OTSC reveals that the CD requirements are fulfilled but with crops different from the ones declared in the farmer's application, with an exception for the crops that have an impact on the exemption thresholds for CD or EFA (e.g. leguminous crops, "temporary grassland", crops under water), the CD requirement should be considered as met.

Inspection workflow

As already outlined above, the verification process of the compliance of the holding with respect to CD requirements, it consists of two distinct parts:

- Inventory of the eligible agriculture land cover; quantification of the total arable land of the holding; and detection of the different crops present;
- Checking for presence of conditions allowing an exemption of the holding from CD and, in case such conditions are not present, a verification of the relevant CD requirement at holding level.

Inventory of the eligible agriculture land and quantification of the Total Arable Land (TAL) of the holding

In order to verify whether the holding is subject to CD requirement and to assess its compliance in case no exemption exist, the presence, extent, and nature of the eligible agriculture needs to be assessed. This inventory should encompass all the declared parcels of the holding, regardless their size and crop groups declared in accordance with Article 17 of Regulation (EU) No 640/2013. In addition, the amount and nature of the Total Arable Land (TAL) available at farm level needs to be qualified and quantified.

The type of eligible agriculture land will be detected through observation of the land cover and land use present on the spot. In certain cases, such as the presence of permanent grassland, assessment of the eligibility conditions will need to be carried out.

In any case, this scope inventory will be limited to the area of parcels declared by the farmer in his aid application.

The extent of the eligible agriculture land and total arable land will be derived through measurement of the area occupied by every distinct land cover and land use feature present on the area represented by the declared agriculture parcels. Landscape features, considered as being part of the Good Agricultural and Environmental Conditions will be also considered part of the eligible area. In cases where agriculture parcel matches the reference parcel, the determined area will derived directly from the reference area as recorded in the LPIS.

During the process of agriculture land inventory, information from the LPIS on the present agriculture land cover categories (permanent grassland, permanent crop and arable land) should be used as reference. Same is valid for the spatial and alpha-numeric information present in the farmer declaration, which will be used as ancillary information to support the land identification and area calculation.

The tolerance for area measurement (i.e. single buffer tolerance times the perimeter) shall be calculated for all cases when area is derived by a new measurements made either by CAPI or GNSS. Tolerance is applied according to rule provided in paragraph 2.4.5. of the OTSC guideline document DSCG/2014/32. Area, perimeter and determined area shall be recorded for each measurement.

The Total Arable Land and Total Eligible Agriculture area will be obtained by summing up all determined areas.

Determining and checking CD requirements

Determining the CD requirement

Based on the information collected during the agriculture land inventory, the holding is assessed with respect to the requirements for CD (number of crops and crop shares) that needs to be checked. The following actions are performed at holding level:

1. Check how much arable land is occupied by crops under water
2. Check the exact amount of arable land
3. Check the location of the whole holding land with respect to the 62nd parallel
4. Check on the basis of the current and previous year farmer declarations,
 - ♦ The percentage of the declared land that are newly declared (not present in farmer's declaration in previous year)
 - ♦ The crops that were cultivated on all the arable land currently declared, in the previous year
5. Check the presence of permanent grassland and, if present, the percentage of the permanent grassland, grasses and other herbaceous coverage and crop under water, of all eligible agriculture land
6. Check the percentage of the grasses and other herbaceous coverage and land laying fallow, of all eligible arable land

Each of these actions results in a set of observations that can trigger either an exemption of the holding from CD requirement, or application of specific CD requirements different from the standard ones given in Article 44 (1) of Regulation (EU) No 1307/2013. It triggers also decision with respect to the particular CD requirements that needs to be present - at least 2 different crops, or at least 3 different crops required.

For the quantification of the area occupied by each agriculture land cover or crop, as defined by Article 44 (4) of Regulation (EU) No 1307/2013, the individual areas covered by the particular land cover or crop should be summed up. These individual areas are:

- directly obtained from the reference area of the LPIS, in those cases when the individual area matched completely a given reference parcel;
- derived through area measurements - CAPI on orthoimage or GNSS on the field - in all other cases

When area is obtained directly from the LPIS, no new measurements is performed, therefore no tolerance is calculated. When area is derived through new measurement, a single buffer technical tolerance is calculated.

In order to assess if exceptions or specific scenarios for CD apply, some of actions specified above require a comparison of the total area (Mg) derived for particular land cover category (permanent grassland) and crops (land lying fallow) with a given threshold. This threshold (TR) can be a fixed percentage (usually 75%) of the eligible agriculture land, or the total arable land (TAL) of the holding, a value given in Article 44 of Regulation (EU) No 1307/2013. In such case, the exemption is triggered when $Mg > TR$.

If a Member State makes use of article 38(1) of Regulation (EU) No 809/2014, a systematic Land use/ Land cover check is done for of all single crop parcels (eligibility check). Then, the area measurement/determination is done for 50% of agricultural parcels randomly selected. If no discrepancy is found, the farmer declaration is considered as trustful and the retained TAL and/or Total Eligible Agriculture area is/are equal to the declared ones. Then, the controller will check if he/she can come to a conclusion on the requested crop shares with crop parcel areas measured/ determined in the 50% agricultural parcels sample. For example, if 2 crops are required, one should verify that the sum of the measured/ determined areas of the parcels occupied by the second crop is equal or higher than the requested threshold in ha (25% of the TAL as given in the application). If the threshold is reached, then this CD requirement check stops. If the threshold is not reached, measurement/ determination of area of the second crop parcels is done among the remaining 50% agricultural parcels until the requirement is verified. Then this CD check stops.

In case discrepancies are found in the 50% agricultural parcels sample, all agricultural parcels will have to be checked and area measured/ determined. CD requirements will then be checked by summing up all determined areas of the different crops.

Should the controller decide to apply the extrapolation rule, the following will be applied:

- The determined TAL will be computed by multiplying the ratio “arable area found” on “arable area declared” with the declared TAL, that is:

$$TAL_{Determined} = \frac{TAL_{50\%,Measured}}{TAL_{50\%,Declared}} TAL_{Declared}$$

- The shares of the crops observed on the 50% agricultural parcels will be directly compared with the pre-established percentage, according to Article 44 (1) of Regulation (EU) No 1307/2013, i.e. 75% and 95%, in order to assess whether the CD requirements are met and whether exception can be triggered.

Checking the CD requirement

Once the presence or absence from CD requirement is confirmed, the relevant CD requirement is defined. There are 3 options: (some farm scenarios are provided as example in annex 1)

- Option 1: Farm is exempt from CD

In such case, no extra measurement or check is needed. The verification of CD is finalised and the result is reported.

- Option 2: At least 2 different crops are required. Main crop should not cover more than 75% of the total arable land (TAL)

In such case, the process is organized as following:

- Perform, if needed, further land use inventory to detect the presence of additional crops than the ones detected in the previous step;
- Check the minimum number of crops required. NOTE: if only one crop is found of the spot, while at least two are expected, the farm is directly reported as not-compliant (N);
- Group all continuous pieces of land occupied by the main crop (main CR); similarly group all area occupied by other crops;
- Measure continuous pieces of land belonging to one of the two groups, depending on whichever is easier to measure, and check, for each individual measurement, whether the declared and the measured areas are within the technical tolerance (i.e. similarly to area determined for BPS/SAPS);
- Sum up the individual determined areas for the group. NOTE: Measurements may stop when at least one of the following conditions is met:
 - all the areas of one of the two groups have been determined;
 - the sum of the determined area at a given point provides sufficient evidence to make a verdict on the crop share.
- Compare the total determined area for the group i (Dc_i) with the relevant threshold (TR1 or TR1b);
 - Derive the thresholds by multiplying the area of the total arable land (TAL) with the pre-established percentage, according to Article 44 (1) of Regulation (EU) No 1307/2013, i.e. $TR1=0.75$ TAL and $TR1b=0.25$ TAL;
- Assess the compliance with CD requirement
 - When main crop is measured, if
 - $Dc_1 > TR1$
Report non-compliance of the holding with CD requirement (N)
Else, report compliance of the holding with CD requirement (O)
 - When all other crops are measured,
 - $Dc_2 < TR1b$
Report non-compliance of the holding with CD requirement (N)

Else, report compliance of the holding with CD requirement (O)

Dc_1 : total determined area of the main crop

Dc_2 : total determined area of the all remaining crops

- Option 3: At least 3 different crops are required. The main crop should not cover more than 75% of the TAL and the two main crops should not cover more than 95% of the TAL.

In such case, the process is organised as following:

- (a) Perform, if needed, further land use inventory to detect the presence of additional crops than the ones detected in the previous step;
- (b) Check the minimum number of crops required. NOTE: if the only one or two crops are found on-the-spot, while at least three are expected, the farm is reported as not-compliant (N);
- (c) Group all continuous pieces of land occupied by the main crop (main CR); group all continuous pieces of land occupied by the second main crop (2nd main CR); similarly group all areas occupied by other crops;
- (d) Measure continuous pieces of land belonging to the second main crop and either the first main crop or the remaining crops, depending on whichever is easier to measure, and check, for each individual measurement, whether the declared and the measured areas are within the technical tolerance (i.e. similarly to area determined for BPS/SAPS);
- (e) Sum up the individual determined area for the groups. NOTE: Measurements may stop when at least one of the following conditions is met:
 - all the areas of two groups have been measured;
 - the sum of the determined area at a given point provides sufficient evidence to make a verdict on the crop share.
- (f) Compare the total determined area for the group i (Dc_i) with the relevant thresholds (TR1, TR1b, TR2 or TR2b)
 - Derive the thresholds by multiplying the area of the TAL with the pre-established percentage (75% and 95%), according to Article 44 (1) of Regulation (EU) No 1307/2013, i.e. $TR1=0.75$ TAL, $TR1b=0.25$ TAL, $TR2=0.95$ TAL and $TR2b=0.05$ TAL
- (g) Assess the compliance with CD requirements
 - 1st requirement
 - When main crop is measured, if
 - $Dc_1 > TR1$
Report non-compliance of the holding with CD requirement (N)
Else, report compliance of the holding with CD requirement (O)
 - When second main crop and all other crops are measured, if
 - $Dc_2 + Dc_3 < TR1b$
Report non-compliance of the holding with CD requirement (N)
Else, report compliance of the holding with CD requirement (O)
 - 2nd requirement
 - When first and second main crops are measured, if
 - $Dc_1 + Dc_2 > TR2$
Report non-compliance of the holding with CD requirement (N)
Else, report compliance of the holding with CD requirement (O)
 - When all other crops are measured, if
 - $Dc_3 < TR2b$
Report non-compliance of the holding with CD requirement (N)
Else, report compliance of the holding with CD requirement (O)

Dc_1 : total determined area of the main crop

Dc_2 : total determined area of the second main crop

Dc₃: total determined area of the all remaining crops

The specific scenarios for CD applicable in case of holdings situated in areas north of 62 parallel or in case of holdings with more than 75% of TAL occupied by grasses and other herbaceous forage and land laying fallow, are simple variations of the Options 2 and 3 given above. At this moment, they are not tackled separately in this technical guidance.

In addition to the reporting on compliance against the requirement, the dossier needs to be checked for correctness of the information provided by the farmer in his/ her aid application with respect to CD. Any deviations observed on the spot from the statements made in the declaration will be reported as important feedback to the farmer.

2.4 Methods and tools

The verification of the CD requirements can be performed either by classical on-the-spot check (i.e. on the field) or by control with remote sensing (CwRS).

When inspection is performed on the field, area measurement should be conducted using either validated GNSS devices or using orthoimagery brought on computer on the field.

When CwRS is used, the same generic principles for computer-assisted photointerpretation (CAPI) apply as for the OTSC of the BPS/SAPS laid down in chapter 4 of the OTSC guideline document DSCG/2014/32.

Considering the difficulty to detect and discriminate certain land use types, such as land lying fallow, the use of rapid field visits (RFV) will be needed.

The procedure for conducting the RFV, as well as the information that needs to be collected, should be based on the field observation approach used by the Executive Test Suite (ETS) inspection as part of the annual LPIS Quality Assessment.

Reporting

The content and structure of the control report for CD will be at the discretion of the MS Administration, often based on the control reports for the BPS/SAPS locally implemented. In any case, the following elements should be included in the control report for CD:

- Type of agriculture land cover and crop types found at the level of the holding;
- Total area measured per land cover or crop, with the correspondent technical tolerance;
- Information on whether the holding is exempted from CD and the reason for that decision;
- Information on the type of the CD requirement found applicable;
- The value of the actual crop share found in case of non-compliance with CD;
- The specific values for the exemption threshold applied at farm level;
- The applicable technical codes (CDi) for categorization of CD conditions.

The report should contain also references to the raw observation and measurements used for the CD calculation. It should include anomalies and findings reported by the inspection during the OTSC that can be relevant to the update of the LPIS or EFA layers.

Finally, it should provide sufficient feedback to the farmer with respect to the correctness of his declaration, regardless whether he/she was found compliant with CD requirements or not.

The table given below outlines the possible technical codes for the categorization of the dossier. All of them are applicable at holding (dossier) level only. No technical codes at individual parcel or crop group level are envisaged.

Cde1	Holding declared to be subject to specific CD requirement (e.g. LLF and GHF > 75% of TAL), while found to be subject to general CD requirement
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Cde2	Holding declared to be exempted from CD, while found to be subject to CD with (at least) two crops
Cde3	Holding declared to be exempted from CD, while found to be subject to CD with (at least) three crops
CDg1	Holding is subject to CD with (at least) two crops required, however <u>only one crop</u> is found on the spot
CDg2	Holding is subject to CD with (at least) three crops required, however <u>only two crops</u> are found on the spot. The actual crop share found is additionally reported.
CDg3	Holding is subject to CD with (at least) three crops required, however <u>only one crop</u> is found on the spot. The actual crop share found is additionally reported.
CDr1	Holding is subject to CD with (at least) two crops required. Number of crop is found on the spot to be correct, however the <u>crop share of 75%</u> is not respected. The actual crop share found is additionally reported.
CDr2	Holding is subject to CD with (at least) three crops required. Number of crop is found on the spot to be correct, however the <u>crop share of 75%</u> is not respected. The actual crop share found is additionally reported.
CDr3	Holding is subject to CD with (at least) three crops required. Number of crop is found on the spot to be correct, however the <u>crop share of 95%</u> is not respected. The actual crop share found is additionally reported.

CDok	Holding found compliant with CD requirements
CDr	Holding found not compliant with CD requirements

Appendix I – Examples of inspection of different CD cases

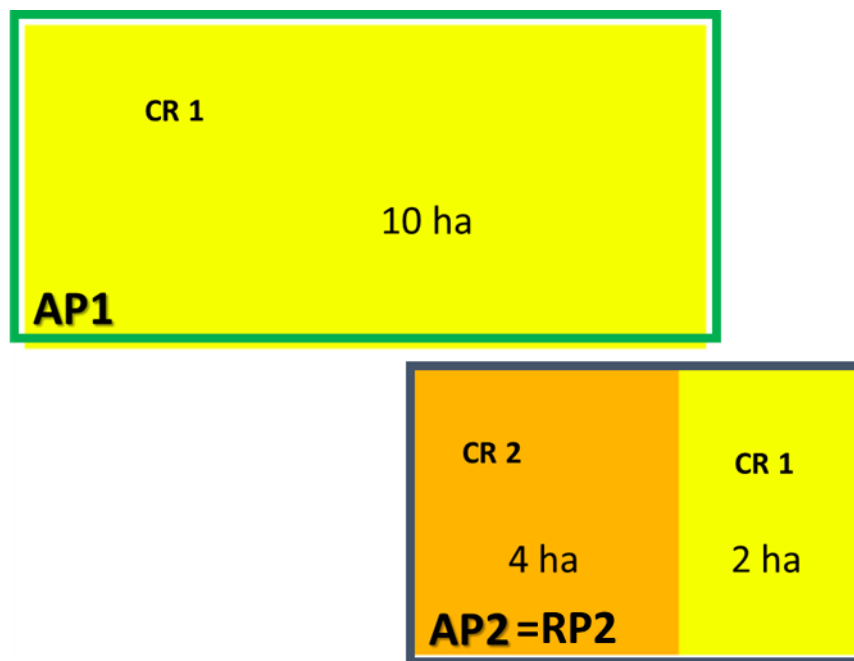
Nota Bene: In these examples the term “piece” is used. It corresponds to a piece of land occupied by one crop. The CR abbreviation means crop.

- Example 1: one mixed piece of AL of less than 10 ha

The farmer declared 9 ha of arable land (AL). All the AL are clustered in a continuous piece of land (agriculture parcel), even if several crops (CRs) are represented within.

- Detection and area measurement of the total amount of arable land to reveal, if number of crops and their shares have to be checked.
 - The measured area is 8.89 ha and the measured perimeter is 1426 m. The single tolerance buffer value is 1 m leading thus to a tolerance of 0.14 ha.
 - The declared area is within the tolerance so it is retained.
 - The total arable land (TAL) is 9 ha.
 - Therefore, the CD is not required so no extra measurement is performed.

- Example 2: two mixed pieces of AL for a total of 16 ha declared.



The farmer declared 16 ha of AL and two different crops. The AL are clustered in two continuous pieces of land (agriculture parcels AP1 and AP2), respectively 10 ha and 6 ha. The main crop is declared over both APs (respectively declared with 10.00 ha and 2 ha) while the second crop is only present in the second piece of AL with a declared area of 4 ha.

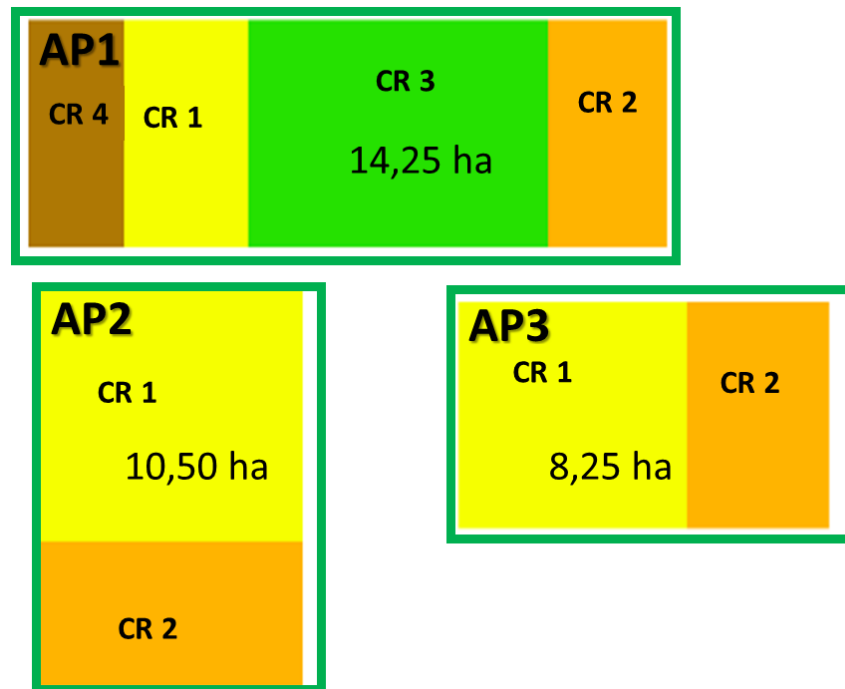
- Detection and area measurement of the total amount of arable land to reveal if number of crops and their shares have to be checked
 - As not matching complete and exact reference parcel (RP) the first piece of AL (AP1) is measured to be 10.43 ha with a measured perimeter of 1541 m.
 - The single tolerance buffer value is 1 m leading thus to a tolerance of 0.15 ha.
 - The declared value is outside the tolerance so the measured area of 10.43 ha is retained.
 - The second piece (AP2) matches a reference parcel (RP) in the LPIS with a MEA equal to 6 ha. This value is taken into account, i.e. no new measurement is done.

- The TAL equals the sum of the retained areas and is $10.43 + 6 = 16.43$ ha.
 - The TAL value is more than threshold of 10 ha.
 - The CD is required with at least 2 different crops.
- b. Checking of occurrence of exemption conditions
- Types of crops present on both APs are observed. Crops found belong to valid crop groups, as defined by MS Administration
 - Presence and extent of the permanent grassland (PG) belonging to the agriculture land of the holding is checked. PG is neither declared nor present.
 - Farmer declaration is consulted for presence of newly declared arable land. Previous year declaration is checked for the crop declared.
 - No conditions detected that can trigger an exemption from CD
- c. Calculation of crop shares
- The second CR is measured in AP2 and the measured area is 3.50 ha with a measured perimeter of 688 m.
 - The single tolerance buffer value is 1 m leading thus to a tolerance of 0.07 ha.
NOTE: Alternatively, the part occupied by the CR1 on the AP2 can be measured instead. The area of CR2 can be then derived from the total area of AP2 (as AP2 is a RP) minus the area occupied by CR1. The choice will depend on which measurement will be less effort and time consuming.
 - The declared area of CR2 on AP2 is outside of the tolerance so the measured area of 3.50 ha is retained.
 - The Total Arable Land (TAL), the sum of determined area is 16.43 ha. To comply with CD requirement the total measured area of CR2 should be bigger than the CD threshold (TR1b) of $(1-0.75)*TAL$, which is 4.11 ha.
 - The retained area of CR2 is smaller than TR1b.
 - The CD requirement is thus not met.
 - Code CDr1 is applied for TR1b
 - Code CDr is applied at holding level

	Piece 1	Piece 2	TOTAL	Rule 1 (75%)	Rule 2 (95%)
Declared	10.00	6.00			
Measured	10.43	No (RP)			
Tolerance	0.15	No (RP)			
Determined	10.43	6.00	16.43		
	CR1	CR2			
Declared	2.00	4.00			
Measured		3.50			
Tolerance		0.07			
Determined		3.50	3.50	Not met $(3.50/16.43=21\% < 25\%)$	Not applicable as area $\leq 30ha$

As the determined area of CR2 is 3.50 ha and the determined TAL is 16.43 ha, the determined area of CR1 is $16.43 - 3.50 \text{ ha} = 12.93 \text{ ha}$, exceeding thus TR1 (12.32 ha) by 0.61 ha.

– Example 3: three mixed pieces of AL of 33 ha



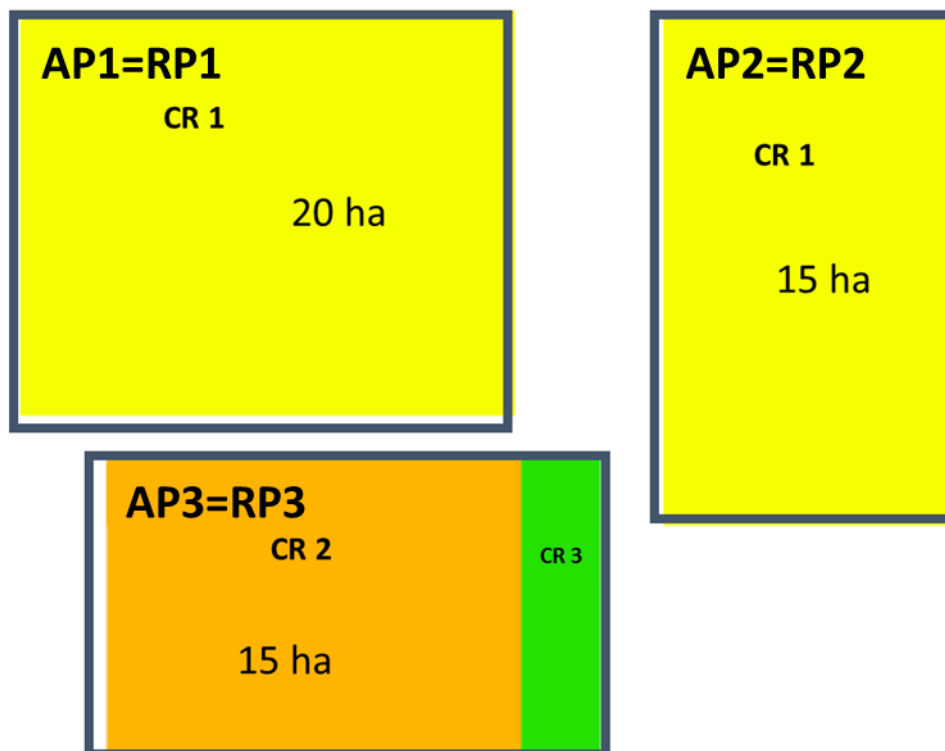
The farmer declared 33 ha of AL and four different crops. The AL is spread over three continuous pieces of land (agriculture parcels AP1, AP2 and AP3), declared 14.25 ha, 10.50 ha and 8.25 ha. The two main crops are split over the three pieces while the third and fourth CRs are only present in the first piece, declared with 6.70 ha for the third crop and 2.15 ha for the fourth crop.

- a. Detection and area measurement of the total amount of arable land to reveal if number of crops and their shares have to be checked
 - First agriculture parcel (AP1) is measured to be 14.09 ha with a measured perimeter of 1796 m.
 - Second agriculture parcel (AP2) is measured to be 10.53 ha with a measured perimeter of 1275 m.
 - Third agriculture parcel (AP3) is measured to be 8.77 ha with a measured perimeter of 1164 m.
 - The single tolerance buffer value is 1 m leading thus to tolerances of 0.18 ha, 0.13 and 0.12 respectively for AP1, AP2 and AP3.
 - The declared areas of AP1 and AP2 are within their respective tolerances so the areas 14.25 ha and 10.50 ha are retained.
 - The declared area of AP3 is outside of its tolerance so the measured area of 8.77 ha is retained.
 - The TAL equals the sum of the retained areas and is $14.25 + 10.50 + 8.77 = 33.52 \text{ ha}$.
 - The value of TAL (33.52 ha) is more than threshold of 30 ha.
 - The CD is required with at least 3 different crops.
- b. Checking of occurrence of exemption conditions
 - Types of crops present on all APs are observed. Crops found to belong to valid crop groups, as defined by MS Administration
 - Presence and extent of the permanent grassland belonging to the agriculture land of the holding is checked. PG is not present.

- Following farmer's declaration for presence of newly declared arable land, previous year declaration is checked for the crop declared.
 - No conditions detected that can trigger an exemption from CD
- c. Calculation of crop shares
- The third crop (CR3) is measured in AP1 and the measured area is 6.57 ha with a measured perimeter of 1010 m.
 - The single tolerance buffer value is 1 m leading thus to a tolerance of 0.10 ha.
 - The declared area of 6.70 ha is outside of the tolerance so the measured area of 6.57 ha is retained.
 - The fourth CR is measured in AP1 and the measured area is 2.13 ha with a measured perimeter of 698 m.
 - The single tolerance buffer value is 1 m leading thus to a tolerances of 0.07 ha.
 - The declared area of 2.15 ha is within the tolerance and is retained.
 - For the total Arable Land (TAL), the sum of retained area is 33.52 ha. The total area of CR2, CR3 and CR4 should be bigger than the threshold of $0.25 \times \text{TAL}$ (TR1b), which is 8.38 ha. The total area of both CR3 and CR4 should be bigger than the threshold of $0.05 \times \text{TAL}$ (TR2b), which is 1.67 ha.
 - The sum of the determined areas of both CR3 and CR4 is $6.57 + 2.15 = 8.72$ ha, which is bigger than both TR1b and TR2b.
 - As both CR3 and CR4 already cover more than TR1b, there is no need to measure CR2.
 - Both CD requirements are thus met and there is no need for extra measurement. Code CDok is applied.

	Piece 1	Piece 2	Piece 3	TOTAL		
Declared	14.25	10.50	8.25			
Measured	14.09	10.53	8.77			
Tolerance	0.18	0.13	0.12			
Determined	14.25	10.50	8.77	33.52		
	CR1	CR2	CR3	CR4	Rule 1 (75%)	Rule 2 (95%)
Declared	15.70	8.45	6.70	2.15		
Measured			6.57	2.13		
Tolerance			0.10	0.07		
Determined			6.57	2.15	Ok: (1-8.72/33.52 - CR2/33.52 = 74% - CR2/33.52 < 75%)	Ok: (1-8.72/33.52=74% < 95%)

- Example 4: three mixed pieces of AL of 50 ha



The farmer declared 50 ha of AL and three different crops. The AL is spread over three continuous pieces of land (agriculture parcels AP1, AP2 and AP3, declared 20 ha, 15 ha and 15 ha. The main CR is split over the first two pieces and is declared to cover the whole areas. The second and the third CRs are only present in the third piece with 12 ha declared for the second CR and 3 ha declared for the third CR.

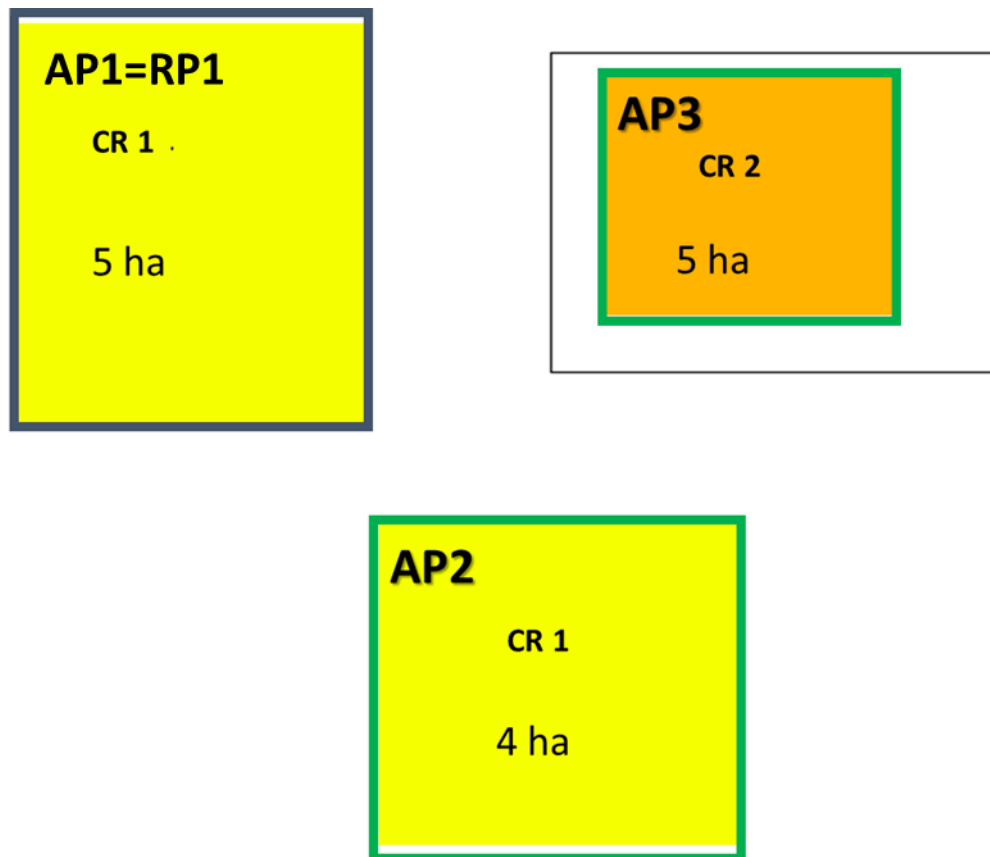
- a. Detection and area measurement of the total amount of arable land to reveal if number of crops and their shares have to be checked
 - The three AP match exactly three LPIS reference parcels for which the respective reference area are 20 ha, 15 ha and 15 ha. Thus, no measurements are required, and no tolerance is calculated.
 - The TAL equals the sum of the reference areas of all reference parcels (RP1 + RP2 + RP3) and is 50 ha.
 - The value of TAL is more than threshold of 30 ha.
 - The CD is required with at least 3 different crops.
- b. Checking of occurrence of exemption conditions
 - Types of crops present on all APs are observed. Crops found to belong to valid the crops groups, as defined by MS Administration
 - Presence and extent of the permanent grassland belonging to the agriculture land of the holding is checked. PG is not present.
 - Farmer declaration is consulted for presence of newly declared arable land. Previous year declaration is checked for the crop declared.
 - No conditions detected that can trigger an exemption from CD
- c. Calculation of crop shares

- The main crop (CR1) is only present on the two first RPs for which both the areas and the limits are confirmed and is the only represented crop.
- No measurement is required and the determined area of CR1 is $20 + 15 \text{ ha} = 35 \text{ ha}$
- From this point TR1 can already been calculated with $(20+15)/\text{TAL} = 35/50 = 0.7$ thus less than 0.75 thus CD compliant first rule.
- The third AP is covered by the second and the third CRs. It is thus sufficient to measure only one of them.
- The smallest (third crop, CR3) is measured and its measured area is 2.40 ha with a measured perimeter of 602 m
- The single tolerance buffer value is 1 m leading thus to a tolerances of 0.06 ha.
- The declared area of 3 ha is outside of the tolerance so the measured area of 2.40 ha is retained for CR3.
- For the total Arable Land (TAL), the sum of measured area is 50 ha. The total area of both CR2 and CR3 should be bigger than the threshold of $0.25 \times \text{TAL}$ (TR1b), which is 12.50 ha. The total measured area of CR3 should be bigger than the threshold of $0.05 \times \text{TAL}$ (TR2b), which is 2.50 ha.
- The retained area of CR3 is only 2.40 ha compared to TR2b.
- The second CD requirement is thus not met. Code CDr3 is applied for TR2b
- Since one of the CD requirements is not met, the holding is not compliant with CD requirements. Code CDr is applied at holding level.

	Piece 1	Piece 2	Piece 3	TOTAL		
Measured	No (RP)	No (RP)	No (RP)			
Tolerance	No (RP)	No (RP)	No (RP)			
Determined	20.00	15.00	15.00	50.00		
	CR1	CR2	CR3		Rule 1 (75%)	Rule 2 (95%)
Declared	35	12	3			
Measured	No (RP)		2.40			
Tolerance	No (RP)		0.06			
Determined	35		2.40		Ok: (35/50=70% < 75%)	No met: (1- 2.40/50=95.2 % > 95%)

As CR2 and CR3 are present on the same RP3 (15 ha) and as the determined area of CR3 is 2.40 ha, the determined area of CR2 is $15 - 2.40 \text{ ha} = 12.60 \text{ ha}$. Thus, the determined area of CR1 and CR2 is $35 + 12.60 \text{ ha} = 47.60 \text{ ha}$, exceeding TR2 (47.50 ha) by 0.10 ha.

- Example 5: part of the AL was not claimed (or not declared correctly)



The farmer declared 9 ha of AL with the same crop CR1. Those 9 ha are spread over two continuous pieces of land, declared 5 ha and 4 ha. However, he also declared 5 ha as “Other uses” part of which is in fact AL covered by a second crop CR2.

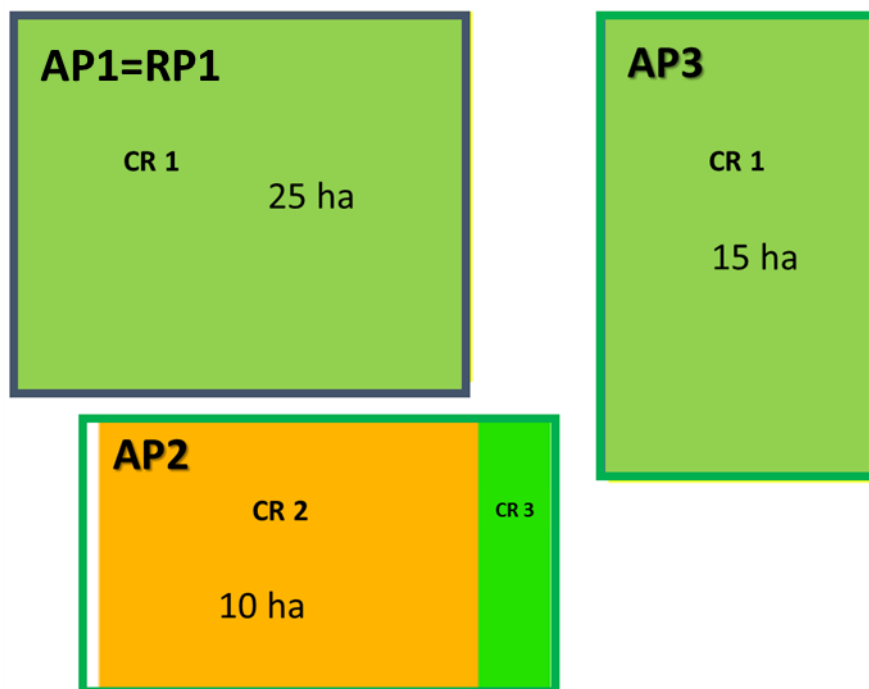
- Detection and area measurement of the total amount of arable land to reveal if number of crops and their shares have to be checked
 - The agriculture parcel AP1 matches exactly the RP1 for which the respective reference area is 5 ha. Thus, no measurement is required, and no tolerance is calculated.
 - AP2 is measured to be 3.96 ha with a measured perimeter of 763 m. The single tolerance buffer value is 1 m leading thus to a tolerances of 0.08 ha.
 - The declared area of 4 ha is within the tolerance so it is retained.
 - AP3, which is declared for “other uses” is measured to be 2.48 ha with a measured perimeter is 600 m. The single tolerance buffer value is 1 m leading thus to a tolerance of 0.06 ha.
 - As there is no declared value to compare with, the measured area of 2.48 ha is retained.
 - The value of TAL ($5+4+2.48=11.48$ ha) is more than threshold of 10 ha.
 - The CD is required with at least 2 different crops.
- Checking of occurrence of exemption conditions
 - Types of crops present on both APs are observed. Crops found to belong to valid the crops groups, as defined by MS Administration
 - Presence and extent of the permanent grassland belonging to the agriculture land of the holding is checked. PG is not present.

- Farmer declaration is consulted for presence of newly declared arable land. Previous year declaration is checked for the crop declared.
 - No conditions detected that can trigger an exemption from CD
- c. Calculation of crop shares
- The second crop (CR2) is only present on the AP3, which was already measured to be 2.48 ha.
 - For the Total Arable Land (TAL), the sum of measured area is 11.48 ha. The total area of CR2 should be bigger than the threshold of $0.25 \times \text{TAL}$ (TR1b), which is 2.87 ha.
 - The first CD requirement is thus not met. Code CDr1 is applied.
 - Since the CD requirement is not met, the holding is not compliant with CD requirements. Code CDr is applied at holding level.

	Piece 1	Piece 2	Piece 3	TOTAL	
Declared	5	4	5		
Measured	No (RP)	3.96	2.48		
Tolerance	No (RP)	0.08	0.06		
Determined	5.00	4.00	2.48	11.48	
	CR1	CR2			Rule 1 (75%)
Declared	9.00	Not declared			
Measured	5 (RP) + 3.96	2.48			
Tolerance	0.08				
Determined	5 + 4 = 9	2.48		11.48	Not met: $(2.48/11.48 = 22\% < 25\%)$

The determined area of CR1 is 9 ha, exceeding TR1 (8.61 ha) by 0.39 ha.

- Example 6: three mixed pieces of AL of 50 ha; first and third pieces are being land laying fallow



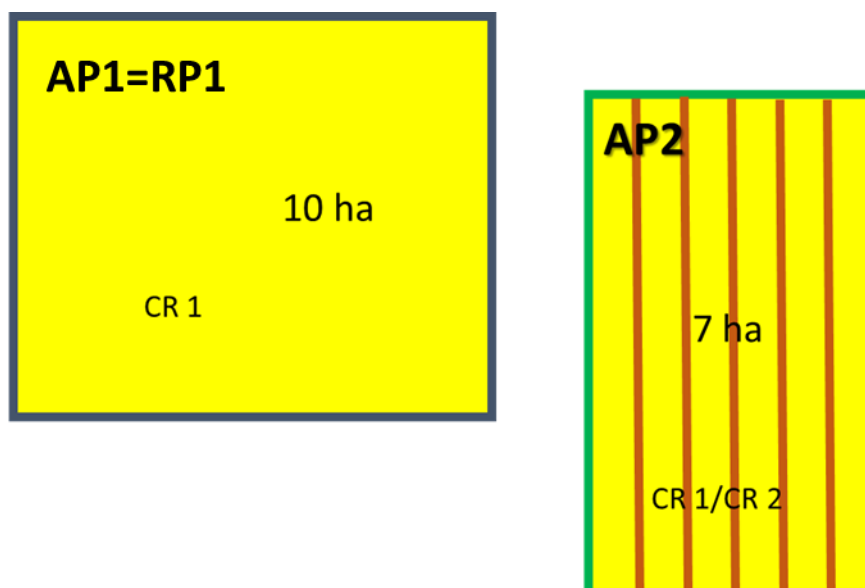
The farmer declared 50 ha of AL and three different crops. The AL is spread over three continuous pieces of land, declared 25 ha, 10 ha and 15 ha. The first and third pieces of land (AP1 and AP3) are being dedicated as land laying fallow (CR1). The second and the third CRs are only present in the second piece (AP2) with 8 ha declared for the second CR and 2 ha declared for the third CR.

- Detection and area measurement of the total amount of arable land to reveal if number of crops and their shares have to be checked
 - The agriculture parcel AP1 matches exactly the RP1 for which the respective reference area is 25 ha. Thus, no measurement is required, and no tolerance is calculated.
 - AP2 is measured to be 10.32 ha with a measured perimeter of 1196 m. The single tolerance buffer value is 1 m leading thus to a tolerances of 0.12 ha.
 - The declared area of 10 ha is outside of the tolerance so the measured area of 10.32 is retained.
 - AP3 is measured to be 14.88 ha with a measured perimeter of 1632 m. The single tolerance buffer value is 1 m leading thus to a tolerances of 0.16 ha.
 - The declared area of 15 ha is within the tolerance so it is retained.
 - The TAL equals the sum of the all retained areas and is $25 + 10.32 + 15 = 50.32$ ha.
 - The value of TAL (50.32 ha) is more than threshold of 30 ha.
 - The CD is required with at least 3 different crops.
- Checking of occurrence of exemption conditions
 - Types of crops present on both APs are observed. Crops found to belong to valid the crops groups, as defined by MS Administration.
 - Presence and extent of the permanent grassland belonging to the agriculture land of the holding is checked. PG is not present.
 - Farmer declaration is consulted for presence of newly declared arable land. Previous year declaration is checked for the crop declared.

- The main crop is on AP1 and AP3 which are fully dedicated for land lying fallow with total area of 40 ha. The threshold for exemption in case of presence of land lying fallow is $0.75 \times \text{TAL} = 37.74$ ha
- The total retained area of land lying fallow is bigger than the threshold and the remaining AL (AP2) is $10.32 \text{ ha} \leq 30 \text{ ha}$.
- Conditions for exemption of the holding from CD are detected.

	Piece 1	Piece 2	Piece 3	TOTAL	
Declared	25	10	15		
Measured	No (RP)	10.32	14.88		
Tolerance	No (RP)	0.12	0.16		
Determined	25.00	10.32	15.00	50.32	
	CR1	CR2	CR3		Rule GHF/LLF (75%)
Declared	40	8	2		
Measured	$25(\text{RP}) + 14.88$				
Tolerance	0.16				
Determined	40.00				met: $(40/50.20=80\% > 75\%)$

- Example 7: two disjoint pieces of claimed arable land (AL); second piece is subject to mixed cropping



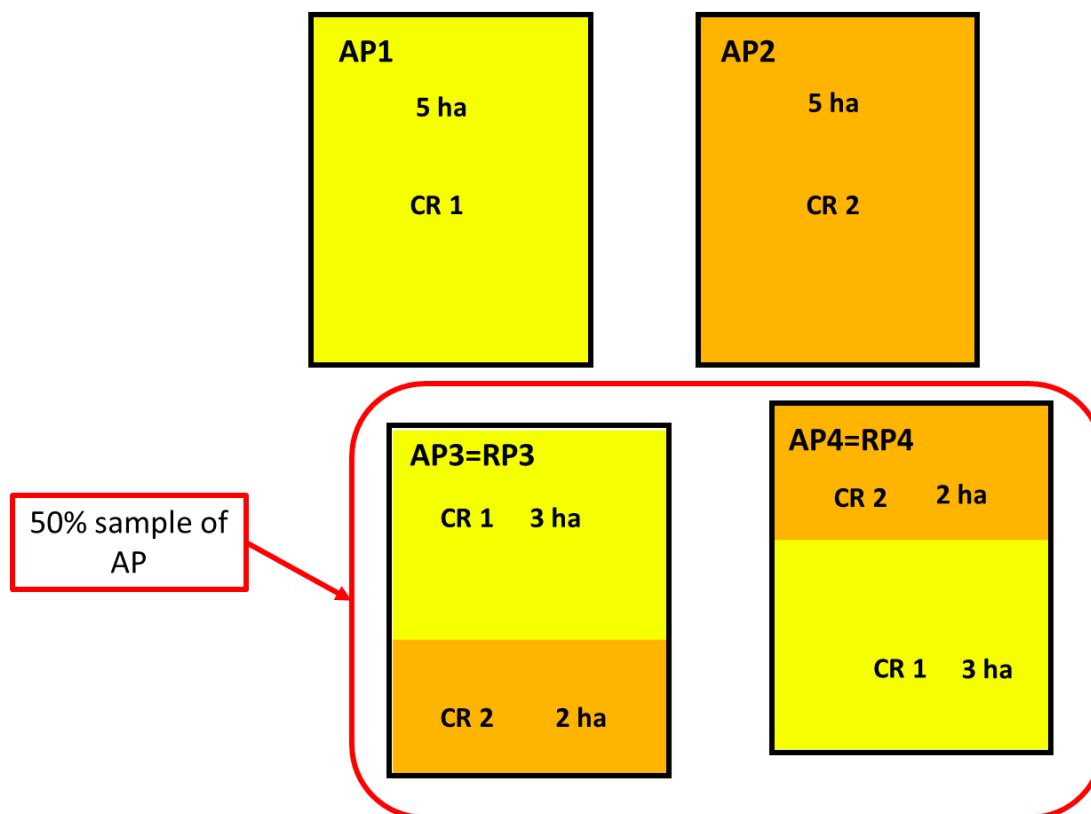
The farmer declared 17 ha of AL and two different crops. The AL is spread over two continuous pieces of land, declared 10 ha, 7 ha. The first piece of land (AP1) is fully occupied by the main crop (CR1). CR1 and CR2 are simultaneously grown on AP2 in distinct rows. CR2 is declared to cover 40% of AP2.

- a. Detection and area measurement of the total amount of arable land to reveal if number of crops and their shares have to be checked

- The agriculture parcel AP1 matches exactly the RP1 for which the respective reference area is 10 ha. Thus, no measurement is required, and no tolerance is calculated.
 - AP2 is measured to be 6.95 ha with a measured perimeter of 872 m. The single tolerance buffer value is 1 m leading thus to a tolerances of 0.09 ha.
 - The declared area of 7 ha is within the tolerance so it is retained.
 - The TAL equals the sum of the retained areas and is $10+7 = 17$ ha.
 - The value of TAL (17 ha) is more than threshold of 10 ha.
 - The CD is required with at least 2 different crops.
- b. Checking of occurrence of exemption conditions
- Types of crops present on both APs are observed. Crops found to belong to valid the crops groups, as defined by MS Administration
 - Presence and extent of the permanent grassland belonging to the agriculture land of the holding is checked. PG is not present.
 - Farmer declaration is consulted for presence of newly declared arable land. Previous year declaration is checked for the crop declared.
 - No conditions detected that can trigger an exemption from CD
- c. Calculation of crop shares
- The second crop (CR2) is only present on the AP2, and occupies the area simultaneously with CR1 well separated in distinct, identifiable rows.
 - The number of rows occupied by CR2 and their average width indicates that this CR2 occupies more than 25% of the area of AP2. So Article 40(3) of Reg. 639/2014 applies (i.e. the share for each crop is equally distributed).
 - The measured area of AP2 is 7 ha and two crops are found on its area. Thus, the share of the CR2 is half of the area of AP2, which is $7/2 = 3.5$ ha.
 - For the Total Arable Land (TAL), the sum of measured area is 17 ha. The total area of CR2 should be bigger than the threshold of $0.25 \times \text{TAL}$ (TR1b), which is 4.25 ha.
 - Total determined area for CR2 is less than the TR1b threshold.
 - The CD requirement is thus not met. Code CDr1 is applied.

The determined area of CR1 is 13.50 ha, exceeding TR1 (12.75 ha) by 0.75 ha.

- Example 8: four pieces of AL of 20 ha and application of Article 38(1) of 809/2014



The farmer declared 20 ha of AL and 2 different crops. The AL is spread over four continuous pieces of land (agriculture parcels AP1, AP2, AP3 and AP4), each of them declared 5 ha. CR1 is present on AP1, AP3 and AP4 and declared respectively 5 ha, 3 ha and 3 ha. CR2 is present on AP2, AP3 and AP4 and declared respectively 5 ha, 2 ha and 2 ha.

After having performed the eligibility check of all declared parcels, the controller decides (based on Article 38(1)) to select randomly 50% of the parcels. The random sample is composed by AP3 and AP4.

- Detection and area measurement of the total amount of arable land to reveal if number of crops and their shares have to be checked
 - Both selected agriculture parcel (AP3 and AP4) match exactly their respective LPIS reference parcels RP3 and RP4 for which both respective reference areas are 5 ha. Thus, no measurements are required, and no tolerance is calculated.
 - As no irregularity is found on the 50% sample, the declared TAL is accepted to be 20 ha.
 - The value of TAL (20 ha) is between thresholds of 10 ha and 30 ha.
 - The CD is required with at least 2 different crops.
- Checking of occurrence of exemption conditions
 - Types of crops present on all APs are observed. Crops found to belong to the valid crop groups, as defined by MS Administration
 - Presence and extent of the permanent grassland belonging to the agriculture land of the holding is checked. PG is not present.
 - Farmer declaration is consulted for presence of newly declared arable land. Previous year declaration is checked for the crop declared.
 - No conditions detected that can trigger an exemption from CD
- Calculation of crop shares

- The second crop (CR2) is measured in RP3 and the measured area is 2.05 ha with a measured perimeter of 610 m.
- The single tolerance buffer value is 1 m leading thus to a tolerances of 0.06 ha.
- The declared area for CR2 on RP3 is 2 ha which is within the tolerance so the declared area of 2 ha is retained for that piece.
- CR2 is measured in RP4 and the measured area is 1.97 ha with a measured perimeter of 590 m.
- The single tolerance buffer value is 1 m leading thus to a tolerances of 0.06 ha.
- The declared area for CR2 on RP4 is 2 ha which is within the tolerance so the declared area of 2 ha is retained for that piece.
- At this point, CR2 is determined to cover 4 ha, which is not sufficient to assess the compliance with CD, and no remaining piece can be measured on the 50% sample. Extra measurements are needed on the rest of the declared areas.
- CR2 is found on AP2 and measured 4.93 ha with a measured perimeter of 1050 m.
- The single tolerance buffer value is 1m leading thus to a tolerance of 0.10 ha.
- The declared area for CR2 on AP2 is 5 ha which is within the tolerance so the declared area of 5 ha is retained for that piece.
- CR2 now cumulates to 2+2+5.00 ha = 9.00 ha.
- Threshold is $0.75 \times \text{TAL} = 0.75 \times 20 = 15\text{ha}$. Main crop = TAL-9ha which is less than 15ha .
- The CD requirement is thus met and there is no need for extra measurement. Code CDok is applied.

	Piece 1	Piece 2	Piece 3	Piece 4	TOTAL	
Declared	5.00	5.00	5.00	5.00	20.00	
Measured			No (RP)	No (RP)		
Tolerance			No (RP)	No (RP)		
Determined			5.00	5.00		
	CR2_1	CR2_2	CR2_3			Rule 1 (75%)
Declared	2.00	2.00	5.00			
Measured	2.05	1.97	4.93			
Tolerance	0.06	0.06	0.10			
Determined	2.00	2.00	5.00			Ok: $(1-9/20 = 55\% < 75\%)$

Appendix II – Use of satellite and/or aerial imagery

This appendix provides general information on the use of satellite and/or aerial imagery. Further information and examples on how to identify, discriminate specific types of crop (e.g. land laying fallow) can be found in WikiCAP.

Optical Imagery

Optical imagery is acquired by the so-called passive sensors that capture the sunlight reflected by the Earth surface. Since every type of vegetation reflects (and absorbs) sunlight along the spectrum in specific way, the amount of energy recorded by the sensor in every specific segment of the wavelength (image band) will be different. This will be reflected by the resulted image by its pixel values. Each vegetation (or crop types, crop phenologies and even species) will be characterized by a set of specific intensities for each of the image bands. The availability of more spectral bands will allow better discrimination of the particular vegetation or crop types.

Each sensor or image datasets that can be used for the detection of the CD through remote sensing can be assessed from the point of the 4 main image parameters – spatial resolution, spectral resolution, radiometric resolution and temporal resolution. Here, they will be assessed only with respect to their roles in the differentiation of the different types of arable land (grasses, fallow and crops), and not for the agriculture parcel or landscape features delineation (as these issues are tackled in other guidance)

- Spatial resolution

This is the level of detail that an image holds. Since the different crops and grasses are herbaceous plants that are too small to allow detection by the appearance of the individual plant, the spatial resolution, although important, is not a crucial characteristics with respect to crops/fallow land differentiation. Also in the majority of the cases the crop coverage is expected to be dense and homogeneous; thus, no particular textures or patterns are expected.

- Spectral resolution

This is the number and range of the different image bands (wavelength). Spectral resolution is a key parameters of the imagery, with respect to crop detection, since every crop, due to the leaf structure and chlorophyll content, has specific reflectance profile along the visible and infrared wavelength ranges. The availability of infrared bands is crucial since it is in this range on the electromagnetic wavelength (especially the short-wave infrared), where the crop discrimination is most evident. Images from sensors “rich” of multispectral bands, allow crop discrimination though automatic classification (supervised or unsupervised), or though visual interpretation using specific band combinations. Band combinations (in RGB order) suitable for such visual interpretation are:

- Near infrared, Short-Wave Infrared, Red
- Near infrared, Red Edge, Red

Although not compulsory, images might need specific radiometric calibration or atmospheric corrections to derive the Top-Up-Atmosphere (TOA) and ground reflectance. This can be particularly important when automated classification of multi-temporal data is conducted. For some sensor, the so-called biophysical parameters (BioPar), such as fraction of vegetation cover (FCover) or fraction of green vegetation cover (FGreen) can be derived and used in the process of image classification.

- Radiometric resolution

This is the number of bits recording the DN value (intensity) of the image pixel. Although important, its relevance comparing with spectral resolution is relatively marginal in relation to CD. However, for visual interpretation a proper adjustment of DN values to the available image bits (stretching of histogram) is of key importance for proper visual interpretation. Any

clipping of data, especially in the upper tail of the histogram, is not acceptable as important information on crop reflectance might be lost.

- Temporal resolution

This is the number of image acquisition (observations) that can be available per year (or season). It is a crucial parameter of the sensor and the correspondent image dataset, as it will allow proper assessment of the plant life cycle (leaf phenology and crop calendar). It should be however noted, that in some countries due to economic or other reasons, farmers do not respect fully the local crop calendar. In such cases the results from the multi-temporal image analysis, should be always complemented and cross-checked with information from the assessment of the multi-spectral image data.

The upcoming sentinel satellite constellation in the frame of the COPERNICUS program of the EC, is considered a very promising source of freely available multi-temporal image data (both optical and SAR). The recent launched Sentinel-1 (SAR) is already in operational mode and provides continuously image data over Europe and the rest of the world. It can reach up to 5 meters resolution in strip map mode and will have 12 days revisit time with one satellite only. Of particular interest for crop discrimination would be the optical Sentinel-2 satellite launched recently (23.06.2015). It is a multispectral imager (MSI) covering 13 spectral bands (443 nm–2190 nm) with a swath width of 290 km and spatial resolutions of 10 m (4 visible and near-infrared bands) and 20 m (6 red-edge/shortwave-infrared bands). Revisit time will be 10 days with one satellite only.

More information can be retrieved on:

http://www.esa.int/Our_Activities/Observing_the_Earth/Copernicus/Overview4

SAR Imagery

Synthetic Aperture Radar (SAR) imagery is acquired by the so-called active sensors that capture the fraction of energy emitted by the sensor that is reflected by the Earth surface. SAR imagery is much more difficult to generate and interpret, as the information provided is not natural for the human cognitive perception. However, since SAR is sensitive to the structure, alignment, and moisture content of the crop and can collect information in cloudy conditions, it can thus provide complementary information to the optical data. SAR sensor records also some specific characteristic of the signal, such as phase and polarimetry that opens further possibilities with respect to crop detection, especially when full polarimetric, multi-temporal SAR data is available. Combining the information from optical and SAR sensors increases the information available for distinguishing each target class and its respective signature, and thus there is a better chance of performing a more accurate classification.

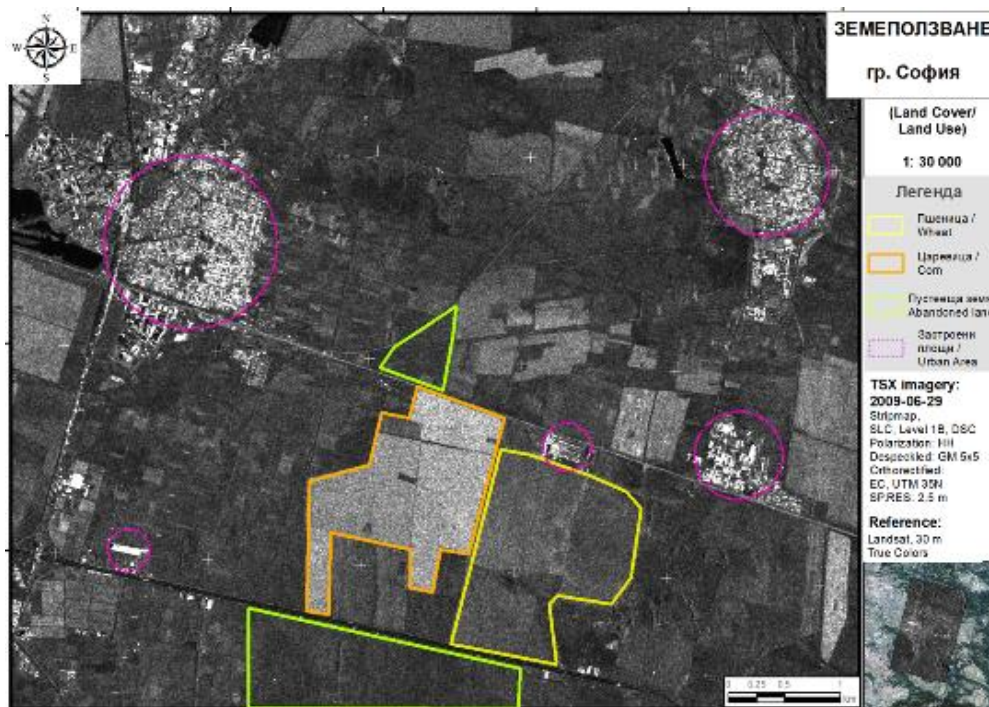


Figure 1. Crop detection using SAR imagery (TerraSAR-X)

Added-value of vegetation indices for crop identification

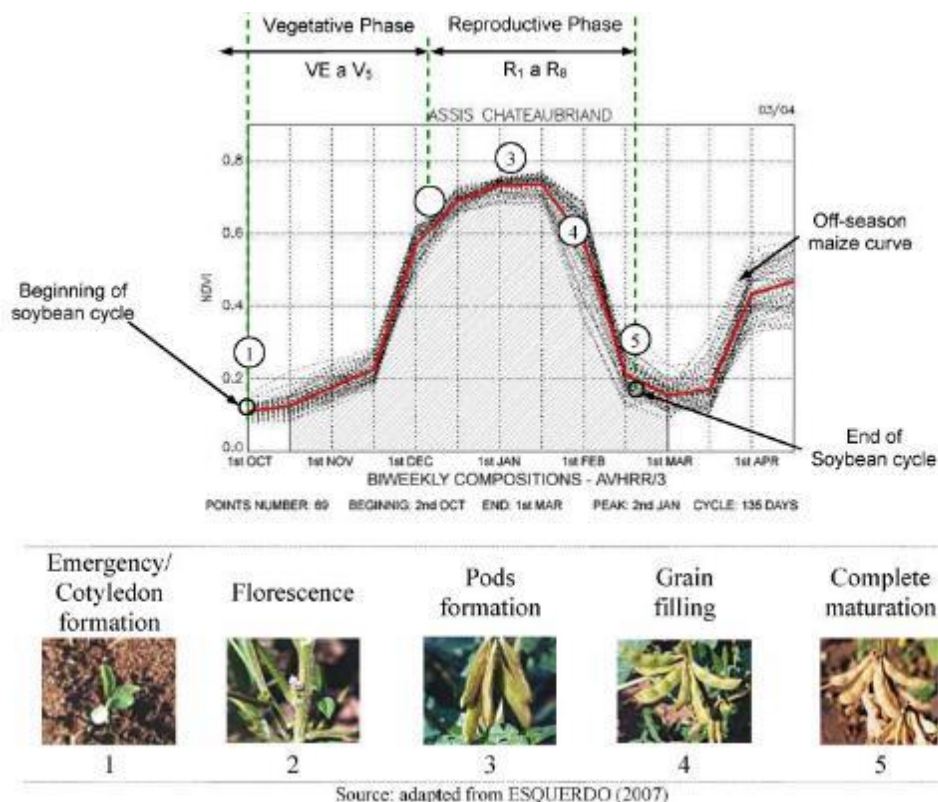


Figure 2. Example of NDVI temporal profile, during cropping season

Usually and ideally, crop identification is based on the use of different characteristics of temporal profiles such as the date of the beginning of crop cycle, the duration of the vegetative phase, the date of peak of green vegetation, the duration of senescence phase etc. as shown in the figure above. It represents the temporal evolution of the Normalised

Difference Vegetation Index (NDVI) of a crop ($NDVI = (NIR - R) / (NIR + R)$ where NIR is the near infrared band value for a pixel and R is the red band value for the pixel). NDVI is quite commonly used vegetation index in crop monitoring and crop yield forecasting using remote sensing. It is simple to produce and it can be derived from practically any satellite sensor, as it requires the availability of only the near-infrared in addition to the visible band.

In addition to the NDVI, there are other indices that can be relevant for CD, such as: Red Edge NDVI, Normalized Difference Water Index (NDWI). However, in order to provide operational solution, further studies needs to be conducted.

Few years ago GTCAP Project of the MARS Unit of JRC, conducted a successful study of using the temporal evolution of the red Edge NDVI derived from multi-temporal RapidEye Imagery for assessing the land in good agriculture conditions (GAC) in Bulgaria. Some of the results can be extended and applied in the field of CD. More information can be found on:

http://www.isprs.org/proceedings/XXXVIII/part7/b/pdf/568_XXXVIII-part7B.pdf

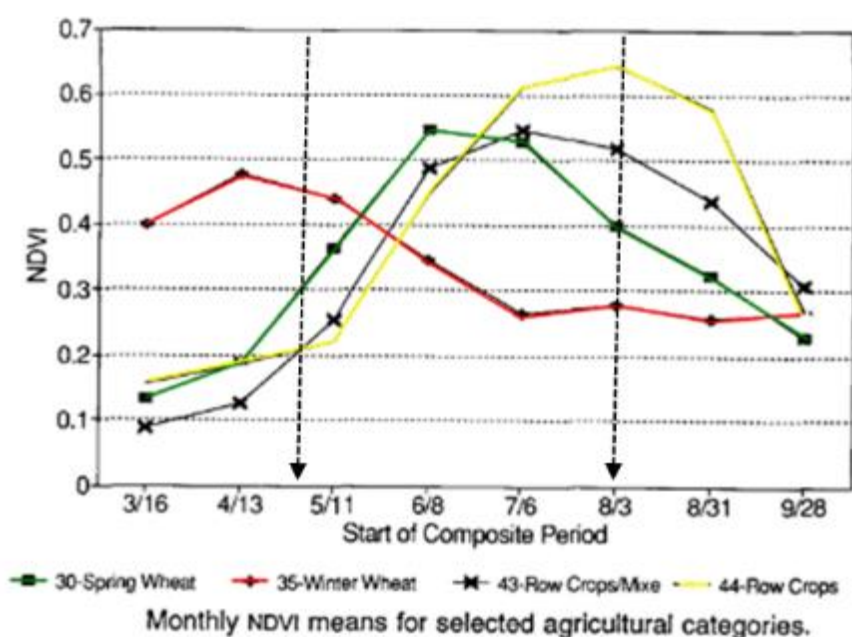
<http://www.sciencedirect.com/science/article/pii/S0168169912000300>

However, in the current technical and financial situation, it is not possible, in the frame of the On-The-Spot Checks using remote Sensed imagery (CwRS) to acquire and provide images on a regular (e.g. weekly) basis. Identification and discrimination of crops will depend in near future on the sound identification of a limited number of optimal image acquisition dates during the CwRS campaign.

However, HR imagery collected for the CwRS can be further complemented with additional freely accessible high-resolution data, from the operational Landsat 8 and upcoming Copernicus Sentinel -2. This freely accessible data will have in most of the cases spatial resolution inferior to the HR data from the CwRS, but in any case will be able to provide valuable spectral and temporal information on crop type and crop development.

Once Sentinel -2 is launched and its commissioning phase completed, a specific feasibility study of the satellite data required for crop identification can be conducted.

In the example provided in the figure below, are represented the temporal evolutions of the Normalised Difference Vegetation Index (NDVI) of spring wheat, winter wheat, Row crop/mixed and raw crops in a hypothetic region. In such situation, image acquisition dates that offer the higher crop discrimination probability would be positioned around beginning of August. Further information for crop discrimination can be brought by also acquiring an image beginning of May.



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