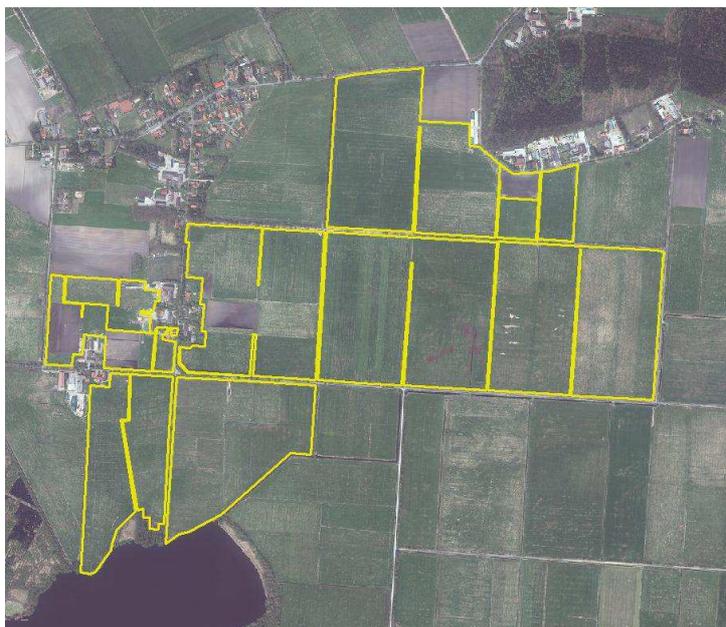




# The first year of implementation of the LPIS quality assessment in the frame of Comm. Reg. No 1122/2009 art. 6.2

Findings and analysis of the Member States' first assessment of the LPIS QA methodology

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## **1. Report outline**

- 1.1.1. This document reports on the activities on and developments of the LPIS quality assurance framework during 2011. It represents deliverable 2.2 of the 2011 work plan for the GeoCAP action (JRC H4 – 21102)
- 1.1.2. Since, to the knowledge of the authors, there is no other report published on the implementation of the first LPIS quality assessment or on the LPIS quality assurance (QA) framework; they support the distribution of this internal report to the Member States.
- 1.1.3. 2011 was the first year that actual results of the pan-European implementation of the inspection methodology were reported, that inspection records (on 2010 data) were delivered and screened. This report includes a summary of these findings. However it is important to note that, as indicated by the Deputy Director General of DGAgri J during the Taormina conference (2009) and later confirmed by the chair of the Direct Payment Management Committee meetings (DPMM), these 2010 results would be considered in a trial context. This first year of implementation was not expected to yield a comparable scores or definitive verdict on the quality of an individual LPIS implementation. Rather the 2010 implementation would offer the general rehearsal for an operational assessment from 2011.
- 1.1.4. The 2010 scores and inspection records were therefore analysed with a focus on the correct application of the inspection methodology with two outputs in mind; first a screening of each Member States quality assessment to enable individual guidance and correction and second, an analysis of the overall performance to guide improvements in measures, methodology and guidance.
- 1.1.5. The screening activities, combined with the feedback retrieved from the LPIS workshop, training sessions, a technical working group and DPMM review cycles led to a major revision of the methodology by October 2011. This review was received as a simplification and improvement by the Member States. Upon request of the Member States, a peer review study was launched and it concluded that it the methodology is generally sound and relevant although some improvements are still possible.
- 1.1.6. The report concludes with an outlook on the strategic LPIS QA framework options that lay ahead for 2012.

## **2. Legal developments leading to the LPIS QA**

### **2.1. LPIS establishment and the original 95%/75% rule**

2.1.1. Although a spatial LPIS (or identification of agricultural parcels with GIS) became a requirement by the amending Council Regulation 1593/2000, a single quality element was introduced as late as the Commission Regulation 796/2004 art 6.2:

*"The Member State shall ensure that with regard to at least 75 % of the reference parcels being subject to an aid application, at least 90 % of the respective area is eligible pursuant to the single payment scheme. The assessment shall be made on an annual basis using appropriate statistical method"*

2.1.2. This rule and its target (at least 3 quarters of the reference parcels should have less than 10% problematic area inside) proved to be ineffective. A LPIS system could easily meet this requirement, without being an appropriate tool for the farmer to declare his agricultural land of for the administration to perform the crosschecks on double declaration. As audits found that a weak LPIS was the main factor for many irregular applications, it became obvious that allowing that the LPIS quality became crucial. In financial terms, one could simply not defend that nearly one quarter of the parcels could be more than 10% incorrect. A revision of the quality became necessary.

2.1.3. In July 2008, the then deputy director general of DGAgri J and the head of clearance of account unit came to the JRC to discuss possible LPIS quality assessment approaches. From these discussions and their follow-up, the DGAgri opted for a quality assurance approach, where the Member States would annually inspect and inform on the quality of its LPIS system. JRC would develop the methodological framework in close collaboration with the Member States.

### **2.2. New quality elements in Commission Regulation 1122/2009 art. 6.2**

2.2.1. In the year following the meeting, the JRC laid down a structure for the quality framework, and focussed on the specifying the quality requirements that DGAgri believed were relevant. JRC also designed several technical prototypes of the methodology and launched a feasibility study with 6 LPIS implementations. The test confirmed feasibility and offered shared experiences that helped further development.

2.2.2. By the end of 2009, discussions on the quality expectations were advanced enough to allow for a substitution of the 75%/90% rule in the (post-health check) Commission Regulation 1122/2009 art. 6.2. The resulting change forms the legal basis for the activities described in this report.

*"Member States shall annually assess the quality of the identification system for agricultural parcels. That assessment shall cover the following quality elements:*

- (a) the correct quantification of the maximum eligible area;*
- (b) the proportion and distribution of reference parcels where the maximum eligible area takes ineligible areas into account or where it does not take agricultural area into account;*
- (c) the categorisation of reference parcels where the maximum eligible area takes ineligible areas into account or where it does not take agricultural area into account;*
- (d) the occurrence of reference parcels with critical defects;*

*(e) the ratio of declared area in relation to the maximum eligible area inside the reference parcels;*

*(f) the percentage of reference parcels which have been subject to change, accumulated over the years;*

*(g) the rate of irregularities determined during on-the-spot checks.*

*When performing the assessment referred to in the first subparagraph, Member States shall:*

*(a) use data allowing to assess the current situation on the ground;*

*(b) select an adequate random sample of all reference parcels.*

*An assessment report and, where appropriate, the remedial actions and the timetable for their implementation shall be sent to the Commission by 31 January following the calendar year in question at the latest. However, in respect of the calendar year 2010, this information shall be sent to the Commission by 28 February 2011 at the latest"*

### **3. Member States interaction on the methodological development**

#### **3.1. Sofia Workshop and the role of INSPIRE**

- 3.1.1. The 2008 LPIS workshop was held in Sofia (Bulgaria) on 17-18 September, 2008 and the DGAgri's desire for a quality approach was presented. At that time Member States were addressing quality issues; some by overhauling their LPIS (often triggered by auditors), others implemented some kind of quality management.
- 3.1.2. Meeting minimum quality requirements was conceived as essential by Member States for avoiding financial correction by the EC, although some were also concerned on quality issues for tracking changes and facilitating update automations. A lack of common understanding of the LPIS elements, scope, rules and update processes, emphasized the importance of a core data mode that allowed a clarification of the semantics behind the concepts.
- 3.1.3. The workshop also confirmed that LPIS creation and upkeep face the same challenges and could apply the same technologies as any other spatial data base subject to European harmonization under the INSPIRE Directive. Although the community were still little conscious of the advantages of interoperability and many LPIS kept operating in a standalone manner, it was clear that INSPIRE would provide the technology components from which the LPIS quality assurance would be developed. .
- 3.1.4. Development would start with the conceptual approach of the LPIS, which is an indispensable basis for common documentation and for the development of exchangeable components, despite the concerns that GI modelling and standardisation methodologies were considered too abstract and costly.

#### **3.2. Tallinn workshop**

- 3.2.1. The 2009 workshop (Tallinn, 6-8th October) involved the first presentation of the draft LPIS QA framework and the first results of the feasibility trial. The proposed quality framework was generally accepted, but documentation needed improvement such as clarification and simplification,
- 3.2.2. Member States requested a trial year (without compliance thresholds) as well as quality compliance thresholds that take into account the local agricultural practices. They would repeat these concerns during the Taormina conference one month later, where the former was acknowledged but the latter not.
- 3.2.3. Member States pointed out the discrepancy between the nominal specification of the Regulations/guidelines (1/10.000, 2.5m RMSE, 0.1ha MMU) and many implemented LIPS systems (1/2.500, 25cm resolution, 0.01ha measurement) which affects the testing environment and the rationale of thresholds.

3.2.4. To accommodate a general request for training, all key elements of the 2010 version of the ETS were explained in details to delegations of all Member States during a dedicated LPIS-day in April 2010.

### **3.3. Copenhagen and Amsterdam workshops**

3.3.1. The Copenhagen LPIS workshop (September 20-22, 2010) held a balance between a number of introductory presentations and the subsequent discussion in the small working groups. These discussions and the new format were highly appreciated by the participants.

3.3.2. The general position of the Member States on the LPIS QA was that, although it laid a burden and was labour intensive, it would provide a valuable instrument. Member States had learned a lot on their LPIS during this exercise.

3.3.3. By this time, most Member States had acquired hands-on experience and this allowed to formulate of an important number of issues and constructive proposals. DGAgri and JRC analysed and responded on site to many of these. Member States and the two Commission services agreed that this way, a lot of technical progress had been made that quickly found its way into the formal guidance on WikiCAP.

3.3.4. The Amsterdam LPIS workshop (April 6-8, 2011) can be considered as an continuation of the Copenhagen one, using the same format, covering the same issues and resulting in yet more suggestions for improvement. An independent academic presented supporting conclusion as his review of the methodological framework.

### **3.4. WikiCAP**

3.4.1. WikiCAP is the Mediawiki platform hosted by the GeoCAP action since 2006. It serves as the publication media for the official technical guidance for OTSC and LPIS QA guidance as well as for any supportive information and technical discussions. Official technical guidance on the LPIS QA was published under the category [art6] but as this category is coding only for articles valid in the assessment year (currently 2011), the 2010 guidance can now only be accessed via [http://marswiki.jrc.ec.europa.eu/wikicap/index.php/GAMMA\\_0](http://marswiki.jrc.ec.europa.eu/wikicap/index.php/GAMMA_0). In July 2011, the revised 2011 guidance was published under <http://marswiki.jrc.ec.europa.eu/wikicap/index.php/LPISQA2011>, a version which has been frozen since October 7<sup>th</sup>.

3.4.2. Upon the request from the Member State to use stable documentation, the key inspection procedure (Chapter 2 and annexes) was frozen after it was presented to the DPMM. The support pages with FAQ, Q&A and other clarifications were kept as dynamic pages to enable a smooth transfer of know-how. To accommodate the requests for printable documents, an online pdf creation utility was integrated in the guidance.

### 3.5. The LPIS QA portal

3.5.1. The LPIS QA Portal Web Application (<https://lpis.jrc.ec.europa.eu/lq/index.php>) has been developed as the technical platform for the exchange of spatial and non-spatial data between a Member States and JRC. Its main functionalities are the creation and download of sample pre-selection and the upload of LPIS quality assessment XML and GML data packages. The portal uses secure SSL connection technology to control permissions (LPIS authorities and Lot instances paging). It supports file uploads with cardinality control and package editing (deactivating, updating of individual files) as well as file download of sampling and validation results. This bilateral communication between Member States and JRC is organised through reporting packages.

3.5.2. To accommodate and to report spatial and non-spatial inspection results produced by the ATS and ETS tests through the LPIS QA Portal in a coherent and structured way, a series of XML and GML schemas were developed, complying with the ISO and OGC standards. These schemas are integrated into the LPIS QA Portal that may, in future, allow for further automatic validation of the reported files' contents.

3.5.3. For the 2010 campaign, the LPIS QA Portal supported the data exchanges depicted in Figure 1. The data files are organised in three main packages: Sample Pre-selection package, ATS Reporting Package and ETS Reporting Package. The Sample Pre-selection Package supports the centralized generation of a random list of reference parcels to be inspected during the LPIS QA. The formats for the transferred files are: XML for non-spatial data, GML for spatial data and PDF for optional supportive documents.

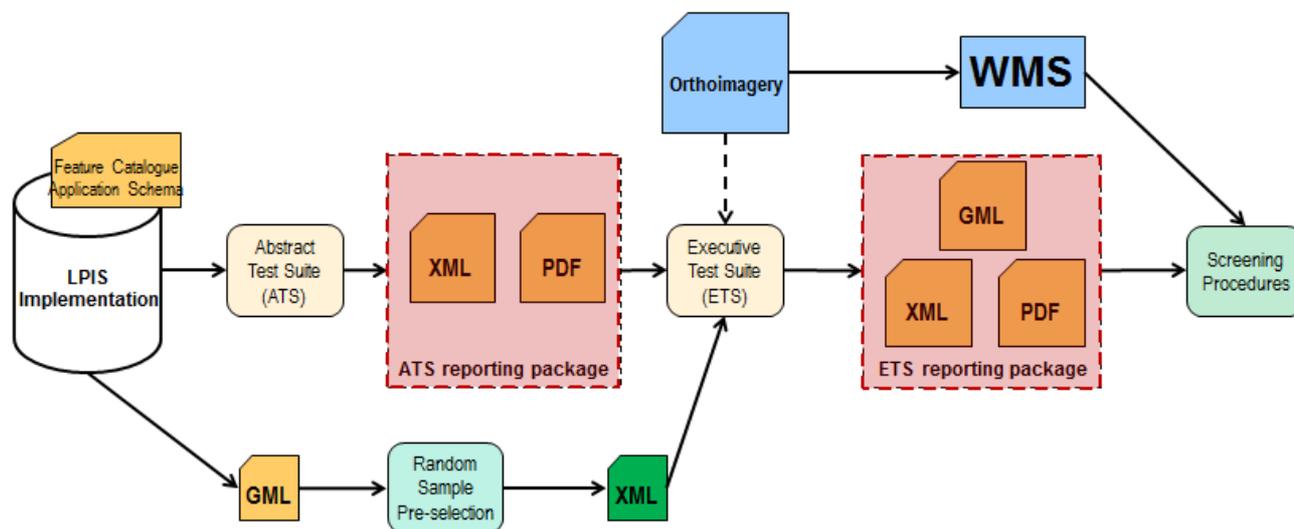


Figure 1. Data flow supported by the LPIS QA Portal. The main data types are XML, GML and PDF formats.

3.5.4. A User Manual for the LPIS QA Portal is published on the WikiCAP: [http://marswiki.jrc.ec.europa.eu/wikicap/index.php/LPISQA2011\\_3.b.i](http://marswiki.jrc.ec.europa.eu/wikicap/index.php/LPISQA2011_3.b.i) There were also two independent presentations of the Portal interface during two workshops: Amsterdam (April 2011) and Tallinn (November 2011).

The main actions supported by the Portal and explained in detail in the user manual are:

- Registering/recovering of a new user account (to identify a LPIS- authority: 43 in total)
- Logging into the LPIS QA Web Application
- Establishing LPIS Settings (to identify a particular LPIS implementation: 45 in total)
- Uploading ATS Reporting Package (describing the LPIS implementation structure)
- Creating a sample pre-selection (indicating which reference parcels to inspect)
- Downloading a sample pre-selection
- Uploading an ETS reporting package (holding all inspection results)
- Verifying a dashboard (monitoring the upload process)

3.5.5. To help the Member States to produce XML and GML files according to the pre-defined schemas, a series of customized tools was produced by the JRC (Table 1).

**Table 1. JRC custom built tools that help to provide XML and GML files valid according to the required schemas.**

JRC Tool	Description
LPIS Point Zero State	A customized script that creates a valid LPIS Point Zero State GML file from a point-type shapefile.
LPIS Polygon Zero State	A customized script that creates a valid LPIS Polygon Zero State GML file from a polygon-type shapefile.
ETS Inspection Measurements	A customized script that creates a valid ETS Inspection Measurement GML file from a set of corresponding layers/shapefiles.
XML (GML) Validator	An application that validates XML and GML files against their schemas.

3.5.6. Some additional third-party tools (from private companies and Member States) have been gathered. The list of the tools, download possibility, contact details and more exhaustive information is available at: [http://marswiki.jrc.ec.europa.eu/wikicap/index.php/LPISQA2011\\_3.b](http://marswiki.jrc.ec.europa.eu/wikicap/index.php/LPISQA2011_3.b)

3.5.7. The LPIS QA Portal functionalities were upgraded during 2011. The most important innovation is a mechanism for fully automated Sample Pre-selection generation for 2011 campaign. Still, the portal involves continuous monitoring and administration and requires some further developments into the Automatic validation of the ATS Reporting Package and ETS Reporting Package files and the a automatic pre-screening of the inspection data.

### **3.6. Peer review of the LPIS quality assurance Framework**

3.6.1. The Member States embraced the suggestion of the academic during the Amsterdam workshop, calling for a systematic evaluation of the assessment framework. This meta-evaluation was set up as a kind of "peer-review" and contracted to two independent experts, Sytze de Bruin, geoinformation quality expert and Gabor Csornai, a former LPIS responsible. The former focused on

the technical and methodological robustness of the framework, the latter on the "fitness for purpose" or usefulness for a LPIS-authority.

3.6.2. By November 2011, they produced their meta-evaluation report on both the original 2010 and the revised 2011 inspection methodologies and concluded:

1. The LPIS QA framework is unique initiative as no comparable frameworks could be identified. Considering the important financial consequences, it represents a long due step forward in the field of LPIS quality management and reporting. What makes the framework exemplary is that it involves very close Member States -EC interaction, including digital data exchange, and that it is supported with comprehensive documentation and well defined guidance.
2. Still, the documentation can be improved further, by using the templates of the recent ISO standards and by improving documentation search functionality.
3. The quality elements thresholds applied to the scoreboards appear reasonable but some measures need further investigation (to conform that this inspection result is unbiased and precise) and several thresholds require a stronger political motivation (to validate the relevance of that threshold).
4. In its current form, the instrument can certainly be used for self-assessment; however, for justification of LPIS involved risks in discussion with the EC, the above weaknesses on some quality elements need addressing, in particular:
  - a. the reference data need to be of appropriate quality; the inspection data sources should be comparable or better than the LPIS creation data source.
  - b. data must be independent; inspection feasibility checks and inspection observations should not be performed by the same person.
  - c. parcel shape/size and positional accuracy need further research; these parameters affect the area measurement precision.

3.6.3. The latter conclusions and recommendations of the expert panel could not yet be considered for the 2011 review of the inspection methodology and will be considered for the 2012 adaptations.

## 4. The 2010 Implementation

### 4.1. Sampling

4.1.1. The general sample pre-selection workflow is presented in Figure . The work consisted of three distinct activities. First, JRC received reference parcel point-data in the GML format and analysed their structure. Second, the reference parcel data were inserted to the spatially-enabled database and clipped with the appropriate LPIS Control Zones or proprietary aerial image zones. ISO 2859/2-1985, procedure was applied to determine the appropriate sampling size for one homogenous Lot of reference parcel to produce a random sample pre-selection for every LPIS implementation. The sample pre-selection was made available for download to the Member States in the XML format, following the defined schema.

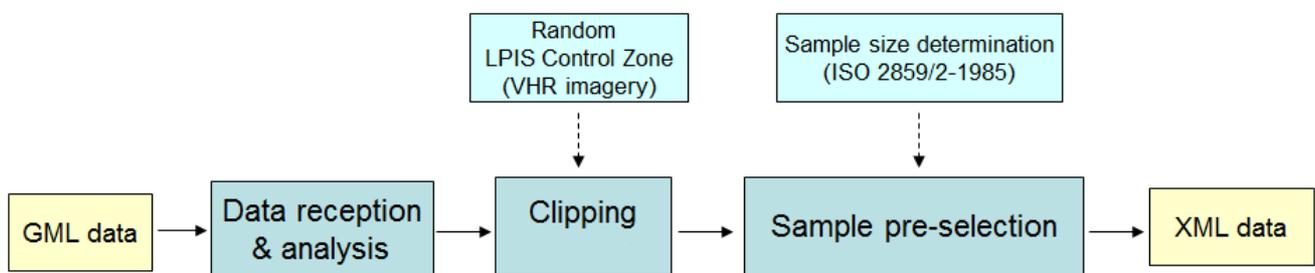


Figure 2. Sample pre-selection workflow.

4.1.2. In a European SDI (INSPIRE), the transfer of spatial (vector) data must use the GML format. The GML that an LPIS custodian creates contained for each reference parcel from the LPIS implementation:

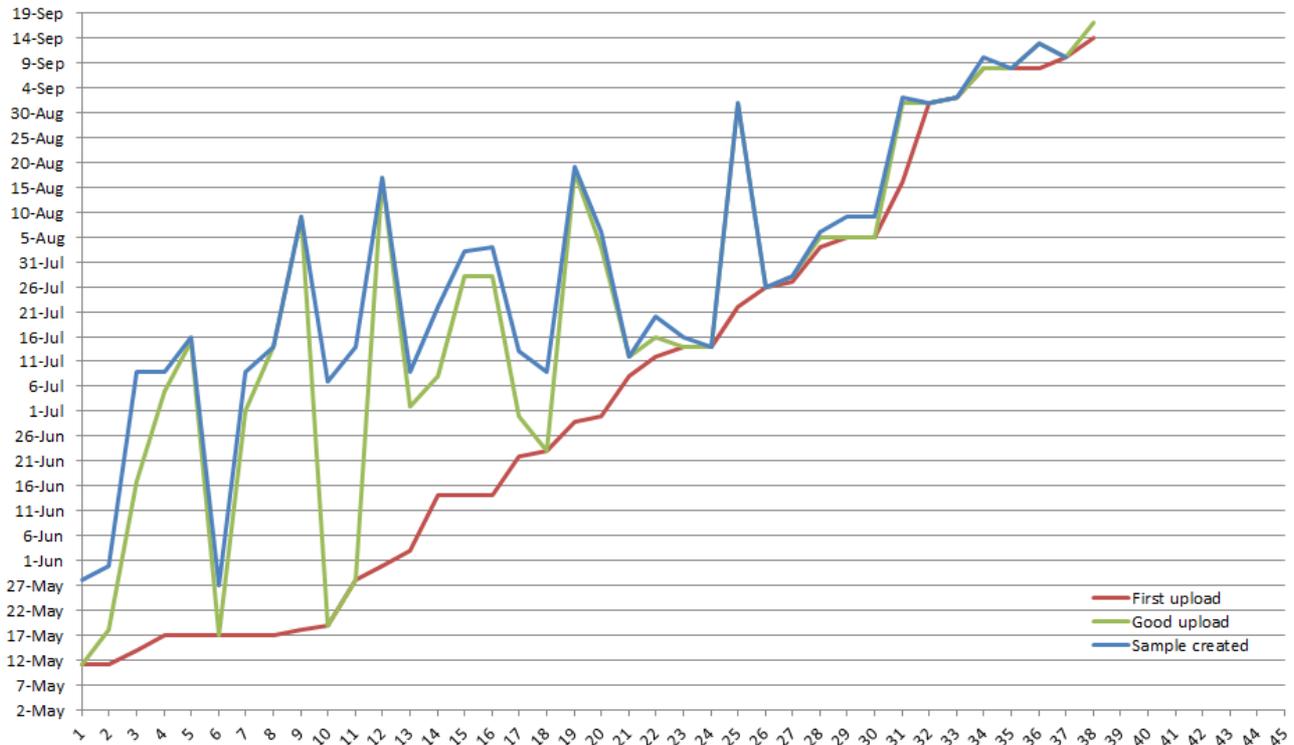
- A point representation of the reference parcel “X” and “Y”
- Information on coordinate system used, i.e. EPSG: 4326
- The unique identification of the reference parcel: “rpID”
- The “maximum eligible” area of the reference parcel, as recorded in the system “referenceArea”.

This summary information on the full population of reference parcels allows to monitor the integrity and representativeness of the inspection sample for a given assessment year and over longer time spans.

4.1.3. Frequent interactions and bilateral consultation allowed obtaining a correct GML file that could be validated against the required schema. The experience resulted in the already mentioned in-house tools/scripts for GML creation through ArcGIS scripts, Excel scripts and ogr2ogr instructions.

4.1.4. Some of the received GML files were enormous in size, up to 4Gb. Zip compression reduced these to reasonable sizes (up to 250Mb) for upload. After some initial problems with viewing and validating the large GML files, an in-house tool for validation (XML validator).was successfully created.

4.1.5. **Figure** shows the time differences, that passed between a first version GML upload, which was often not valid accord to the required schema, the final valid-GML upload and the subsequent 2010 sample pre-selection generation time.



**Figure 3. Processing times from the 1st GML upload (starting point), the valid GML upload, to the sample pre-selection generated (end point).**

4.1.6. Sample pre-selection net processing time for non-clipped populations (data reception to XML sample pre-selection generation): from 24 seconds (64000 parcels) up to 1h 40minutes (around 10,3 million parcels), plus decompression time (2min 40s) and GML validation 6min 30.

## 4.2. Key facts for the 2010 implementation

4.2.1. JRC defined common schemas for all data that needed to be exchanged during the LPIS QA Framework implementation. The schemas follow the INSPIRE recommendations and industry standards:

- 20 XML and GML schemas and templates
- 20 instance documents (examples)
- Several tools to follow the required schemas
- In collaboration with 27 Member States, 43 LPIS authorities and private companies

4.2.2. Sample pre-selection 2010 campaign was successfully conducted from May to December 2010.

4.2.3. 43 LPIS Authorities have been identified during the LPIS QA registration period and the following numbers were reported:

- More than 143M reference parcels declared to be in the LPIS Scope 2010
- More than 10 Gb of GML/XML data transferred for the Reporting Packages (ATS, ETS and Sample pre-selection). Additionally, the orthorectified imagery has been made available for the JRC screening purposes through WMS or CID services
- 43250 reference parcels had to be inspected (0,03% of reference parcels inspected)

4.2.4. Member States successfully approved 35 out of 43 ETS Reporting Packages, which were subsequently screened by the middle of December.

4.2.5. Remedial action was taken on the incorrect/incomplete ETS reporting packages through an extensive communication with LPIS Contacts. All the errors found were reported together with their and technical explanation (since May 2011). The follow-up was conducted through bilateral consultations to correct the errors up to November 2011.

### **4.3. A particular case: Scotland**

4.3.1. The JRC performed the reference parcel inspection of the Scottish LPIS (the ETS part), on behalf of the Scottish Administration as the Scottish LPIS custodian was then lacking the necessary technical capacity on image processing and image photointerpretation. The task lasted from January to February 2011.

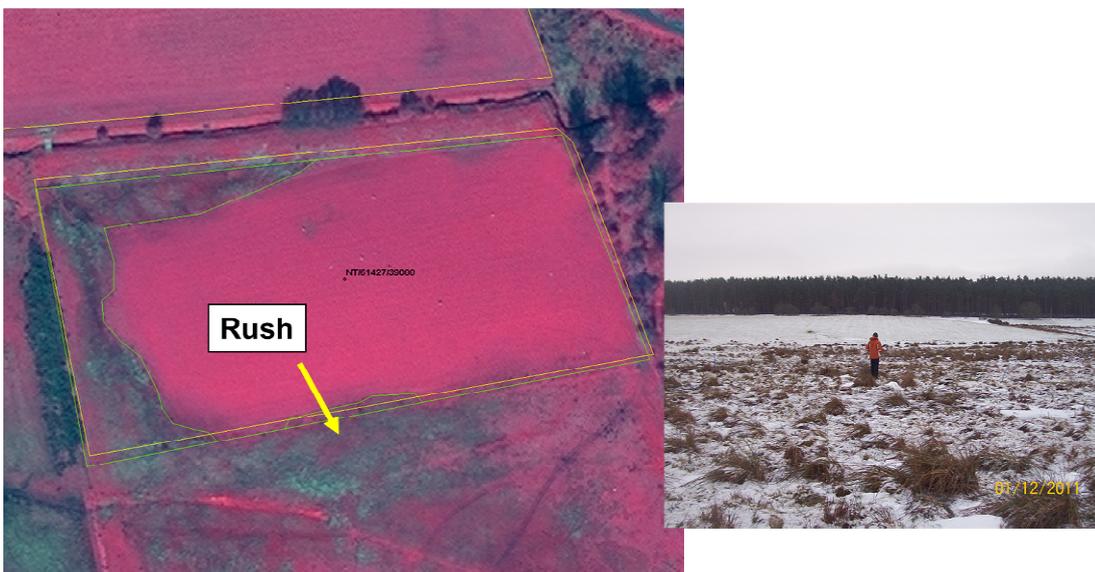
4.3.2. The whole inspection process took about 220 man-hours. It included: data pre-processing, quality assessment and integration (very-high resolution satellite data, OS maps), ground truth collection, CAPI inspection, validation (completeness, topology check), analysis and reporting.

4.3.3. The first step was a conformity check of the Scottish LPIS against the LPIS core model (ATS). This required extensive consultation on the Scottish land cover types that are considered eligible for direct aid. The LCCS codification of the land cover types in the eligibility profile, yielded the proper keys for the photointerpretation of complex land cover types as grazed forest, rough grazing with heather or rush). It took a month to finalise all clarifications on the ATS.

4.3.4. The inspection was performed by three operators working in parallel (two from GeoCAP and one from CID). Due to their different level of experience, on-the-job training and bilateral discussions on weekly basis were regularly conducted. Inspection performance doubled from 5-7 RPs per hour in the first week of inspection to 10 to 15 RPs in full process. RP per hour. The most time-consuming task was the proper identification of the land under inspection (LUI), accounting for more than 30% of the inspection time spent on a single reference parcel. Due to the complexity of the LPIS design in Scotland and the heterogeneous landscape, clarification of LUI conditions by means of ancillary data, were needed in a majority of cases. "Virtual" Rapid Field Visits were performed through Google StreetView, and found to be extremely useful. These geo-positioned photos from the ground were

extremely useful where the land cover beneath the tree canopy was not visible on the orthoimage. A total of 852 parcels were inspected, digitizing 1519 eligible land cover features.

- 4.3.5. Local terrain knowledge is indispensable for performing the ETS and a field visit to Scotland was performed on 12.01.2011 to the LPIS control zone RS 02 (Kelso, Scottish Borders, Scotland). The main purpose of the ground truth visit was resolving selected cases of LUI Identification and validating the interpretation key for certain specific natural or semi-natural land cover types as bracken or rush). For each visited reference parcel, a verification of land cover on the LUI was made; its land features were measured with GNSS and documented with photos. In some cases full area measurements using GNSS were made in order to replicate the GNSS-based ETS-observations.



**Figure 4. Collection of interpretation keys from ground truth (visit in Kelso)**

- 4.3.6. The inspection on the Scottish ETS was completed on time for the 2010 reporting deadline of 28.02.2011 and results were discussed with the Scottish Administration. Due to issues with the scope of the reference parcels, subject to the LPIS QA, a second, ETS scoreboard was created – alternative to the formal one,. The JRC team helped the Scottish administration in compiling the ETS reporting package.



**Figure 5. Rapid field visits**

4.3.7. The conduction of a full LPIS quality assessment by JRC yielded valuable information on the true workload and the robustness of the methodology. It showed that conduction of the ETS in the foreseen timeframe (2-3 months) is feasible even in such complex environments as Scotland with large size reference parcels holding several land cover types. A particular challenge for the Scottish "topographic block" is the difficult LUI identification, which often required multilayer analysis (VHR orthoimage + ordnance survey topomaps).

4.3.8. This JRC ETS experience revealed that

- the importance of the ATS and the correctness of the eligibility profile in particular.
- operator experience in land cover mapping is important, but not critical. The ETS methodology requires tailored training and some days of intensive on the job training allowed any operator with basic CAPI knowledge to perform the ETS inspection.
- critical is the knowledge on the local agriculture practices. Most of the interpretation problems the JRC operators encountered during the inspection could be linked to their lack of knowledge on the specific land context. For that reason, regular supervision of the mapping and inspection was essential.
- The user-friendly design of the GIS environment also is important and must offer an easy way to browse through the sample and to the mapping. A customised viewing environment is recommended.

4.3.9. From a methodological point of view, the Scottish exercises allowed for comparative analysis between the efficiency and reliability of the two major land inventory methods of CAPI and terrestrial GNSS survey (Table 2.). 149 reference parcels inspected with CAPI and with field GNSS. Both methods provided equivalent results. The outliers encountered could mostly be explained with the fact that both operators (CAPI and GNSS) interpreted the extent of the given LUI differently and simply measured different objects.

**Table 2: Comparative analysis between CAPI and GNSS based ETS**

Quality measures and elements	with CAPI	with GPS
Area obs (LPIS = 906.2 ha)	899.8 ha	877.8 ha
Result QE1	99.3 %	96.9 %
Non-conforming for QE2	33 out of 149	35 out of 149



**Figure 6. CAPI ETS and GPS ETS**

## 5. Quality Reporting by the Member States

### 5.1. Scoreboard documents

- 5.1.1. The original scoreboards of the 2010 LPIS quality assessment were sent by email to DGAgri in doc and pdf format, together with assessment reports and –if appropriate- remedial action plans. (deadline: February 28). These documents were delivered to the JRC via ARES. Xml-version of the scoreboards were directly uploaded by the Member States as part of the ETS reporting package; however these uploads were spread much later in the year.
- 5.1.2. In this trial year, the individual scores and the score board as a whole can only be considered as an intermediate methodological indicator, not as a final indicator for the state of quality of the LPIS. The findings and analysis in the chapters below revealed strong arguments that prevent to look at the raw scores as the final results of an LPIS:
1. Confusion and mistakes in the scoping by several Member States directly affected their score, but is not directly linked to the quality, e.g. inspecting reference parcels that are outside of scope inevitably leads to more no-conforming parcels and worse ratios in an individual score. Inappropriate scoping could sometimes yield better scores, e.g. by not inspecting known problems.
  2. Incorrect application of the inspection methodology (deliberate or not) also affects the scores directly, e.g. presenting boundaries from the LPIS as if they were independent observations improves the scores as does mitigation of findings (motivated as "*this condition is not a problem for our LPIS*"). A screening program was set up to identify problematic application of the inspection and
  3. Not all conformance level thresholds proposed for 2010 were based on scientific evidence as some represented general expectations with intend to trigger analysis and feedback into a revision of the methodology. In many cases, a Member States analysis should have led to the revision of its individual score e.g. when a scoping issue was discovered. In other cases, poor scores indicated weaknesses in the measure.
  4. The application of two quality measures has been contested and rejected by some Member States. Furthermore, three quality elements have been completely overhauled for the 2011 exercise, evidencing that the original measure and its score were not optimal for the quality element concerned.
  5. Many Member States submitted incomplete scoreboards, because they misinterpreted the instructions.
- 5.1.3. Although the scores remain essential in the 2010 methodology, the above considerations demonstrate that the 2010 scoreboards cannot be considered as a final quality mark (or "school report") for the individual LPIS implementation. These scores rather represent a calibration mark for the 2010 LPIS QA methodology itself, indicating which measures needed further tuning and which instructions needed better guidance. **The 2010 LPIS quality assessment scores were not**

**intended to and can in isolation not provide an objective and final score on the quality of the individual LPIS implementation.** As communicated to the DPMMs in July and September, no attempt was made to validate the individual scores.

5.1.4. Table 3 offers the mean scores and basic statistics from the 39 scoreboards submitted to DGAgri by the end of June. From a total of 45 LPIS implementations, 6 scoreboards representing 1 Bundesland, France, Portugal (2x) and Romania (2x) were not available and are not considered in the table. The table has not been updated or confronted with the scores of the xml-files of the ETS reporting packages, although 6 scoreboards have been updated by the Member States after the discovery of obvious reporting errors in their original submission.

**Table 3: Summary of the 39 scoreboards of the 2010 LPIS QA available at 30/6 2010. For 2010, formal expectations were only applied on QE1, QE5 and QE4**

	Quality measure	expectation	Mean observation rates (%)	min	max	LPIS reported	LPIS conforming
<b>QE1</b>	total eligible area	98%<x<102%	100,74	82,91	101,1	39	33
<b>QE2</b>	parcels with incorrect MEA	<5%	18,04	1,8	83,37	37	14
<b>QE3</b>	causes for problems	<5%	11,53	0,8	96,4	34	16
	failed update					34	
	failed upgrade					7	
	incomplete processing					11	
	erroneous processing					23	
	poor LPIS design					6	
	GAC restrictions					3	
<b>QE4</b>	potential critical defects	<1%	6,28	0,2	54,125	35	15
<b>QE5</b>	incompletely declared parcels	>95% with (90%<x<110%)	35,69	0,88	97,5	38	9
<b>QE6</b>	parcel change rate	<25%	11,50	0,9	68,4	20	19
<b>QE7</b>	application error rate	<2%	1,38	0,17	5,75	25	22

5.1.5. The Table 3 indicates that for every individual quality element, at least a quarter of the LPIS systems comply, and for most, nearly half of the group does. So in theory, each measure could make sense. However, the flip side is that for 5 of 7 measures, more than half of the implementations fails and this poor result was not expected, nor supported by indirect evidence (e.g. QE7 scores "irregular

application rate" should to some extent be related to QE2 and QE4 scores (resp. incorrect and defective parcels).

5.1.6. Another way to look into the overall score is via the number of implementations that pass all quality measures. Table 4 provides the number of LPIS implementations that pass a given number of quality measures. Again this test is based on the original scoreboards only and if a score is not mentioned the system is considered non-conforming for the measure, even when a conforming score was available in the assessment report.

**Table 4: Performance of LPIS implementations in terms of passing quality measures.**

Score	Number of LPIS
# passing all 7 QE	0
# passing 6 QE	5
# passing 5 QE	5
# passing 4 QE	7
# passing 3 QE	7
# passing 2 QE	10
# passing 1 QE	4
# passing none	1
mean EU passes	3.3

5.1.7. Looking at the scoreboards exclusively, none of the LPIS implementations would pass all criteria and this is manifestly not true. Several Member States have come forward and claimed to be conforming with all measures, although they did not report all their scores. Some because they believed it was not required for measures without a threshold, other because they felt they were complying anyway. **The 2010 scores provide a too pessimistic view on the quality of the LPIS implementations.**

## **5.2. Assessment reports**

5.2.1. The assessment reports accompanied the scoreboards to hold the self-analysis of the Member States on the observations and scores resulting from the quality inspection. The guidance indicated this document should not exceed three pages to make it concise and to the point.

5.2.2. By the end of October, all assessment reports were available; one for each LPIS authority. JRC went through the set of reports several times to discover and compare the nature and depth of the self-analysis performed by the Member States. As could be expected, the robustness of the analysis varied from Member States to Member States. However, the JRC was pleasantly surprised about the amount of knowledge and insight that had been picked up by the majority of the Member States and about the transparency many offered.

- 5.2.3. The reports from the 13 German Laender were clearly subject to a federal coordination round, often resulting in an identical positions and analysis. In principle, there is no objection to such coordination, but it does make it sometimes impossible to distinguish between the individual LPIS findings from nationally tailored arguments. Therefore, in what follows, the 13 German reports are generally considered as one report. As a result, most numbers will relate to (43 minus 13 plus 1) 31 independent reports.
- 5.2.4. All reports record conformances where possible. A total of 22 out of 31 indicated their LPIS was not fully conforming. 9 LPIS implementations thus consider themselves conforming, bearing in mind that for 2010, the focus laid on conforming thresholds for QE1, QE5 and QE7. Table 3 illustrates that QE5 is the culprit for half the failures.
- 5.2.5. Most reports elaborate on the non-conforming scores although, unfortunately, some discarded such analysis for quality elements without a formal expectation. This analysis is of interest, not only in respect to the score itself, but especially in view of the methodological weaknesses the Member States identified as a contributing cause in the poor score. Three unrelated major issues arose
1. Limitations of the photo-interpretation methodology (mentioned 9 times). This comment mostly relates to the limited quality of the imagery that is the basis for the inspection. It is considered inferior to the (spatial / radiometric) quality of imagery used for LPIS causing false non-conformances on QE2, especially for smaller parcels
  2. Inability to pick up LPIS information from any image (mentioned 9 times). The LPIS is based on information that does not correspond to visible, physical features (e.g. cadastral boundaries, alphanumerical values)
  3. Necessity to go in the field to collect the required observation (mentioned by 4 Member States and 1 Land). And although this activity seems an obvious workaround for the two earlier issues, none of the 18 above endorsed this;
- 5.2.6. The JRC detected several other methodological issues, albeit that some of these issues were also identified by the Member States in their report:
1. Poor scoping (11 occurrences): Member States that did not inspect the correct sample, either because they misunderstood the scope or because they failed to perform the correct query due to inappropriate model mapping. This is a major concern when comparing scopes
  2. Inappropriate land cover and eligibility coding (2 occurrences): Member States that explicitly deviate from the guidelines to create a land cover inspection legend.
  3. Misunderstanding causal processes (7 occurrences): Member States where the analysis provides evidence that the concept of failed process causes is not well understood or applied. E.g. the a-priori exclusion of "erroneous processing".
  4. Not applying acceptance number An (21 occurrences). The report and scoreboard provide no evidence that the Acceptance numbers have been applied when a conformance verdict was issued. E.g. the score of the sample was compared directly with the expectation rate.
  5. Mitigating observations (7 occurrences). Member States deviate from the inspection methodology, mixing observations and analysis during the inspection procedure. Observations

are analysed during and when considered "not a problem for our LPIS system", an incorrect observation record is entered.

5.2.7. The reports were deliberately kept very short and various authorities approached the report for different perspectives, it's therefore not possible to grade individual reports as if they were exam sheets. Still, of the 31 reports, JRC counted 23 that –in its opinion- demonstrated clear added value from the self-assessment and withheld from mitigating observations. In addition, 5 Bundesland reports excelled beyond the national (coordinated) German average. This high number of "favourable outcomes" indicates that the 2010 assessment has enabled a large majority to meaningfully implement the common assessment methodology and bring the self-analysis to relevant conclusions. **In the qualitative and surely subjective opinion of the JRC, 3/4 of the assessment reports demonstrated a value added outcome of the LPIS quality assessment.**

### 5.3. Remedial action plans

5.3.1. For 2010, a remedial action plan was due when at least one of the QE1, QE5 or QE7 scores exceeded a threshold derived from the quality expectation. However, Some Member States produced a remedial plan based on unsatisfactory scores of the other QE or to confirm continuation of quality efforts. The German Bundeslaender had, as for their assessment reports, performed some prior national coordination, so also here only 31 independent positions could be identified.

5.3.2. For 2010, a remedial action plan was due when at least one of the QE1, QE5 or QE7 scores exceeded a threshold derived from the quality expectation. However, Some Member States produced a remedial plan based on unsatisfactory scores of the other QE or to confirm continuation of quality efforts. Several types of remedial strategies can be identified.

1. No indication of any extra remedial action (5 occurrences): this approach can be acceptable when there is not a problem when the LPIS passes all conforming elements. JRC would consider it a statement of great confidence.
2. Correct the truly non-conforming parcels identified during the LPISQA ties (2 occurrences); this low number could indicate that not all LPIS custodians are familiar of this good governance practice. The JRC guidance on LPIS data flow suggests that such anomalies should be processed before the next application deadline.
3. Apply database changes (14 occurrences): These changes relate both to modifying the structure of tables as well as recalculating or recoding existing data values. Actions of this type are essential for any LPIS that encountered scoping problems, but obviously can affect any part of the LPIS and thus the 2011 scores.
4. Strengthen at least one the traditional update paths (26 occurrences): The five paths are
  - a. improve farmer input: on LPIS changes (8 occurrences)
  - b. improve integration of OTSC findings (6 occurrences)
  - c. start-strengthen intergovernmental collaboration (6 occurrences): main institutions mentioned are the national mapping agency (topographical block systems) and cadastre (cadastral parcel systems)

- d. start or strengthen periodic refresh activities (17 occurrences): this involves cyclic imagery acquisition followed by appropriate processing.
- e. Continue an already on-going “acute update” (10 occurrences): these are the systems that are being replaced by new databases, tools and data on a project basis,

Some 20 replies indicate doing at least 2 of these 5 update paths.

- 5.3.3. Regarding the main factor that drove the LPIS authority to take the chosen line of actions, 18 authorities related to the findings of the self-assessment, whereas 5 documents referred to earlier audit findings.
- 5.3.4. Half of the combined assessment report and remedial action plan pairs proactively looked into improving the inspection methodology; 6 authorities requested to take into account updated information provided by the farmer during the annual declaration process and 10 asked for a modification of certain QE conditions and thresholds. Both requests were accommodated for in the revision of the methodology for 2011.
- 5.3.5. Short reports, absence of validated scores and lack of detailed knowledge on the individual LPIS implementation render it impossible to grade the effectiveness of an individual remedial action plan; time (and the next series of LPIS QA outcomes) will be the judge of this. To provide a rudimentary categorisation of the set of reports, JRC favoured remedial action plans that related to at least some the findings of the assessment reports and proposed—in the opinion of the JRC- responses sensible. This yielded a count of 20 out of 31 (and 5 of the 13 Laender) remedial action plan. **In the qualitative and surely subjective opinion of the JRC, 2/3 of the remedial plans demonstrated sensible responses to the quality findings.**
- 5.3.6. For the sake of completeness, we report that half the LPIS QA participants (16 of 30 LPIS authorities and 4 of 13 Lander) produced both an assessment with extra value added as well as a remedial action plan that stood firm. The mismatch is due to some unimpressive reports that led to convincing remedial plans and some good reports that were followed by an unimpressive action plan (which is evident in cases scores were considered sufficient).

#### **5.4. ATS reporting packages**

- 5.4.1. Since the CAP legislation does not provide a specific instruction on how the Member States should conceive and implement their LPIS systems, multiple solutions and designs have emerged and a need for harmonization appeared. Therefore a common LPIS Core Model (LCM) has been produced, for translating legislative terms into the technical language used in the geospatial realm.
- 5.4.2. The Abstract Test Suite (ATS) is the set of abstract tests organized in modules, to verify the conditions of these specified requirements. If all were found satisfactory, a statement of conformance for the LPIS implementation under test can be issued (ISO19105). An ATS deals with database structure, logical and conceptual consistency and how the database design is ‘fit-for-purpose’. Logical consistency describes the degree of adherence to logical rules of data structure, attribution and relationships (compared to the LCM) while completeness checks presence or

absence of features, their attributes and relationships. Conformity of the model is a pre-requisite for a meaningful testing of the data values in the ETS by capacity tests.

5.4.3. The ATS reporting package that had to be sent to JRC for the screening was composed of the following elements:

- An ATS-scoreboard (XML) holding conformance statements on individual database requirements
- Implementation Conformance Statement with
- An Eligibility profile , identifying the local land cover types and their eligibility status
- Applicable waivers (XML), a priori defined vindications of observed non-conformities
- Procedures (PDF), providing support for the waivers above
- ATS-log report (XML), holding the factual observations of the test suite

5.4.4. More than a third of the Member States (12 out of 27) consulted the formal content of their eligibility profile with JRC, prior to the conduction of the ETS. Most of them had country-specific agriculture land cover types (classes), for which tailored user-defined codes had to be generated. In the majority of cases, these specific classes were related either to various mixtures of different life forms (implying often the use of the “pro-rata” concept) or to landscape features, subject to retention according to Art 34(3) of Commission Regulation 1122/2009. All these land cover types were considered as eligible by the EU Member States themselves, on the grounds of their national legislation, country-related agriculture practices and supporting schemes applied.

5.4.5. JRC staff discussed individually with each of the 12 Member States the definitions of the nation-specific land cover types and the motivation for their inclusion. During this bilateral information exchange, both parties managed to gain valuable information with respect to the agriculture landscapes in these countries. They also found out and agreed that the local traditional agronomic practices play an important role when a decision whether a given land cover type should be considered as valuable for agriculture or not. This is particularly valid for mixed land cover features combining elements of cultivated land and natural or semi-natural vegetation. JRC constantly emphasized that the scope of the eligibility profile is strictly limited to pillar I of CAP, therefore any land cover types eligible for pillar II only (RDP) and all strictly non-agriculture land cover features should not be included in the eligibility profile. Later, upon request from some Member States and after consultation, JRC introduced in the list of classes in the eligible profile template (Table 2 of annex III), some specific non-agriculture land cover features (afforested areas, wetlands, etc.), for which entitlements for SPS are still granted.

5.4.6. The most common country-specific land cover classes, for which specific LCCcode were designed, can be grouped in the following categories:

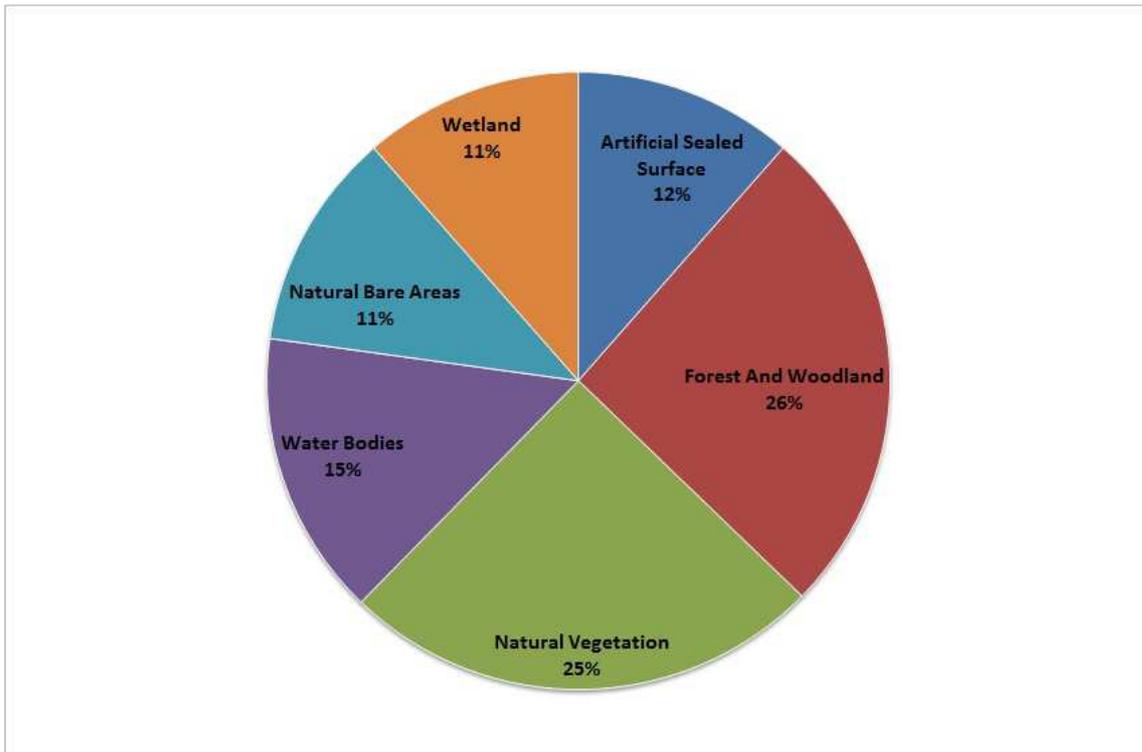
- An intrinsic mix of two or more cultivated crops, belonging to different life forms (intercropping): 100% eligible
- An intrinsic mix of cultivated land and natural (semi-natural) vegetation: pro-rata reduction:
  - Same life forms
  - Different life forms
- Landscape features: 100% eligible in certain conditions
- Main discussion points

5.4.7. The main discussion point during the preparation land cover classes of the eligibility profiles was related to the application of the “pro-rata” concept. Many EU Member States experienced initially difficulties to understand the essential idea behind the “pro-rata”. The problem arises from the fact that the notion of “mixed land cover” is by default interpreted in the strict cartographic sense, as a combination of two or more single land cover types found inside the minimum cartographic unit. In the context of ETS, which is (cartographic) scale independent, the “pro-rata” is typically a well described land form/habitat with an intrinsic land cover mix that is:

- Defined and (typically) named
- Easily identifiable and distinguishable:
  - By its characteristic (physiognomic-structural) components
  - In a specific local context
- Has well known and stable proportions of the mixture components
- Often the result of a typical agricultural practice

The “pro-rata” class has agriculture component that cannot be precisely mapped by any means, but can be correctly expressed as percentage of the total area of the delineated “pro-rata” polygon. In any case, whenever ETS operator needs to deal with land cover features subject to “pro-rata”, he should always separately delineate any distinct patches of homogenous components larger than 0.1 ha, as well as any non-mixture components (e.g. roads).

5.4.8. Landscape features: Another issue that required substantial iteration between JRC and the Member States Administration was related to the proper LCCS codification of the landscape features, subject to retention. JRC had to explicitly clarify that regardless the fact the landscape features to retention are potentially eligible for direct aid, they become eligible only if certain additional criteria (inside or adjacent to agriculture land) are fulfilled. There were certain landscape features with complex definition, involving not only land cover, but also soil, lithology, altitude and climate-related properties. Their codification in LCCS, while completely feasible using the optional environmental classifiers, required the design of some specific user-defined attributes, not available in the standard LCCS package.



**Figure 7. Distribution of the nature of landscape feature type expressed as non-agricultural land cover categories reported in the eligibility profiles**

5.4.9. The pre-ETS communication of the eligible profile to JRC and the Member States and the triggered discussion were extremely important and useful for both parties in order to ensure correct data capture and interpretation of the land cover features in the ETS. This process helped convincing certain Member States that the eligibility needs to be addressed through the land cover paradigm. Last, but not least, JRC managed to collect indispensable information on the agriculture eligible land cover types and landscape elements in the EU Member States.

## **5.5. ETS reporting packages**

5.5.1. The core objective of the ETS is to collect the necessary and sufficient observations to assess the ability of an LPIS to effectively perform its tasks: the unambiguous geographic location of agriculture fields and to quantify the area of eligible land. The corresponding performance criteria are expressed via the 7 quality elements in the revised article 6.2.

5.5.2. The ETS reporting package that the Member States sent to the JRC for the screening proposes is composed of the following reporting files. The data file format is XML but where coordinates are involved, GML is used:

- A statement on the ATS conformity, if the LPIS conceptual model has not been changed since previous year (PDF)
- An xml version of the ETS scoreboard, holding the summary of findings

- ETS observations: raw observations (observed values) for all measures on all inspected parcels of the sample
- ETS inspection measurements: geographical features mapped during the ETS inspection for all measures on all inspected parcels of the sample
- Orthorectified imagery access via an INSPIRE compliant WMS. If a Member State doesn't yet have such online service available: delivery of the orthorectified images to JRC's CID portal
- A List of query statements used to analyse and process the data quality measures of ANNEX IV
- Rapid Field Visit forms containing a description of a field visit and a link to its graphical documentation
- The Sample pre-selection status table containing a list of the inspected and skipped (with a valid reason) reference parcels
- LPIS polygon zero state: extract from the LPIS data under inspection, i.e. reflecting the state at the first step of the ETS:
  - the selected reference parcels (geographical and alphanumeric attributes)
  - boundaries, identifier and reference area of any parcel within a distance of 100 meters from the boundary of the inspected parcel

5.5.3. Member states operating SAPS with historical GAC restrictions, shall in addition report:

- GAC vector data for the inspected parcels (historical GAC mask)
- ETS observations GAC: raw observations (observed values) for all GAC-related measures on all inspected parcels of the sample
- ETS scoreboard GAC: the supplemental scoreboard

5.5.4. By the end of 2011, 37 out of 45 ETS Reporting Packages were successfully approved by the LPIS authorities, indicating the completion of the upload process. AT, CY, IE, HU, LV and PL failed to complete the upload process. Incomplete packages were not subject to screening. Extensive communication with LPIS Contacts followed any incorrect/incomplete ETS reporting package. All the errors found were reported together with their and technical explanation (since May 2011). The follow-up was conducted through bilateral consultations to correct the errors up to November 2011.

5.5.5. ETS 2010 packages have been uploaded, approved and successfully screened for 37 separate Lots out of 45. The latest approval of the ETS 2010 package took place in early December 2011 at which time 7 Member States had not fully uploaded data or failed to approve their ETS 2010 package. Correct and complete data for the screening have been at the first attempt provided for only 8 Lots. As a result, many uploads involved repetitive uploads and bilateral communication with the Member

States, when in data preparation and screening environment setup a series of inconsistencies in the ETS packages have been identified. The observed package inconsistencies were:

- absence of the parcels skipped from the inspection in the data set - occurred for 23 Lots;
- delivery of an invalid GML/XML file - occurred 18 times;
- an insufficient or excessive number of inspected parcels - occurred for 11 Lots;
- absence of required LPIS data (neighboring within 100 m of the inspected parcel in Zero State Polygon) - occurred for 7 Lots;

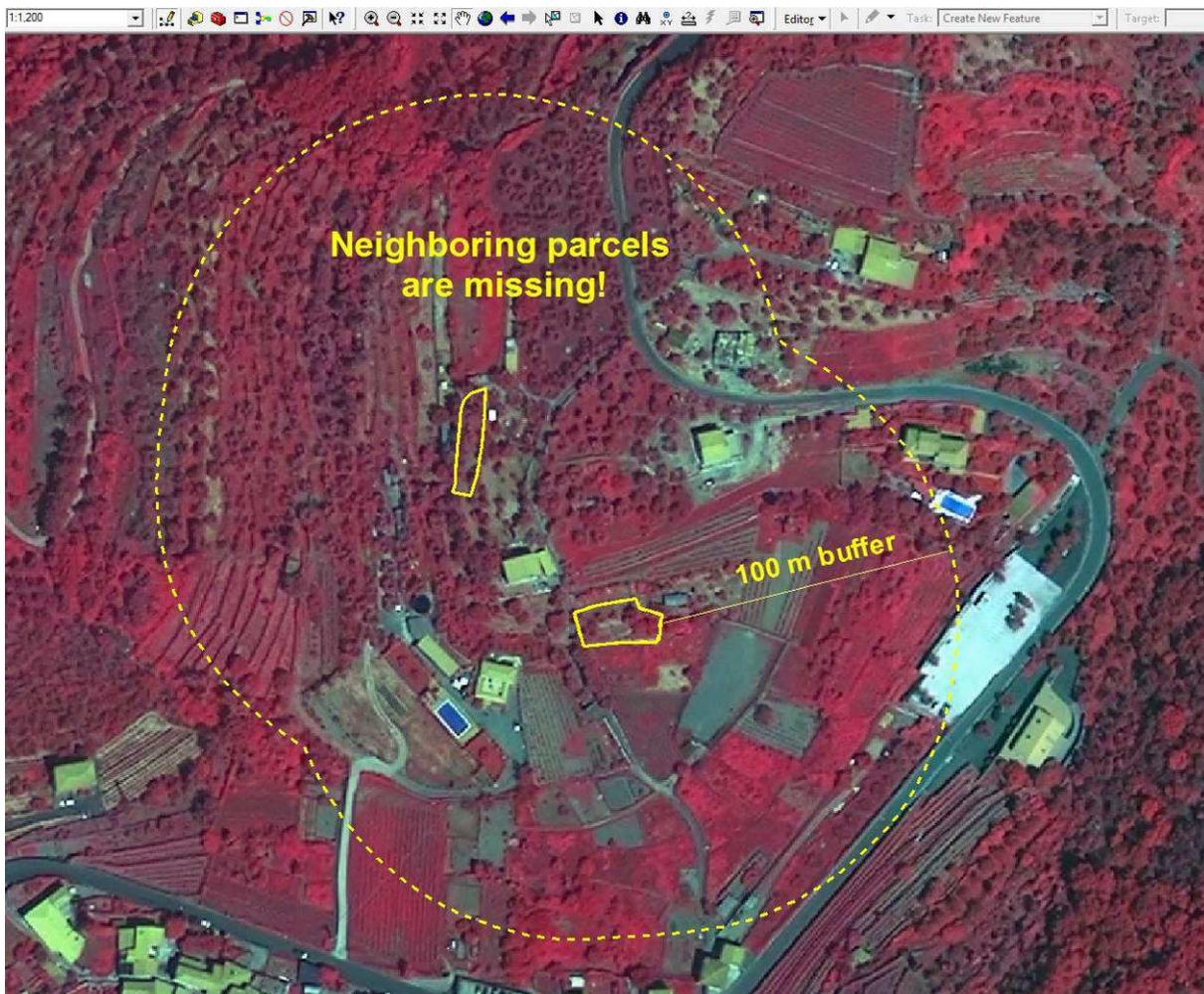


Figure 8. Example of an incomplete LPIS polygon zero state GML file

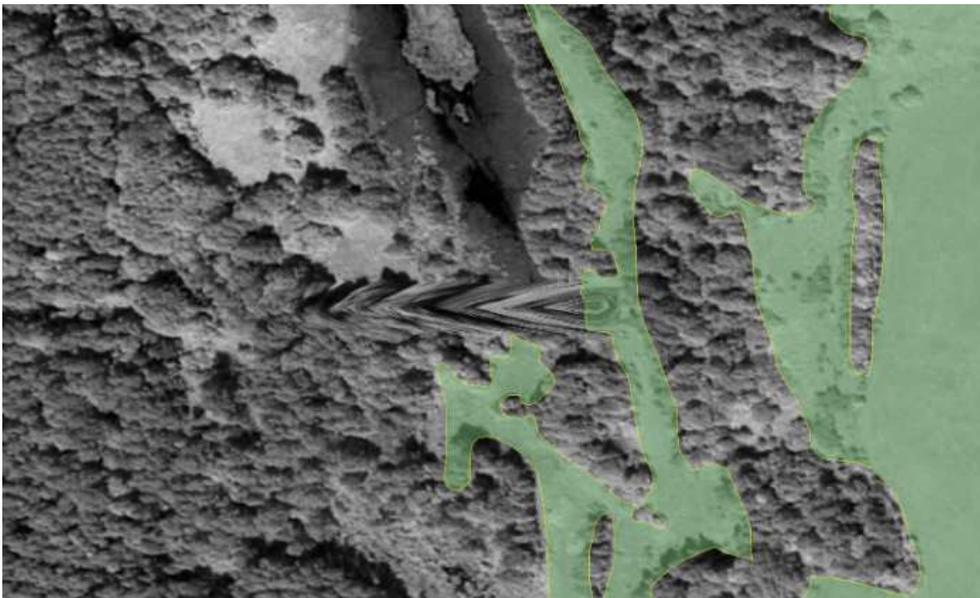
- different attribute value assignment of the same observation in 2 parallel data sets - occurred 5 times;
- coordinate system mismatch between data files in the same sets - occurred 4 times;
- erroneous rounding of the recorded attribute values;

- uniform (default) attribute value assignment for all inspections;
- damage of complicated polygon geometry (during the exporting process);
- incomplete uploaded files;
- incorrect geometric attributes of the features (f. ex. points instead of polygons).

5.5.6. Number of Lots accompanied by orthoimagery of the recommended quality was 18 (out of 37). The number of Lots with combined proper orthoimagery and complete inspection data sets is only 6. The orthoimages used as basis for the screening were those available to JRC via a WMS by CID or by the Member States. The processed images and information on imagery metadata have been foreseen to be collected by JRC, MARS Unit, CID Action, according to the technical specification: <http://mars.jrc.ec.europa.eu/mars/Bulletins-Publications/Common-Technical-Specifications-for-the-2010-campaign-of-Remote-Sensing-Control-of-area-based-subsidies>

5.5.7. During the screening, inconsistencies in image processing and quality have been observed, such as:

- partly missing imagery - occurrence for 6 Lots;
- evidence of local DEM errors - occurrence for 5 Lots;



**Figure 9. Example of an orthoimage with local artefacts caused by DEM errors**

- degraded pixel size for the sensor's GSD - occurrence for 2 Lots;
- radiometry issues degrading image content - occurrence for 2 Lots;
- usage of image with worse data content where a better alternative was available;

- use of sensors that were not approved in the 2010 campaign (such as WV1) - occurrence for 2 Lots.

5.5.8. The screening of the 31 Lots – Lots without full and consistent data package for ETS 2010 - has been performed under the assumption that the missing data caused no hidden bias. Even so, it is important to underline that the incomplete packages always create an extra challenge for the screening and assumptions inevitably lead to inconclusive findings.

5.5.9. 4 Packages contained Rapid Field Visit data and a valid format delivery occurred for 2 packages.

5.5.10. To minimize time losses for manual data validation and subsequent bilateral communication, a fully automatic package validation before upload and approval could be performed in future. This should involve:

**Table 5. ETS packages – list of candidate items for automatic checks**

<b>ETS-packages - list of possible things for automatic check</b>	
1	check whether the RPid in ETS observations follow the LPIS Sample Pre-selection Status order
2	check whether the amount of 'inspected' parcels meets the required sample number for the given Lot
3	check whether the amount of parcels in LPIS Polygon Zero State is significantly greater than amount of inspected parcels (indicating the presence of the 100m neighborhood around inspected parcels)
4	check whether a parcel's RPid flagged as 'skipped' in LPIS Sample Pre-selection Status, is present in ETS Observations table
5	check whether the name of the agriculture Land Cover Class in ETS Observations table is expressed by two-letter mapping codes, present in the Eligibility Profile
6	check whether, an attribute field from the ETS Observations table, is not populated with a uniform value for all Reference parcels
7	check whether the attribute fields storing area measurement values in the ETS Observations table, have the same precision (eliminating rounding), and whether their format correspond to the one stated in the specifications

## **5.6. Archiving Packages**

5.6.1. Any quality other information and supporting documents that were not included in the above reporting, should have been stored by the Member State in either the ATS archiving package or the ETS archiving packages to be stored for possible access.

5.6.2. In particular, the ATS archiving package holds:

- The application schema or feature catalogue, holding the LPIS data model
- An ICS textual part, holding unstructured observation records.
- The ETS archiving package is composed of:

- inspection records, i.e. the observation logs, source data and ancillary data used for filling in the tables of raw observations
- an ETS inspection log: i.e. documentation on the environment, tools and activities involved during the inspection

## **6. Screening of the 2010 ETS-packages**

### **6.1. Objectives**

6.1.1. The fast screening of the 2010 ETS-packages had two main objectives

1. evaluate the inspection methodology and feedback issues and examples into an ETS revision;
2. identify issues with the application of the inspection methodology for each individual LPIS custodian to help them organizing remediating actions.

6.1.2. The fast screening activity has not been designed to validate the 2010 scores nor to validate the analysis report produced by the individual LPIS custodians. JRC made no attempt to link this screening to the 2010 QE scores. Furthermore, the fast screening of the inspection did not deliberately seek to inventory particular LPIS problems in a specific LPIS implementation.

### **6.2. The screening methodology and process**

6.2.1. The screening involved a visual re-inspection, either on the first records encountered from the sample pre-selection list (from 'inspected' parcels) or on a set of randomly selected records. 'Skipped' parcels, where available, have all been screened in view to verify their technical reason for skipping.

6.2.2. The screening validated whether the parcel inspection methodology was applied according to the steps of activity diagram of Annex II. A screened parcel was subjected top-down to all steps of the diagram. Therefore the screening report is activity (i.e. Annex I measure) based. When a methodological issue was detected this was counted to the corresponding activity and the first parcel occurrence of the problematic measure was recorded on the report. Optionally, the rpID of other affected parcel(s) was given as an example.

6.2.3. The number of inspected parcels actually screened varies from 20 to 125 inspected parcels. In the summer months, the smaller number tended to relate to packages that presented systematic issues rendering further screening less relevant, the higher number indicated fewer issues. Time constraints forced that the screening performed on the ETS-packages that were approved late were limited to 20 parcels, regardless the findings.

6.2.4. It is important to note that the screening reports only indicate what the JRC could notice or detect during its screening process. All screening observations are, apart from the influences indicated above, also -at least partly- depending on the technical environment, as set up by JRC.

6.2.5. The ETS 2010 package screening findings were recorded in the report, individually prepared for each LPIS implementation and every report requires individual analysis. The reports are intended to

be informative, not normative. Detailed information on the 2010 screening reports and the nature of methodological issues can be found via the WikiCAP articles:

[http://marswiki.jrc.ec.europa.eu/wikicap/index.php/GAMMA\\_3.c.iiiiiii](http://marswiki.jrc.ec.europa.eu/wikicap/index.php/GAMMA_3.c.iiiiiii)

The screening report 2010 template can be found here:

[ftp://mars.jrc.ec.europa.eu/lpis/templates/ETS\\_Screening\\_2010/screeningreport\\_template\\_4\\_3\\_3.pdf](ftp://mars.jrc.ec.europa.eu/lpis/templates/ETS_Screening_2010/screeningreport_template_4_3_3.pdf)

### 6.3. Identified inspection issues

6.3.1. The most common ETS inspection errors 2010-2011 identified during the screening of 37 available ETS packages are listed in Table 6. The table lists for each issue ("type of error") the number of packages which are significantly affected and those where the problem is absent.

6.3.2. A LPIS "Lot" is affected significantly by the error, if the given error occurs in:

- 100% of screened parcels, for most of the errors affecting the result of at least one quality element from the scoreboard, OR
- More than (or equal to) the percentage indicated in brackets, for specific type of errors affecting the results of most of the quality elements from the scoreboard.
- The remainder of both (from 37) is not represented a separate column, but represents packages with sporadic occurrence of the specified issue.

**Table 6. The most common ETS inspection errors 2010-2011 identified during the screening of 37 available ETS packages**

TYPE OF ERROR	N° OF LOTS AFFECTED SIGNIFICANTLY BY THE ERROR	N° OF LOTS NOT AFFECTED BY THE ERROR
topological errors in the DB	2 Lots (more than 30% of screened parcels)	15 Lots
incorrectly (inspected and skipped) parcels	3 Lots (out of 29 Lots that have provided skipped parcels; more than 40% of screened parcels)	8 Lots (out of 29 Lots that have provided skipped parcels)
incorrect clear/unclear boundary	0 Lots (more than 40% of screened parcels)	14 Lots
incorrect processing of parcels with unclear boundary	3 Lots (more than 40% of screened parcels)	23 Lots

land cover mapping issue	9 Lots (more than 70% of screened parcels)	0 Lots
eligible area counting issue	5 Lots	26 Lots
landscape features scope issue (LF not assigned to the reference parcel)	0 Lots	33 Lots
landscape features mapping issue	4 Lots	28 Lots
landscape feature area derivation issue	4 Lots (more than 50% of screened parcels)	28 Lots
non-agricultural land cover issues (determination/counting)	1 Lot	25 Lots
potential critical defect detection issue	0 Lots	25 Lots
area-based conformance check issue	10 Lots	18 Lots
contamination based conformance	2 Lots	18 Lots
non-conforming parcel check issue	1 Lot	19 Lots
<b>total</b>	<b>44</b>	<b>280</b>
correctly inspected parcels (some affected by systematic issues)	11 Lots correctly inspected parcels is 0%	14 Lots correctly inspected parcels is equal or more than 40 %

ETS 2010 inspection errors distribution by Lots:

**Table 7. ETS inspection errors 2010-2011 distribution by Lots**

N° OF LOTS SIGNIFICANTLY AFFECTED BY 4 ERRORS	5
N° OF LOTS SIGNIFICANTLY AFFECTED BY 1 – 3 ERROR(S)	20
N° OF LOTS NOT AFFECTED BY THE SIGNIFICANT ERROR	12

6.3.1. Although based on simple and robust flow of events, synchronized with the principle ETS workflow, the “screening” relies on clear prerequisites, which if absent or not fulfilled, could render the whole process useless. The completeness, correctness and readability of the ETS reporting package, is a first crucial prerequisite for meaningful screening and analysis. Even one ne missing element can jeopardize the whole screening process. For that reason, JRC invested considerable time and efforts into pushed the EU Member States to provide complete and correct data. .

6.3.2. A second factor of primary importance was the appropriate understanding and implementation of the land cover concept during the ETS. The terms “land cover” and “land use” were often confused and

such conceptual error had an immediate adverse effect on certain ETS observations and the subsequent screening. Without a standardized and concise LC language the ETS observations are simply not verifiable. Despite JRC's efforts to raise the importance of the eligibility profile for the proper inspection, land cover was somehow marginalized (not used efficiently in the image interpretation process).

6.3.3. Last but not least, the quality of the reference CwRS orthoimagery was often the major bottleneck. Poor imagery not only hindered the ETS inspection, but it also made the work of the screening operator nearly impossible. In several cases, the provided orthoimagery was far from the optimal quality expected for the given sensor. Partial or total absence of metadata prevented our investigation into the causes of these poor orthoimage products.

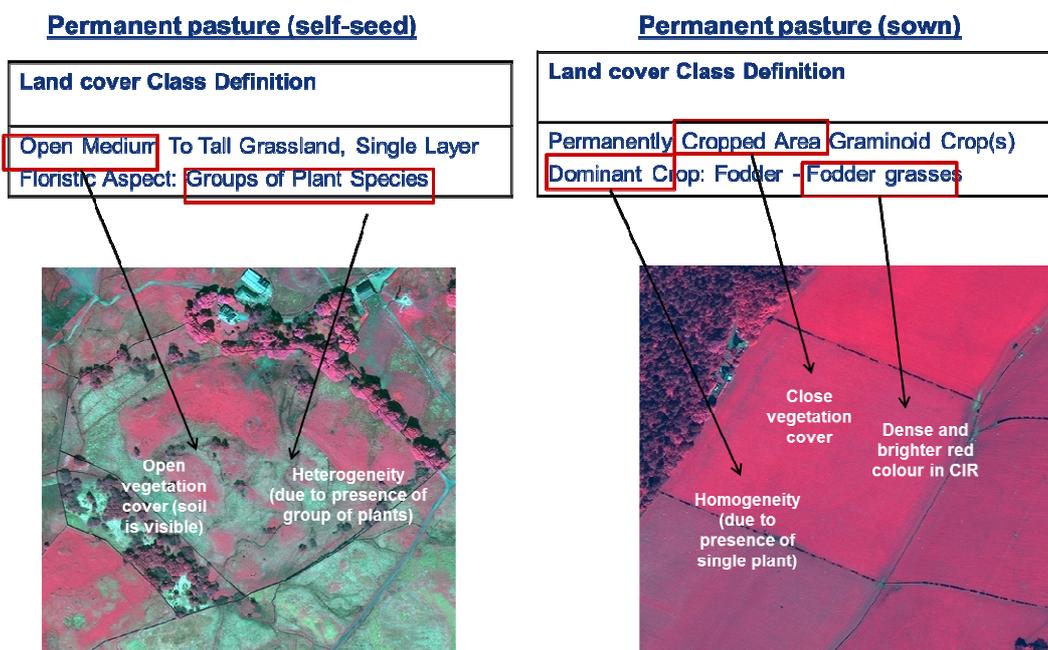


Figure 10. Interpretation keys derived from the LCC class definition in the eligibility profile

#### 6.4. Feedback to the Member States

6.4.1. The first screening objective was to investigate the presences of errors to gain a better insight in the inspection methodology. This outcome is addressed in chapter 8.

6.4.2. The other objective was to setup a feedback channel to the actual LPIS quality inspectors. This was implemented by indicating detected issues and illustrating each issue with at least one parcel that was affected. An experienced LPIS inspector could be expected to understand the issue and recognize other occurrences. Additionally, after communicating an individual ETS 2010 screening report, JRC offered telephone support on issues that seemed not clear or not understood. 4 LPIS authorities took advantage of this offer and 5 received subsequent clarifications via e-mail.

6.4.3. ETS errors revealed during the screening could be attributed to the following causes:

- Inappropriate LPIS concepts

- spatial reference objects unrelated to the land
- In some limited cases, insufficient level of awareness of the LPIS QA scope and purpose
- Inappropriate eligibility profile; incorrect interpretation keys for CAPI
- Specific design and behaviour of the GIS environment
- Poor quality of the reference data (orthoimagery) Incomplete/incorrect eligibility profile
- Non-standard ETS mapping legend

6.4.4. This feedback from the screening triggered fruitful bilateral discussions with the Member States on certain conceptual aspects of LPIS Quality Assessment and future update issues. It identified potential ideas in relation to the technical support for CAP post-2013 such as use of the land cover concept, quality assessment of reference orthoimagery and INSPIRE compliant data exchange.

## **6.5. Some further observations**

6.5.1. The Eligibility profile was found to be the key bridge between land and eligibility. As it provides the conversion “schema” from land cover types into eligible hectares, an incomplete or incorrect eligibility profile renders the ETS outcome unreliable. The harmonised description of the local “agricultural land” concepts and semantics, required for the screening, is currently ensured through the FAO Land Cover Classification System (LCCS); In future the migration toward the Land Cover Meta Language (future ISO 19144-2) will be required.

6.5.2. The screening revealed also that the skills and expertise of the ETS operator are decisive for the correct collection of ETS observations. This required knowledge in ETS-tailored large scale land cover mapping as well as sufficient knowledge of the local landscape elements and agriculture practices.

6.5.3. The screening identified the clear need to reinforce the quality control of the orthoimagery used for the Control with Remote Sensing (CwRS) and LPIS QA respectively. In parallel, the specifications on orthoimagery need to be revised; and appropriate quality inspection procedures have to be designed for each of the quality elements and expectations (geometry, radiometry, and information content). The outcomes of the INSPIRE TWG on orthoimagery will have to be considered therein.



Figure 11. Quality issues with the orthoimagery delivered in the frame of the CwRS

## 7. **A review of the methodology: ETS4.3 > ETS5.1**

### 7.1. **Summary of findings**

7.1.1. A substantial feedback from the 2010 LPIS QA implementation was collected from the Member States reports, dedicated workshops and bilateral meeting with Member States, as well as from the screening of the ETS results. The outcomes of this feedback point to certain issues and weaknesses in the LPIS QA framework, triggering a number of conceptual and technical changes in the methodology. The most important modifications were related to: clarification of the data quality scopes for each quality element; the re-definition of the critical defects; the inclusion of the farmer input; the complete revision of QE5, QE6, QE7 and the ability to use proprietary imagery (combined with a stricter rejection of orthoimagery imagery with disputable quality). A general clarification and update of the role of the self-assessment based on the ETS scores, was made as well. Some of the major changes were explained more in detail in the paragraphs given below.

7.1.2. Data quality scopes: The original subdivision of the LPIS QA sample on “total population” and “subpopulation” was abolished as it was found confusing; its revision kept only 1 population, that has to reflect the yearly LPIS QA scope, and equals to the Lot. A separate (de)nominator for each quality element has been introduced, though the DQ\_scope descriptor. This was made to account the simple fact that each quality element applies only for the group of reference parcels, where it was possible to inspect the ETS supporting quality measures. This needed a separate flow schema, that directs parcels into DQ\_scopes and so maximises information extraction;

- 7.1.3. Critical defects: The list of "potential" critical defects was completely revised, in response of the numerous demands from the Member States Administration to further clarify their meaning and purpose. Moreover, it became evident that the original definitions allowed unacceptable arbitrary interpretation. The two-stage process of the RP having critical defects (first flagging as potential, and then applying waivers to filter out the non-confirmed ones) was complicated and offered no substantial added-value for the inspection; This tempted the Member States to use the waivers as wildcards in all doubtful case, even where clearly not appropriate. For these reasons the critical defects were re-designed to address only true cases of reference parcel with properties that prohibit correct use in the LPIS processes. The list of local conditions for each defect was enhanced and amended to ensure that only cases with sufficient evidence from the ground will be picked up in the ETS.
- 7.1.4. As a consequence of that the above paradigm shift of "potential" to "confirmed", the type "unclear boundaries" disappeared, and a new type "invalid boundary" entered. Therefore, reference parcels whose LUI is not measurable, due to invisible limits, were no longer flagged as having critical defect, unless there were specific evidences of a true critical defect.
- 7.1.5. The resulting list of these "confirmed" critical defects counted 6 cases; some are RP-type dependent:

Total absence of eligible area	<input type="checkbox"/> scoping issue: should not be a RP
Invalid perimeter (not 1 correct point)	<input type="checkbox"/> not a land unit as all boundaries are virtual
Invalid common boundaries (min 2)	<input type="checkbox"/> sliding "tube", does not represent a practical parcel for holding agricultural land
Incomplete block	<input type="checkbox"/> open "container" as there is unaccounted agriculture land, associated to the block
Multiparcel (min 10)	<input type="checkbox"/> amalgamate of land units
Multipolygon	<input type="checkbox"/> design issue

As unconfirmed defects were no more picked up, waivers for this quality measure was all abolished.

- 7.1.6. Several Member States argued that as the sample of the reference parcels for the ETS, is selected before the end of the application year, the inspection is not accounting for the regular changes and updates that farmers are reporting during the declaration procedure. Thus, the ETS is missing important input, which if not accounted, can bias the results of the ETS towards a much larger number of non-conforming reference parcel reported. For that reason, the ETS procedure was revised in a way that, any input from farmer in accordance with rules of Article 14 from Regulation 1122/2009, as well as any input triggered by the annual LPIS update procedures, is processed into the sample prior to the inspection.

- 7.1.7. There was criticism that the definition and score of quality elements 5, 6 and 7. QE 6 and QE 7, was based on IACS and OTSC data, rather than on the LPIS QA sample; Furthermore, QE 5 monitored the farmer behaviour at RP level, which according to the LPIS custodians was out of their control. In response, all these 3 quality elements were revised and strictly based on the LPIS QA sample. The new QE6 was derived on selected QE3 results for quality elements 3 (categorization of non-conformities), while the new QE7 builds further on partial QE2+QE4 results, applying simple probability statistical analysis to spot for correlations.
- 7.1.8. Regarding QE5 (Area declared rate) a special Thematic Working group (TWG) involving JRC and representatives from 6 Member States Administrations was established. After a short period of consultation and working meeting, the group came up with several alternative suggestions for Quality Measure 5:
- parcel based, scoped on changed parcels
  - sample based, with common threshold
  - sample based, with “local” threshold

Based on the above proposal, some trial tests were launched were launched. The responses received were interesting, but inconclusive. Finally, it was decided to revise QE 5 as LPIS sample-based informative measure with no specific threshold, comparing the sample value with the overall IACS statistics. Please note that this informative status misrepresents the importance of QE5 in the LPIS QA; the status merely reflects the current lack of clearly specified DGAgri expectations regarding the role of RP in the farmer area declaration process.

## **7.2. Impact on the 2011 guidance**

- 7.2.1. The major methodological changes listed above, together with number of other suggestions and modifications, entailed the revision on both the ETS Annexes (consisting the formal instructions), and the WikiCAP articles (instructions plus support pages).
- 7.2.2. The core ETS Annexes (I and II) have been revised to accommodate the major issues, describe above namely: clarification of the data quality scopes; re-definition of the critical defects; introduction of the farmer input; the new QE5, QE6, QE7 (Annex IV was removed); introduction of stricter quality control of the reference orthoimagery.
- 7.2.3. In addition the following major modifications have been made
- the check of the historic GAC was incorporated into the core inspection flow, (Annex V, as well as the additional GAC ETS scoreboard, were removed) as was the processing of RPs, with a reference area value obtained by methods/tools, different than CAPI of GNSS delineation (Exclusion from QE2).

- the scopes of the landscape features, subject to ETS and of RPs for which contamination is reported were clarified;
- the actions “Feasibility for inspection” and “Feasibility for measurement” were incorporated as separate quality measures at the initial phase of the inspection;
- Mapping instruction on handling land cover features, smaller than the minimum mappable unit (MMU) have been added, Separate reporting for non-conforming reference parcels larger than a 0.1 ha was introduced;

7.2.4. With respect to Annex III, a specific chapter on pro-rata eligibility was introduced. A small section on individual parcel eligibility reductions was amended as well. The template of the eligibility profile was expanded with land cover classes representing the types of potentially eligible non-agriculture areas listed in Article 34 (2b I and 2bii) of COUNCIL REGULATION (EC) No 73/2009.

7.2.5. WikiCAP instructions were updated following the changes introduced in the ETS annexes, whereas the support articles were revised on documentation, illustrations (in particular the newly introduced critical defects), FAQ and more than 70 new Questions and Answers. Newly added articles covered

- a complete set of example of the error types identified during screening.
- a: Specific technical section on orthoimage quality;
- Detailed Explanatory documentation on the “5 meter buffer” rule;
- Guidance of the use of GNSS measurement on the field for the ETS.

7.2.6. By the end of November, a training workshop on LPIS QA, dedicated to the technical staff of the Member States Administration was conducted in Tallinn. It was organized in the margin of the annual GeoCAP conference. As a result of this session and the discussions held with the Member States representatives, some last-minute amendments to the ETS methodology have been introduced and posted in a specific Errata page in WikiCAP.

### **7.3. Status Implementation for 2011**

7.3.1. XML and GML schema revision facilitated methodological changes in the ETS inspection procedures, as well as to improved data exchanges between the Member States and the JRC. The main changes are the adoption of a new GML version (2.1.2.1) (to implement an official OGC bug-fix concerning the geometry of spatial features) and measures to reflect the evolution of the ETS5.1. To improve the reporting on the orthorectified imagery set used during the ETS inspection, a better specification was produced. For each revised schema, the JRC produced a series of a valid example.

7.3.2. All technical changes were communicated in an email sent to all the LPIS QA portal accounts, and published at the WikiCAP page:

[http://marswiki.jrc.ec.europa.eu/wikicap/index.php/LpisSchemaSetChangeLog\\_2011](http://marswiki.jrc.ec.europa.eu/wikicap/index.php/LpisSchemaSetChangeLog_2011) Furthermore, the changes were concisely presented during the workshop in Tallinn 2011.

- 7.3.3. Sample pre-selections for the 2011 campaign have been produced for the Member States by the LPIS QA Portal automatic functionality started in July and closed in December. Despite this automation, the LPIS QA Portal was constantly monitored and substantial resources and many bilateral e-mail communications were needed to make all sample pre-selection files valid according to the corresponding set of schemas.
- 7.3.1. Furthermore, JRC will continue to provide support to the EU Member States with respect to the formal conformity of their eligibility profile in 2012. The support will be focussed in particular to the formal definition and codification of the land cover types (incl. landscape features).

## **8. Overall conclusion**

### **8.1. The LPIS quality assurance framework**

8.1.1. Development on the LPIS Quality Assurance framework started in mid-2008 in response to a growing concerns for managing and the need for demonstrating the quality of the various LPIS implementations in the Member States. 2011 saw this development culminate in a first ever reporting and feedback cycle.

8.1.2. This first quality assurance exercise demanded considerable efforts from Member States and the JRC, but it ultimately demonstrated that all Member States' Administrations are capable of successful implementation, provided appropriate training and automation are ensured. Furthermore, process involved frequent and Intensive bilateral communication between the Member States and the JRC throughout.

8.1.3. Data exchange was considered a key element in the LPIS QA framework, to ensure integrity of the inspection results in a quality audit setup. This two-way data exchange involved the provision of samples for inspection to the Member States and the delivery of all inspection results by the Member States. The key success factors for the exchange identified during this first LPIS QA implementation are:

- the use of INSPIRE standards (for documentation and formats as XML, GML and WMS),
- an appropriate documentation of the schemas supported by the examples, viewable using standard GIS tools and by a schema change log for schema upgrades and corrections,
- general support on XML/GML basics through several workshops and frequent bilateral support to address individual problems,
- a semi-automatic LPIS QA Portal platform for data exchanges with tools for XML and GML generation and validation,
- the various 2011 deadlines have not been strictly applied so all LPIS implementations were able to inspect a defined sample of reference parcels and to deliver the quality reports to DGAgri. 37 out of 45 LPIS implementations managed to fully complete the methodological upload cycle and received individual feedback,
- ensured harmonization and compatibility of the land cover semantics used in the EU MS, though the adoption of the FAO LCCS.

### **8.2. A tool for quality assessment**

8.2.1. Implementing the ATS (for model conformance) and ETS (for data conformance) significantly improved the level of Member State awareness on and understanding of their LPIS implementation

and LPIS quality. The initiative also raised the motivation of the LPIS community towards a common strategy on LPIS quality assurance and LPIS management. The common assessment framework and its documentation greatly facilitated comparison and discussion between LPIS authorities.

- 8.2.2. These insights are reflected by the content of many assessment reports. Several LPIS custodians acknowledged the discovery of hitherto unknown quality issues and provided further data and analysis as a starting point for their remedial actions. Some offered methodological suggestions for a better quality assessment
- 8.2.3. Remedial action plans are built upon these assessments of weak LPIS data and procedures, clearly demonstrating the value of the information picked up during the inspection. A number of the proposed remedial actions will lead to a direct and significant improvement of the 2012 scores by adapting databases to make scopes appropriate and by tightening some identified loose ends of internal procedures.
- 8.2.4. As was expected, one can easily observe that the 2010 scores, although internally essential to trigger further analyses, suffered from a number of "starter difficulties" that prevented direct comparison from LPIS to LPIS. Even so, QE5, "the rate of declared land" caused a "non-conforming" verdict for many LPIS implementations. QE5 measures have been revised to lead to an informative score for 2011, but this concept of land use and its role in the "Maximum Eligible Area" is so essential an LPIS property that further revision is imperative.
- 8.2.5. An independent peer review confirmed these findings and the great potential for an independent and objective scoring. The reviewers recommended some technical improvements as well as political justification of the thresholds.
- 8.2.6. **The 2010 findings evidence that this LPIS QA is already a successful instrument for Member States' self-assessment. To become an instrument for measuring the state of quality via comparable scores, two issues need addressing:**
  1. **the Member States should overcome their starter difficulties and correctly apply the common methodology,** and a number of Member States have not received screening feedback
  2. **DGAgri and JRC should refine and quantify the quality expectations in the frame of the revised framework,** else the scores should be considered internal for triggering additional analysis, but should not be approached as standalone and final results.

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**Abstract**

This document reports on the JRC activities on and developments of the LPIS quality assurance framework during 2011. It coincided with the implementation of the first LPIS quality assessment by the Member States for the 2010 reporting year.

This report summarizes the findings from the assessment reports and inspection observations by the Member States. All Member States produced a quality report on their LPIS quality and a large majority provided also inspection data. It was not yet the objective to arrive at a comparable scores or a definitive verdict on the quality of an individual LPIS implementation, still, this 2010 general rehearsal evidenced that the LPIS QA is a very powerful instrument for the quality self–assessment by the LPIS authorities. Further actions will be required for the LPIS QA framework to produce common, pan-European scores.

JRC examined the correct application of the inspection methodology through screening of the inspection records which led to two important outcomes; individual Member State feedback on their performance and improvements in measures, methodology and guidance. A major simplification of the methodology resulted.

The report concludes with two strategic choices that will determine the future of the LPIS QA framework.

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