JRC Technical Notes

LPIS quality inspection:
EU requirements and methodology

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1.   **Executive Summary**

1.1.1. The Land Parcel Identification System is the part of IACS based on reference parcels within a GIS environment to allow the identification, location and administrative crosschecks of the agricultural parcels declared by European farmers. Any LPIS has spatial (e.g. boundary coordinates and areas) and alphanumerical attributes (e.g. unique identification, maximum eligible hectares value). This document develops a framework for inspecting the quality of these attributes.

1.1.2. The LPIS is instrumental in safeguarding the aid flows toward the European farmer but to date, no common and systematic assessment of this instrument has been implemented. This document elaborates a series of quality elements that are essential for the LPIS to be able to perform its role:

*   a correct quantification of the truly eligible area within the LPIS as a system;
*   the assessment of ineligible land over the reference parcels;
*   the categorization of reference parcels regarding ineligible land;
*   the occurrence of critical defects within a reference parcel;
*   the proportion of declared area inside a reference parcel;
*   the effectiveness of update processes regarding the LPIS system;
*   the relation of LPIS quality issues with error rates observed during the on the spot checks.

1.1.3. A methodology is proposed whereby industry standard sampling plans are applied by Member States to collect objective data, using an enhanced and harmonised method based upon data collected for the Control with Remote Sensing programme.

1.1.4. Although the tests rely on a direct inspection of external data that are available to most Member States today, these direct inspections need to be completed by data from querying the various IACS registers.

1.1.5. The implementation of a LPIS quality assurance framework would provide to the Member States key entry points for the verification and audit of their. But such framework would above all offer the Member States an instrument to guide the improvement of their LPIS and to streamline the IACS processes that relate to the LPIS.

1.1.6. This proposal includes one or more quality acceptance levels for each quality element. These acceptance levels provide only a conventional target. Failure to meet a particular target does not automatically result in a financial correction but it would warrant a closer study and possibly mitigating action by the Member State.

2. __Introduction__

2.1. __Report objectives__

2.1.1. The document targets policy and decision makers. As a result, it discusses the issues at a general level without going into technical details. The two main topics are an elaboration of the LPIS properties which are considered essential for its good functioning and a methodology on how to implement and integrate an adequate quality policy within the current regulatory framework. Commission Regulation (EC) no 146/2010 is the recent regulatory update of Regulation (EC) no 1122/2009 accommodating the issues elaborated in this document.

2.1.2. Technical details on the GIS-processing, parcel inspection procedures, statistical analysis and operating guidelines are developed in separate technical documents, published on the WikiCAP pages: http://marswiki.jrc.ec.europa.eu/wikicap/index.php/LPIS_QA_Technical_Documentation. The "inspection method" of above Wiki articles act as the technical guideline for complying with the requirements of that Regulation

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2.2. __Rationale for quality assurance__

2.2.1. The importance of the LPIS comes from the requirement that it must channel all area based aids; the corresponding financial value exceeds €41B for 2009. For this specific purpose, LPIS quality can roughly be defined as the ability of the system to fulfil two explicit LPIS functions:

   1. the unambiguous localisation of all declared agricultural parcels by farmer and inspectors,
   2. and the quantification of all eligible area for crosschecks during the administrative controls by the paying agency.

2.2.2. Failure of an LPIS in the unambiguous localisation induces risks for double declaration of land and for ineffective inspections; inadequate quantification of eligible area renders the crosschecks ineffective for preventing and identifying over-declarations by farmers. Both failures involve financial risks for the EU Funds.

2.2.3. Furthermore, any well functioning LPIS will greatly facilitate operations by farmer, inspector and paying agency, resulting in a better performance. Obviously, a better LPIS substantially improves IACS effectiveness and management of EU Funds.

2.2.4. Both Member States and the EU have therefore a keen interest in demonstrating the quality of the LPIS and on addressing quality issues, if any. Such processes of planned and systematic quality demonstration form the hearth of a quality assurance (QA) system. A QA framework relies on mutually agreed quality testing between "consumer" (the European Commission) and "supplier" (the Member State). A test or series of tests assesses compliance for each specified quality requirement.

2.2.5. This document distinguishes between "prime" and "secondary" quality elements. The prime elements are those that the European Commission considers fundamental for a correct LPIS operation and which are applicable to all LPIS systems. Secondary quality elements might not be applicable for all systems, but may provide additional substantive indications for analysing and remediating issues identified on the prime quality elements.

2.2.6. All tests have been developed into quantitative measures and the test results therefore represent an objective and comparable information on the different LPIS. The main application of this quantitative information is to provide an instrument for achieving business process improvement.. Essentially, the proposed quality assurance framework constitutes a yearly check-step within the commonly known plan-do-check-act (PDCA) cycle.

3.   **Seven prime quality elements**

Each prime quality element is described by:
- definition or concept;

- rationale as prime element;

- discussion and/or compliance threshold;

- method to make the assessment;

- and proposed acceptance level.

3.1.   **The correct quantification of the maximum eligible area**

3.1.1. The maximum eligible area is the recorded quantity of land for which farmers can, from a land cover perspective, apply for aid under SAPS / SPS.

3.1.2. The importance of this maximum eligible area value for a system implemented to administrate and control area-based aids is evident. The maximum eligible area value should be correct so that a system does not record more area than is eligible for aid and does not exclude agricultural land from being declared for aid.

3.1.3. Total eligible can easily be calculated by summing up the recorded maximum eligible area of every reference parcel, active or not, over all reference parcels. The key concern is the correctness of the values of maximum eligible area recorded in the reference parcels. These values have been originally assessed by mapping agricultural land during the creation of the LPIS by January 2005 or 2007, but have, or should have been, updated to reflect changes of underlying land. Update actors are farmers, inspectors and database maintenance operators (e.g. using newly available orthoimagery). Apart from changes of the land, some types of agricultural land have, since the LPIS creation, become eligible because of Regulation reforms.

3.1.4. The unbiased estimate of the current maximum eligible area in the LPIS can be obtained from measuring the current day area of agricultural land within a random and representative sample of parcels. The rate of truly eligible land to recorded land in the sample estimates the rate of correct eligible land in the LPIS. This rate can be extrapolated into an absolute area value.

3.1.5. The differences between eligible land and recorded land in the LPIS par parcel have to added up in absolute terms and should be less than 2%

3.2. **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**

3.2.1. Reference parcels allowing payment on ineligible land are those parcels that record more eligible land than is physically available on the ground. Reference parcel that exclude agricultural land record less agricultural land than is physically available.

3.2.2. The distribution of reference parcels with incorrect recorded value of maximum eligible area within a random sample provides a direct indication of the statistical spread, nature and size of the quality problem. E.g. If all reference parcels are "contaminated" with ineligible land, a general methodological problem seems very likely; on the other hand, if only a small proportion exhibits such problems, the issue could be more specific in nature.

3.2.3. Understanding whether an identified problem is systematic or specific in nature is essential for the development of a corrective plan. A distribution of the abundance of the ineligible land inside the parcels provides an even better insight.

3.2.4. The proportion and distribution of parcels allowing undue payment ineligible land or excluding land from aid application can be easily derived from identifying such parcels from the sample for measurement of eligible area of 3.1.4 above. To be included in the "bad side" of the proportion, a parcel must record more than 3% ineligible land or exclude more than 3% agricultural land..(3% is the threshold above which deductions for over declaration would apply when the reference parcel were fully declared for aid as a single and individual agricultural parcel).

3.2.5. The proportion parcels with an incorrect recorded area should not exceed 5 %..There is no predefined conformance threshold for the distribution; the distribution primarily serves as a source of information.

3.3. **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;**

3.3.1. The categorization differentiates the problematic reference parcels along the underlying cause(s) of the problem.

3.3.2. Addressing LPIS quality problems, whether methodological or specific, requires that the cause of the problem is identified and understood. As ineligible land may have entered the system through a series of paths and the problematic paths must be addressed before any remediate action can be planned. The cause of an LPIS problem can always be attributed to one or more of five generic processes, each of which can be further detailed. The list is considered exhaustive.
1. changes of the underlying land were not applied (e.g. inspector findings were not introduced in the update process);
2. revisions of the Regulations were not applied (e.g. LPIS specification was not upgraded);
3. incomplete processing (e.g. some land uses/covers or lands were not included);
4. erroneous processing (e.g. the specifications were not correctly applied);
5. incompatible LPIS design.

3.3.3. The current Regulations do not specify a requirement for this categorization of anomalous parcels by the cause of the anomaly, but the general idea is clearly implied by the good governance principle.

3.3.4. The occurrence and abundance of parcel categories can be established by making structured observations during the sample inspection of 3.1.4. This process involves crosschecking all ineligible area within the reference parcel with the supporting documentation from the paying agency (e.g. original cartographic source, inspection reports, and other metadata). If the nature of the cause can not be precisely identified, this should be considered a design issue. A pan-EU code list of categories based on causes will be the entry point for this categorization.

3.3.5. None of the above categories should affect more than 5 percent of the sampled parcels.

3.4. The occurrence of reference parcels with critical defects

3.4.1. Critical defects are non-compliances with the specifications that obstruct the use of the parcel regarding either the functions of unambiguous localisation of agricultural parcels or the unique identification for crosschecks of declarations. Some examples of a reference parcel defect on its use are:

1. Failure to unambiguously locate agricultural parcels (e.g. reference parcel unidentifiable in the field);
2. Failure to uniquely quantify eligible area (e.g. topologic overlap between reference parcels);
3. or Failure to perform administrative crosschecks (e.g. non-persistent identifiers).

3.4.2. Defective parcels clearly jeopardize the integrity of the LPIS information. They indicate critical design issues and failure of system monitoring.

3.4.3. The occurrence of any critical defect should ideally be discovered during the operation and systematic inspection of the system.

3.4.4. Nevertheless, the sampling proposed above offers an independent opportunity to inspect and validate the systematic occurrence of potential defects. Potential defects indicate an expected failure to perform the anticipated functions within the strict environment of the parcel inspection. Potential defects should be further investigated and the absence of a true defect should be justified with historical IACS records.

3.4.5. In an operational LPIS that is applied to 100% of agricultural parcels and declarations, there should be zero critical defects for the reference parcels that represent eligible hectares. However, for the purpose of the quantitative LPIS measurement, potential defects should not affect more than 1 percent of the sampled parcels.

3.5. The ratio of declared area in relation to the maximum eligible area inside the reference parcels

3.5.1. The declared area inside the reference parcel provides an indication of the ability of the reference parcel to facilitate correct aid declarations by *bona fide* farmers and to prevent aid declarations by *male fide* parties. The area declared, either for aid or other uses, represents the total agricultural land "use" administrated and controlled within IACS.

3.5.2. Farmers may choose not to apply for direct aid and still farm the land while keeping it under GAEC, this make the hectares potentially eligible. A good administration should prevent that other farmers who have not performed any agricultural activities on the land apply for aid on that land.

3.5.3. Without sketched maps, undeclared farmed land cannot be distinguished from declared land. The application for aid is indeed a land use or economic concept rather than a land cover or biophysical concept. Preventing *male fide* applications requires that the pre-printed form provides each farmer with an effective value of land available for aid application and that the Member states operates a control system based on the monitoring of the declared area versus reference area relationship and behaviour from one year to the next, Specific procedures should be activated when the declared to eligible ratio changes. This monitoring implies that the LPIS identifies those reference parcels which were not declared for aid and that it quantifies the agricultural area declared for aid within each RP.

3.5.4. The change of distribution of declared to eligible area ratio can be automatically generated by the IACS after compiling the area declarations per reference parcel, comparing two consecutive years and finally verifying activation of the applicable procedure. An appropriate indicator on the LPIS as a whole would be the rate of parcels with more than 10 percent difference between declared area and recorded area.

3.5.5. At least 95 percent of the reference parcels declared for aid shall be correctly declared taking into account the last sentence of point 3.5.3.

3.6. The percentage of reference parcels which have been subject to change, accumulated over the years

3.6.1. Update (or more general upkeep) processes are instrumental to ensure the currency of the data, ensuring that the information stored in the LPIS corresponds to the actual situation in the field. Update in the stricter sense relates to dealing with the permanent physical changes of the land that impact on the IACS in general and eligibility of the land in particular.

3.6.2. Implementing update processes is the main challenge of any LPIS custodian. Comm. Reg. EC 796/2004 contains elements that relate to the roles of three distinctive LPIS update actors:
1. The farmer must indicate reference parcel boundary changes and area corrections (art 12.4)
2. The inspector must indicate further control measures from his findings (art. 28.1.(g))
3. The paying agency must monitor and address overall LPIS quality issues (art. 6.2.)

3.6.3. As indicated above, there are several aspects to this update process, but crucially is of course the dynamics in the field. The Member state should implement appropriate upkeep processes to monitor the land change and to guarantee the currency of its registers. This relies on both daily update processing and monitoring the need to launch a systematic refresh.
- Daily update processes should enable the member state to keep pace with the land changes for those parcels where update information became available such as those subject to inspection. The daily activities should process any available updated information to be ready by the next aid application.

- But when a significant proportion of the parcels is estimated to have undergone changes, launching a systematic refresh using appropriately recent data source (in preference orthoimagery) should be investigated.

3.6.4. The effectiveness of the daily update processes in the LPIS can be queried from the transaction records of the database. The need and urgency for a systematic refresh relies on the dynamics of the land. To derive an estimate of the rate of change of agricultural land it is proposed to use as indicator the addition of land changes (as explained under 3.6.1 land changes should be the permanent physical changes of the land that impact on the IACS in general and eligibility of the land in particular) reported by the farmer and land changes identified during the On the Spot Check (OTSC) inspections over the years.

3.6.5. As soon as the cumulative change rate exceeds 25 percent, a systematic refresh should be launched. This 25 percent is calculated by adding up, year after year, the working rate of annual land changes

3.7. The rate of irregularities determined during on-the-spot checks

3.7.1. The OTSC represents an external and independent verification of the final outcome of the aid application process and of the role of LPIS herein.

3.7.2. The integrated nature of all control registers is implied in the "IACS" name and compatibility of databases is explicated in several articles of Council Reg. EC 73/2009.

3.7.3. Irregularities identified during the OTSC can reflect shortcomings of the LPIS. This relation can be assessed either qualitatively (e.g. abundance of error categories) or quantitatively (i.e. what is the proportion of ineligible area in the reference parcel that has actually been identified during the OTSC). A good LPIS should ensure there is no "area not-found" on the reference parcels and, since it is a support tool for aid applications, it should not induce irregularities of the applications.

3.7.4. Assessing the relationship between the LPIS and the application irregularities is therefore not relying on an observation of the parcels but on studying its performance as an effective tool for supporting correct aid applications. This effect is quantified as the error rate, expressed in financial terms, determined in the random selection for the OTSC of the year concerned

3.7.5. Two simultaneous targets can be proposed:
1. The error rate of identified irregularities should not exceed 2%
2. The error rate of identified irregularities should not significantly be higher than the rate observed in the preceding application year.

4. Secondary quality elements

A number of secondary quality elements can be identified which, from a Commission viewpoint, provide substantive indications and insight for the Member States concerned regarding the causes of identified LPIS issues. These secondary elements are not embedded in the Commission Regulation (EC) No 1122/2009.

4.1. Historical perspective

4.1.1. The historical perspective provides insights regarding discrepancies that can be attributed to the quality of the geographic source material and the past technology choices still affecting the system.

4.1.2. This non-quantitative quality aspect helps the Member State to position itself within the community of fellow-member states by assessing its use of technology and tools, the effects of source material and the application of best practices in order to develop an appropriate upgrade strategy when needed.

4.2. Reference parcel scope

4.2.1. IACS contains the historical records of the reference parcel use by the individual farmer. Studying the relation between number of the farmers per reference parcel and observed error rates on the aid applications for multi-farmer LPIS parcels can identify reference parcel design issues.

4.2.2. Similarly, the number of agricultural parcels per reference parcel is precisely known within the IACS registers; if too high, agricultural parcel localisation might become very complicated. Studying this distribution of agricultural parcels and the rate of irregularities might reveal other design issues.

4.3. Sub-populations of reference parcels

4.3.1. When the homogeneity of a LPIS is not taken for granted, the probable subcategories should be identified. Indicating the subcategories and studying the respective histograms provides an understanding of the parcel sub-populations and provide input for further handling,
- mountainous or grassland parcels may be different from arable land parcels,
- different contractors may have created regional variation within the LPIS data sets.

4.3.2. Heterogeneity in the LPIS reference parcel population strongly and adversely affects the outcome and usefulness of any sample based inspection procedure such as the one proposed in the LPIS QA framework. Member States should implement all inspection procedures on homogeneous sets of reference parcels.

5. Reference parcel inspection methodology

The proposed inspection methodology to obtain quantitative measurements for the prime quality elements covers five components:
- provision of independent source data to perform an external inspection;
- creation of a representative sample;
- standardised inspection procedure to collect test data;
- processing and analysis of the observed data;
- reporting procedures and guidelines.

5.1. Definition of the LPIS population subject to inspection

5.1.1. Considering that 1) LPIS operates at reference parcel level, 2) LPIS serves as the single GIS for IACS data and 3) this quality assessment focuses on eligibility for direct aid schemes; any reference parcel that is mentioned on the farmer's application shall be subject to inspection.
In practice, this translates to reference parcels that:

- were declared during the previous application year

OR

- hold a non-zero "maximum eligible area" ; i.e. can appear on the pre-printed form or re-enter an application without triggering an additional verification procedure.

5.2. External data for observations

5.2.1. To be resource efficient, it is proposed to build the framework upon existing datasets not older than a year; this could be either satellite Imagery collected under the CwRS program or other remote sensing datasets (e.g. airborne) collected by Member States. The data specification roughly corresponds to VHR quality as used for the CwRS program, and follows INSPIRE implementing rules and ISO19100 series standards. It is not expected to conduct substantial ground collection specifically for the exercise or to use any archive data.

5.3. Parcel sampling

5.3.1. To support a representative sample, the external data should be independent of the LPIS creation and maintenance processes. CwRS zones defined under random selection or within risk zones that are defined in terms of farmer declaration characteristics, independent of any reference parcel characteristic can be considered equally random for the LPIS assessment. When the homogeneity of the LPIS is not taken for granted (see 4.3.2), the Paying Agency can consider stratification of the sites. Within the zones covered by imagery, the Industry standard ISO2859-2 offers a simple sampling plan indexed by lot (= LPIS) size and Limiting Quality (LQ).

5.3.2. Larger sample sizes coincide with larger LPIS or with stricter requirements on the quality element. The following table lists the sample size for a homogenous LPIS according to the requirements currently proposed for the prime quality elements (3.1 to 3.7):

LPIS size (# of reference parcels)	Sample size (# of parcels to be inspected)
10.000 or less	200
10.001 to 35.000	315
35.001 to 150.000	500
150.001 to 500.000	800
more than 500.000	1250

5.4. Parcel inspection

5.4.1. A series of observations reflecting all the quality elements is to be collected by a detailed inspection of each individual reference parcel. This involves a specialized inspection procedure (in fact a mapping procedure), but offers individual acceptance decisions on conformity of quality elements, e.g. identifies the need for an additional explanation. This provides a modular and extensible setup that offers extensive insights to the Member State on the quality of its LPIS.

5.4.2. The inspection procedure details common CAPI rules on how the Member State interprets, measures, counts, classifies or codes an inspected parcel within its resident GIS environment. In view of the relatively small samples in relation to the population size as called for by ISO2859-2, accurate and precise inspection and measurement are essential and all image interpretation ambiguity should be resolved, either through the use of appropriate complementary HR imagery and/or through a Rapid Field Visit (RFV). For some measures, cross-checking with ancillary data and metadata is explicitly specified.

5.4.3. On average, a trained CAPI operator can be expected to inspect 50 to 100 reference parcels a day within a familiar GIS environment.

5.5. Analysis

5.5.1. The acceptance decision rules and acceptance thresholds for each quality measure are applied on the complete sample based on the observations collected during the inspection process. These rules might be mechanical in nature (implemented in software or in a database), and it is proposed that standardised exchange formats (XML) and database interfaces (SQL) are applied for the analysis. This standardisation is required to enable the exchange of both data and software tools.

5.5.2. Note that the mechanical processing with shared tools implies that the collected observations are used to assess the performance of the existing LPIS towards common requirements ("fitness for purpose") rather than to verify the LPIS's compliance with the technical specifications applied for its original creation ("meeting its specification"). This places the current framework in a more pro-active context of improving the future LPIS, rather than a corrective process of compliance monitoring.

5.6. Reporting

5.6.1. As the Member States would undertake this work, all relevant documentation of the above procedure should become available for information and later verification (audit). Standardisation allows for easy exchange and screening of the data collected during the quality assessment process.

6. Organisational issues

6.1. Implementation and planning

6.1.1. The LPIS quality assessment should be implemented once a year, as currently provided for under Commission Regulation (EC) No 1122/2009. As the availability of CwRS imagery conditions the implementation, the CwRS cycle provides a well-established frame for image capture and time schedule. There are only a few specific activities.
1. The JRC will technically verify the appropriateness of the CwRS site selection proposed by the Member State for use in the LPIS inspection (and complement the selection when appropriate).
2. A sampling plan (list of parcels to be inspected) for the Member State will be provided by JRC.

3. The Member State performs the LPIS inspection in parallel with its OTSC activities.

4. The Member State prepares a report and submits it to the Commission.

6.1.2. This LPIS quality report should be due by January 31st following the application year concerned, enabling the Member State to report on the design and implementation of proposed actions and mitigating procedures to overcome any identified weaknesses.

6.2. Financial implications

6.2.1. On the assumption that the majority of existing CwRS images will be suitable, with a current coverage of 25 MS and 80% re-usability, the acquisition cost of additional imagery dedicated for the LPIS quality assessment can be roughly estimated to cover an additional 10 Paying Agencies, As this additional imagery meets the conditions of Articles 1 and 2 of Council Regulation No 165/1994, the European Commission could acquire it on behalf of Member States and combine the image acquisition for both control applications into one acquisition programme as a convenient, efficient and low risk solution.

Abstract
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The LPIS is instrumental in safeguarding the aid flows toward the European farmer but to date, no common and systematic assessment of this instrument has been implemented. This document elaborates a series of quality elements that are essential for the LPIS to be able to perform its role. A methodology is proposed whereby industry standard sampling plans are applied by Member States to collect objective data, using an enhanced and harmonised method based upon data collected for the Control with Remote Sensing programme. Although the tests rely on a direct inspection of external data that are available to most Member States today, these direct inspections need to be completed by data from querying the various IACS registers.

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