

# Sharing the Land Knowledge: The HLANDATA Way to Harmonized Information on Land Cover/Land Use

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## 1 ABSTRACT

An understanding of the causes and the implications of land use and land cover changes and trends is a fundamental part of planning for sustainable development. As consequence, spatial information on land use and land cover become nowadays more and more available, sourced by regional, national as well as European initiatives or programmes. Though, like in case of so much data in Europe, all these investments can run in the risk of losing the real impact due to incompatible data standards, decentralised data storage and high data complexity for operational assessments. The HLANDATA project aims to demonstrate the feasible European level harmonization of the land use and land cover datasets taking into account both the data categorization and the data models through the development of user oriented value-added services to streamline harmonized data exploration and analysis.

## 2 CONTEXT

### 2.1 Land cover or land use?

Land cover and land use and are amongst the most important geographic information themes today and an understanding of the causes and the implications of their changes and their trends is a fundamental part of planning for sustainable development. Land cover represents the biophysical state of the real landscape which means that it consists of natural, but also modified (cultivated) and artificial objects, as referred by the categorization such as artificial surfaces, agricultural areas, forests, natural areas, wetlands, etc.. Land use reflects the socio-economic purpose for which land is used (land function), either current or planned in future, as referred by the categorization such as residential, industrial, commercial, agricultural, recreational, etc. Together thus land cover and land use provide for the particular territory complementary information both on landscape potential and on realizing this potential - the characterization, which essential for many applications areas.

### 2.2 Need for harmonisation

Historically, land cover and land use information has been managed at various levels - from European to national, regional or even local one. The many activities producing information from European to local scale have been mostly developed independently, addressing specific requirements (i.e. information to be acquired, level of detail both geometric and semantic, updating periods, timelines, precision) of specific users. This has resulted in a suite of datasets, mainly not compatible with each other, not taking into account the interoperability of the information. However, in a context where related environmental threats (for example; climate change, biodiversity loss, and food security) become more and more global issue, there is a need to better integrate various sources of information at various scales. One of the succesfull long-term programme providing harmonized land cover and land use at a pan-European level is the European CORINE Land Cover initiative [1], nowadays integrated (together with High Resolution Layers (HRL) and Urban Atlas components) in the initial operational phase of GMES programme framework [4]. Nevertheless, many parallel national, regional and local land monitoring activities still exist and need to be linked or integrated in order to achieve efficient land monitoring set up in Europe. Therefore, at present there is an urgent need for harmonization and standardization of land cover and land use information at various levels.

### 2.3 INSPIREd effort

The main European geographic information harmonization initiative, INSPIRE Directive, set up the rules for the implementation of the datasets included in INSPIRE's Annexes II and III which must be approved by the Member States, and to assure that the datasets owned by the different Member States will be implemented in order to allow their interoperability. All European Member States will have to make available their geographic information as established in INSPIRE, being land cover one of the themes included in the

Annex II of the Directive, and land use one of the themes included in the Annex III of the Directive. The INSPIRE Directive [3] is truly a key driver for the standardization and harmonization of land cover and land use information in the EU, but there is still a long process to reach this situation. Development of the respective INSPIRE Technical Working Groups (TWGs) has to be also regularly tested to assure the best use of the existing experiences in the land cover / land use mapping community. This is why, some initiatives have been / are being carried out which support INSPIRE in achieving its objectives. In prominent position, the HLANDATA project builds on experiences from various previous harmonisation activities and, in close cooperation with respective the INSPIRE TWGs, aims to demonstrate the feasible European level harmonization of the land use and land cover datasets taking into account both the data categorization and the data models through the development of user oriented value-added services to streamline harmonized data exploration and analysis.

### 3 HLANDATA APPROACH

#### 3.1 Project background and objectives

HLANDATA,<sup>1</sup> lead by the Government of Navarre and TRACASA - Spain, is a European project supported by the ICT Policy Support Programme (ICT PSP) between March 2010 and February 2013. ICT PSP aims at stimulating innovation and competitiveness through the wider uptake and best use of information and communication technologies by citizens, governments and businesses. HLANDATA consists of 9 partners, i.e. public authorities, private companies and research institutes from 6 different European Union countries as well as one international planning organization. Primary goal of the HLANDATA project aim is to contribute to a common data sharing infrastructure, contribute and test TWG data specification to assure sharing land cover and land use data between different public administrations and other stakeholders on European, national, regional and local level. More, HLANDATA aims at fostering the use of land use and land cover data at a European level through the creation of value-added services beyond the traditional concept of land cover and land use data provision. The results are web services in different Pilots - different application areas and the support of awareness rising for data harmonization, data sharing, data exploration and analysis guiding holistic planning. The services are based on the development of one land cover and land use harmonization proposals (coordinated with INSPIRE TWGs) which takes into account already existing data models and categorizations as well as the specific requirements of the users.

#### 3.2 Project phases

From technical point of view, the HLANDATA project is phased into following subsequent logical chain of activities (reflected also on organization level by Work Packages (Figure 1)).

##### 3.2.1 Diagnostic phase

The first phase - 'Diagnostic' consisted of assessment of the current European situation regarding the harmonization of the Land Cover and Land Use geographic information, taking into account the categorization and data model initiatives already ongoing in that field (i.e. SIOSE, LISA). Also, being HLANDATA focused on relevant value-added services, thorough assessment of the end users and their needs from the point of view of data harmonization i.e. kinds of users, user purposes and required functionalities for the high-level services was developed in the project.

##### 3.2.2 Harmonization and development of common data infrastructure phase

In the second phase - 'Harmonization and development of common data infrastructure', based on the diagnostic results, a harmonization proposal for the land cover / land use geographic information was developed and provided to respective TWGs, both from the perspective of the data categorization and the data model (i.e. HILUCS for TWG LU). Fruitfull cooperation with INSPIRE TWGs is clearly one of the achievements of the HLANDATA project.

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<sup>1</sup> HLANDATA website <http://www.hlandata.eu>

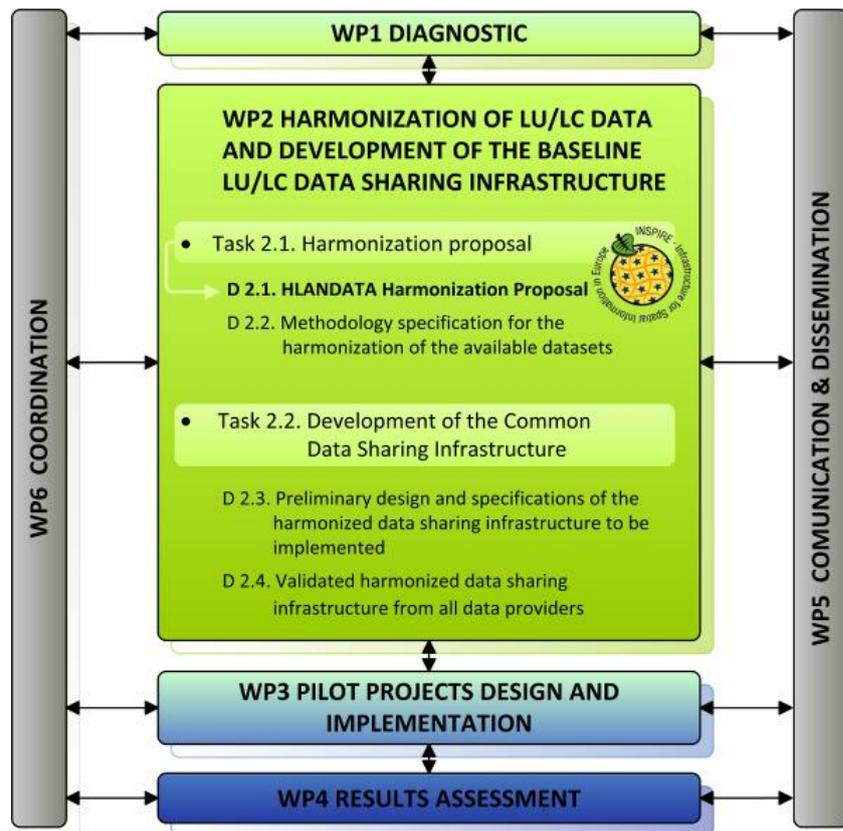


Fig 1: Phases / Workpackage structure of HLANDATA project

More, common data sharing infrastructure (CDSI) has been developed to support harmonised land cover and land use data stored and maintained in different sources across Europe. The HLANDATA geoportal provides a map viewer to overlay and compare spatial data, and a metadata catalogue that allows to search and to find available data. The HLANDATA geoportal follows the principle: one centralised access to decentralised data! The CDSI enables access to the harmonized data via WMS. A common functionality and requirements on WMS are defined, so that interoperability of WMS is given. The HLANDATA geoportal is the access portal to the CDSI and the harmonized WMS, and provides a viewer for mapping and overlaying data.

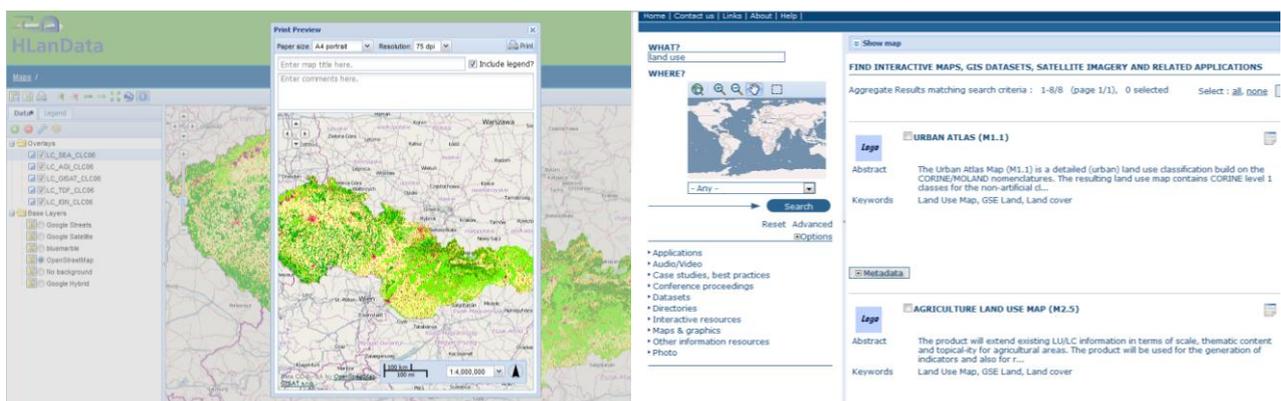


Fig 2: The HLANDATA Geoportal

Additionally a metadata search allows to access relevant information on the datasets according to one common metadata profile. The architectural design consists of a three tier architecture, which has the advantages of flexibility, good scalability and thin clients. The HLANDATA Geoportal is accessible on <http://portal.HLANDATA.eu> (see on Figure 2.)

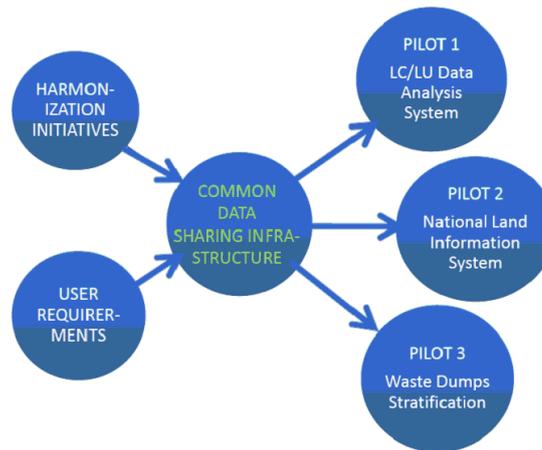


Fig 3: The HLANDATA Pilots and the previous project phases

### 3.2.3 Value-added web services implementation and validation

Finally in the third phase - ‘Value-added web services implementation and validation’, the HLANDATA common data sharing infrastructure (CDSI) is used and data harmonization potential is demonstrated using three specific value-adding thematic web based services (Pilots) developed for the selected users: LC/LU Data Analysis System (Spain), National Land Information System (Czech Republic, Lithuania) and Waste Dumps stratification (Slovakia) as seen on Figure 3. The value-added service within each of the pilot project is a specialized web-based map application that allows users to freely access it and to perform selected operations to obtain desired new information using harmonized land cover / land use data. These functionality is in most cases provided by using standardized web services (e.g. OGC – WMS, WFS, WPS) and standardized IT protocols and formats (REST, JSON, ...). Contained map layers of each Pilot include harmonized WMS that were prepared at previous stages. Some of Pilots offers also additional value-added services based on functionality that needs availability of source data and/or some additional data – through a (geo)database. Both Open Source and commercial development frameworks have been tested in Pilot implementation. User utility assessment is also carried out within this phase to validate pilots design. Following chapter is focused on Pilot 2 - National Land Information System overview provided by GISAT.

## 4 PILOT 2 – LAND COVER / LAND USE DATA EXPLORATION WEBTOOL

In the frame of the HLANDATA project Pilot 2, GISAT and CENIA, which jointly serve as the National Reference Center (EIONET NRC) for Spatial Analysis and Land Cover in the Czech Republic work on exploring the potential of the setup of a national land information system and on the development of its trial which shall be demonstrated as the Czech pilot within the HLANDATA project. The project focuses mainly on technical, but reflects also organizational support required to set up data sharing cycle of the national mandated actors and data providers of partial land cover and land use data in a harmonized way.

Public administrations, decision makers, private companies, NGOs, researchers, planners, GIS analysts, the public, all these stakeholders and more require access to adequate and comprehensive data to achieve interdisciplinary and holistic analysis and planning activities, transparency and participation in decision-making, efficient integrated data management, and monitoring of changes for a sustainable development. Due to the harmonisation according to common standards, land use and land cover data across Europe can be shown on the HLANDATA geoportal together in one map, with one common legend, and therefore become comparable as a key input for cross-border analysis and integrated planning activities, e.g. in regard to environmental, mobility, economic, and social issues.

Nevertheless, The HLANDATA project aims even more by exploring potential how to turn data into standard information and provide user-friendly tools to explore, describe, compare and explain land cover and land use changes in socio-economic context. In order to achieve this level of flexibility and usefulness required by users, the service specification for the Pilot 2 goes far beyond the traditional concept of data provision. Inspired by the European Environmental Agency (EEA)’s the Land and Ecosystem Accounting framework [2], the Pilot 2 is based on an interactive web-based approach, where both spatial and socio-economical statistical data are delivered in an organized way, together with tools, in a fast and flexible

environment. This allows data to be easily viewed and analyzed in user-predefined themes (indicator views), as well as being further explored interactively. The webtool, based strictly on Open Source frameworks, integrates main standard presentation modes - maps, tables and graphs in an interlinked manner i.e. user-defined changes in/via one presentation mode are instantly reflected in all the others. User is also free to choose the most appropriate level of granularity for his analysis or define his own analytical units. Analytical views on data can be stored (using OpenID authentication) and/or shared with other users using URL link. Finally, users can export of each webtool component (into PDF or images) to be used in user reports or assessments.

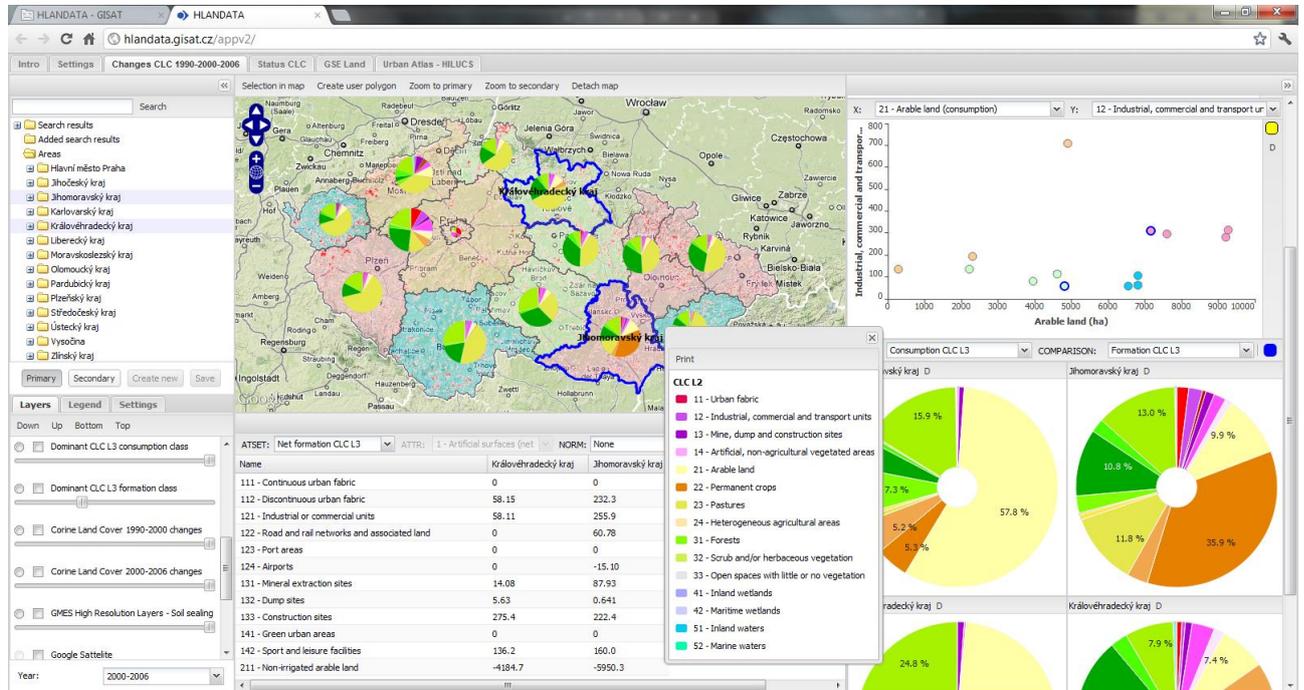


Fig 4: Example of the HLANDATA Pilots 3 – webtool interface

## 5 CONCLUSION

The HLANDATA project demonstrates advantages of current European effort for data harmonization of land use and land cover datasets within the INSPIRE context on example of user oriented value-added services streamlining harmonized data search, exploration and analysis. The web-based approach to the Pilot demonstrators developed within the HLANDATA project then shows not only potential of harmonised land cover / land use data, but also the power of new technological solutions to support the complex spatial information provision to the end-user. Intuitive, fast and user-friendly exploration and analysis webtool handling large spatial datasets integrated with traditional socio-economic statistical data can provide effective support to spatial planning on various administration levels and assure sharing the land knowledge on decision making level.

## 6 REFERENCES

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