

Hub4Everybody - New Collaborative Environment for Sharing

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Abstract

Hub4Everybody is a one-of-a-kind solution for publishing, sharing and cooperative management of geographical datasets, such as professional data and measuring, results of research projects or student papers, educational materials, emotional maps, visualization of in-field research and other maps, tables, or databases. You can easily upload or update your data as well as adjust the parameters of sharing among different audiences. Hub4Everybody is an alternative tool combining online office software with an editorial system for spatial data. It is also an Open-Source alternative to already existing commercial solutions, while offering additional extending options. Hub4Everybody offers all usual functions of geoportals (working with a map, linking of external data and services) but on top of that it offers a possibility to link desktop and mobile solutions for geographical data processing, data visualisation in form of storyboard and communication components via social networks. The solution is scalable and fully adaptable to the end-user needs. You can store your data directly on Hub4Everybody cloud or in your own infrastructure. All technologies used for Hub4Everybody are open source, which enables you to communicate with all kinds of users all over the world while no costs are necessary. The paper describes not only the current system, but also the history of development and potential utilization. An intensive testing and development using a series of INSPIRE Hackathons are an important part of development.

Keywords

Digital innovation hubs, social space, regional development, web mapping, spatial information, hackathon.

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Introduction

What is Web Mapping? What is the current status of Web Mapping technologies? How can Web Mapping be linked with Digital Innovation Hubs? How the development of rural regions could be supported by Web Mapping? And mainly how can it all be done easily? These are the questions which

we will try to answer in this paper.

The history of Web Mapping is already relatively long. Usually, the United States Vice-President Al Gore's 1998 speech about the necessity of geographical information being accessible globally and available to many users is being considered as the first idea about large scale Web

Mapping (Veenendaal et al., 2017; Gore, 1999).

There are a lot of definitions of what Web Mapping is. We can mention for example following two:

- Web mapping is a technique of utilizing maps that are obtained by an information system for spatial and geographical data (Techopedia: What Does Web Mapping Mean?).
- Web mapping is a process of designing, implementing, generating, and delivering maps on the World Wide Web (Neumann, 2008).

Spatial Data Infrastructure (SDI), another term introduced by Al Gore, is connected closely with Web Mapping. SDI is usually defined as technology, policies, standards, and human resources necessary to acquire, process, store, distribute, and improve utilization of geospatial data, services, and other digital resources. It includes maps, data, geospatial services, and tools (Georgiadou et al., 2006; Hendriks et al., 2012). In Europe, building of SDI is closely connected with the Infrastructure for Spatial Information in Europe (INSPIRE) directive, which has focus to release the potential of spatial data managed by governments at all levels (Local, Regional, National, European) and to guarantee reuse data by all actors including business and citizens mainly for the purposes of Community environmental policies and policies or activities which may have an impact on the environment. The INSPIRE Directive, came into force on 15 May 2007, with expected full implementation in every EU Member State required by 2021 (Craglia and Annoni, 2007; Cetl et al., 2019). Similar initiatives exist also in the US, where there is National SDI coordinated by the Federal Geographic Data Committee (FGDC) (Maguire and Longley, 2005) and common SDI between Australia and New Zealand managed by Australian and New Zealand Land Information Council (ANZLIC) (Rajabifard and Williamson, 2001). On a global level, the effort is coordinated by The Group on Earth Observations (GEO) with the goal to build the Global Earth Observation System of Systems (GEOSS) (Giuliani et al., 2017). Spatial Data and Spatial Data Infrastructure play a more and more important role also in rural and regional development (Halbich and Vostrovsky, 2011; Kliment et al., 2015; Pavlik et al., 2015).

Crowdsourcing is the new step in broader citizens participation on collection of spatial data. Crowdsourcing together with Volunteered Geographic Information (VGI) are currently part

of a broader concept – Citizens Science (Charvát and Kepka, 2021). Crowdsourcing is a model where a group of organizations or individuals can contribute to a common goal. It could be used for collecting finance, but also for data collecting. It often relates to citizen science, as the involvement of the public in scientific research (Irwin, 1995; Gura, 2013). We can also speak about Earth Observation or Citizens' Observatories (Newman et al., 2012; Robinson et al., 2018). Volunteered Geographic Information (VGI) is a very similar approach (Elwood, 2008).

Digital Innovation Hubs (DIHs) are mainly used to support local and regional SME in testing new tools and developing new solutions. "Digital Innovation Hubs are one-stop-shops that help companies become more competitive with regard to their business/production processes, products or services using digital technologies, by providing access to technical expertise and experimentation, so that companies can "test before invest" (Kalpaka et al., 2020). Digital Innovation Hubs have to guarantee access of local businesses and public authorities to the newest digital technologies and provide training in digital skills. It needs to support specialization of the regions, in line with their regional Smart Specialization Strategies as a set of priority areas for public investment, corresponding to regional competitive advantages (Miörner et al., 2019; Jarolimek et al., 2009; Kánská et al., 2021). To support regional policies and regional businesses is one of the key priorities on PoliRural projects, where an important part was to develop and test utilization of DIHs in regional context (Ulman et al., 2020).

Various web map platforms, with potential to support DIHs are available on the scene with a wide range of features, target user groups and maturity level.

Provision of web GIS functionality and content can be provided by the large set of open sourced or open license-based solutions like examples mentioned in Table 1.

	Product title	URL
1	Geonode	https://geonode.org
2	Georchestra	https://www.georchestra.org
3	Lizmap	https://www.lizmap.com
4	Mapbender	http://mapmint.com
5	MapLibre	https://maplibre.org
6	Mapmint	https://oskari.org
7	Mapstore	https://mapbender.org
8	Oskari	https://mapstore.readthedocs.io

Source: Authors processing

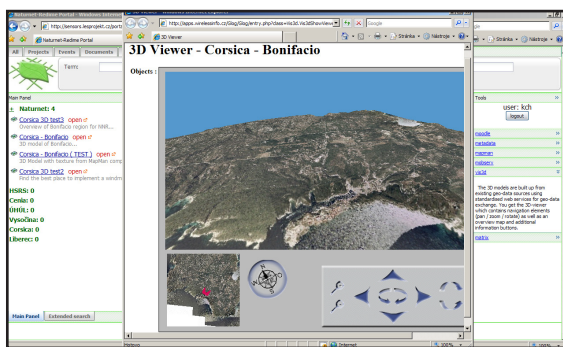
Table 1: Examples of web map platforms.

The goal of this paper is to describe implementation of DIHs and their practical testing and improvements. It was done not only as part of PoliRural projects, but in cooperation with other projects SmartAgriHub, EO4Agri and SIEUSOIL. Based on practical experiences, we have created a new design of such DIH - Hub4Everybody, which can now be easily modified and used in different contexts.

Materials and methods

Current solution

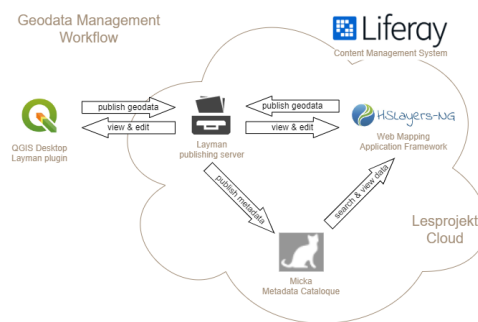
The initial ideas leading to the current Hub4Everybody first concept and first prototyping was the concept of Uniform Resource Management (URM). Uniform Resource Management provides a framework in which communities can share information and knowledge through their description, which is easily understandable within the community, e.g., scientific community, living lab, etc. This URM concept is one of the research results introduced by NaturNet-Redime project and today deeply elaborated by Collaboration at Rural (C@R) project and support sharing of knowledge inside of community using metadata and catalogue standards for their description and discovery (Figure 1).



Source: Charvát et al. (2008)

Figure 1, NaturNet-Redime URM.

This model has been extended throughout the years and new components were added or were modified (Charvat et al., 2009; Charvat et al, 2011; Charvat et al., 2014) and it has led to currently used solutions, based on Liferay CMS (Figure 2).



Source: Charvát et al.

Figure 2: Initial Architecture of Hub with Liferay CMS.

Liferay

The frontend layout of the DIH portal was based on the wireframe for better UX usage and is implemented into the Liferay portal framework. Responsive design based on the Bootstrap framework is used for optimal viewing and navigation across a wide range of devices, including traditional PC, tablet and surface, smartphones, and all other mobile devices. Also, semantic code for better SEO and application of the SEO principles.

Liferay Portal provides a robust platform to build a website on quickly and serve it to all clients - desktop, mobile, or anything in between. It provides all the standard applications which are needed. It also provides an easy-to-use development framework for new applications or customization.

Liferay's collaboration suite resonates with apps and features that foster excellent communication. Its Message Boards app gives users a platform for discussions, questions and answers, and comments. Blogs publish user's ideas using rich content, so readers can understand them clearly and respond to them. Collaboration is enhanced in all these applications through mentioning other users—tagging them by name to get their attention or give them kudos.

CMS - page editor - Liferay Portal's Web Content Management (WCM) system allows non-technical users to publish content to the web without having advanced knowledge of web technology or programming of any sort. Liferay WCM empowers users to publish their own content with a simple point and click interface and it helps them keep the site fresh.

With Liferay Portal's WCM, users have the ability to create, edit, stage, approve, and publish content

with easy-to-learn yet powerful tools. Liferay's WCM streamlines the content creation process for end users. It's much faster to use Liferay's WCM than it would be to create all the content for your site in HTML. WCM is integrated with Liferay's services so advanced template developers can use them to query for data stored elsewhere in Liferay.

- **WYSIWYG Editor:** A complete HTML editor that allows users to modify fonts, add colour, insert images, and much more.
- **Structure Editor:** Easily add and remove fields users want available to content creators and then dynamically move them around. This editor includes an entire suite of form controls you can drag and drop onto your structure.
- **Template Editor:** Import template script files or create their own template that informs the system how to display the content within the fields determined by the structure.
- **Web Content Display:** An application that lets users place web content on a page in a website.
- **Asset Publisher:** An application which can aggregate different types of content together in one view. This app is covered in more detail in the Publishing Assets section.
- **Scheduler:** Lets users schedule when content is reviewed, displayed and removed. This feature is covered in more detail in the Scheduling Web Content Publication section.
- **Workflow Integration:** Run users' content through an approval or review process. This feature is covered in more detail in the Using Workflow section.

Collaboration - Liferay Portal ships with a robust suite of collaboration applications that can be used to build communities of users for the website. These applications provide all the features that would be expected of standalone applications outside a portal setting. The difference with Liferay's collaboration apps, however, is that they all share a common look and feel, security model, and architecture.

Available apps on Liferay and all the components of Liferay's Collaboration suite:

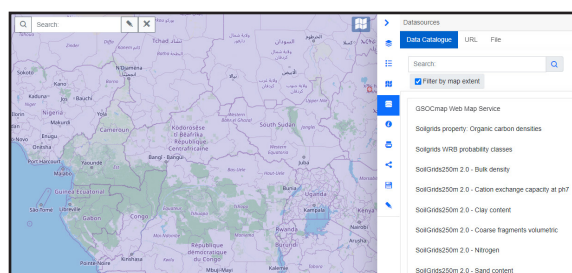
- Blogs
- Message Boards
- Wikis
- Announcements
- Mail
- Knowledge Bases
- Bookmarks

Media manager - Liferay Portal's Documents and Media library provides a mechanism for storing files online using the same type of structure that is used to store files locally. It serves as a virtual shared drive and can mount and browse external repositories. Its companion app, the Media Gallery, displays selected content from the Documents and Media library. It can display image, audio, and video files. Other features in the Documents and Media library include customizable document types and metadata sets, automatic document preview generation, and support for mounting multiple external repositories.

Web Map Application

The web mapping component (Figure 3) uses the open-source mapping framework HSLayers-NG, see <https://ng.hslayers.org/>. This tool is built upon the basis of OpenLayers and enables significant customization and functional additions depending on the requirements of the system. At the same time, there is a functional integration to the Wagtail CMS in the form of a map widget, which allows easy creation of maps within all HTML pages of the content management system, including the detailed configuration of map layers and tools if required.

Important role of the web map is to publish geo-data in the form of single layers or complex thematic maps. Most common vector and raster data formats are supported (GeoJSON, Esri Shapefile, KML, GPX, GeoTiff, JPEG, PNG).



Source: Charvát et al.

Figure 3: Web mapping component.

Desktop GIS Client

All the geo-data publishing tasks that can be carried out in the web application are available also via a desktop client. That is represented by a plugin for the most popular open-source GIS platform QGIS. The plugin is called "Layman" and is available through the native QGIS repository. Similar to the HSLayers web map, spatial data layers can be published as services and thematic maps composed of layers can be created using the Layman plugin.

Data Publishing Server

Both HSLayers and QGIS Layman plugin act as client applications which means they don't do the actual data publishing but are using some other service for that. And that is the role of Layman (<https://github.com/LayerManager/layman>), the publishing server that automatically converts geo-data into web services in OGC WMS and WFS standards. It provides an extensive REST API so any other possible client can be connected.

Metadata Catalogue

Any geo-data management system cannot work without metadata. Micka is the detailed metadata catalogue with INSPIRE standard support. All geodata published by our tools is automatically metadata-recorded. The metadata can be searched back through the HSLayers web client or the QGIS desktop tool.

Existing Hubs installation

Within the projects, HUBs were installed with the aim to:

- Provide a social space for a community of practices
- Promote pilots work and support access to their analysis
- Promote existing best practices
- Support hackathons and promote results of challenges
- Offer new tools and technologies for testing
- Provide access to digital technologies and competencies
- Provide access to infrastructure and tests digital innovations ("test before invest")
- Support effective data management
- Provide development playground for map-based projects
- Offer training and skills development
- Help in networking and connecting users and suppliers of digital innovations

PoliRural Hub (hub.polirural.eu)

PoliRural DIH aims to offer a solution for the global promotion of pilots and regions. This DIH integrated technology, datasets, and libraries in one infrastructure with a complex user-oriented portal in the Web environment. The DIH can connect end-users with developers or researchers to improve the impact of the demo applications or case studies by short-chain feedback from end-users. End users can join larger communities around the DIH to get advice, cooperation potential and access to modern technologies utilization. Important part of the Hub is the pilot section, where pilot work was presented (Figure 4).

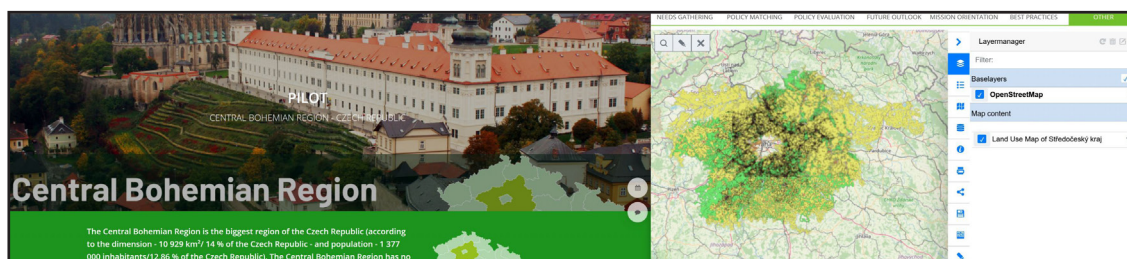
AgriHub CZ (agrihub.cz)

The purpose of AgriHub CZ is to design and develop a smart technological innovation centre for agriculture. The hub is designed to create links between people, companies and other entities with knowledge and technology that will help in the implementation of innovative projects and ideas. AgriHub was initially founded in cooperation with 2 companies - WirelessInfo and Lesprojekt - služby s.r.o. - with the intention of supporting and developing smart agriculture. It is currently being developed in cooperation with the Agricultural Association of the Czech Republic and the Crop Research Institute. In a later stage Plan4all association and Czech Centre for Science and Society contributed to development.

During the Agrihub INSPIRE Hackathon series, AgriHub is widely used as an information guide to individual challenges, presenting results and announcing winners. The presented information and the obtained results from individual challenges are used for the following years of the hackathon.

AgriHub SK (agrihub.sk)

The main goal of the Slovak Agricultural Innovation Hub "AgriHub SK" is to support innovations based on data and technologies that



Source: Charvát et al.

Figure 4: PoliRural Hub presentation of Central Bohemia Pilot.

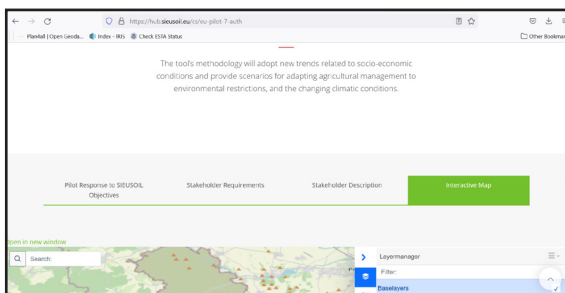
will enable the ecological and efficient development of the agro-sector and thus strengthen its societal benefits. AgriHub SK will be an open platform aimed at supporting cooperation between farmers, researchers, developers, or officials themselves. The portfolio of target groups is therefore open to representatives of the public, private, non-profit, and academic sectors, not excluding the professional and lay public. AgriHub SK will provide space for better definition of problem areas with regard to the transfer of innovations, experiences and knowledge of good practice through the identification of project opportunities and the search for opportunities to support their implementation.

SmartAfriHub (www.smartafrihub.com)

SmartAfriHub is a Digital Innovation Hub that connects people to digital information and services in Africa. DIH integrates African agriculture and climate community members, and beyond, to the knowledge bases e.g., Blog, Forum, Science Shop, WIKI. DIH provides different types of Open Source Software and demo applications, where farmers, developers and researchers can cooperate, test different API for new solutions and also provide common experiments upon geospatial information and agriculture. Currently, there is an existing community around SmartAfriHubs and the extension and development are supported by INSPIRE Hackathons (Charvát et al., 2021).

SIEUSOIL Hub (hub.sieusoil.eu)

SIEUSOIL aims to develop sustainable and holistic soil management practices based on a harmonised land information system suitable for diverse climate and operation conditions along different EU and China locations. A research platform consisting of advanced crop and soil sensing tools, modelling and data fusion, digital soil mapping and farm management information systems will be developed to maximise land productivity and socio-economic benefits, while minimising the environmental impacts. Moreover, there is a strong focus on support of regions and publishing of their results (Figure 5).



Source: Charvát et al.

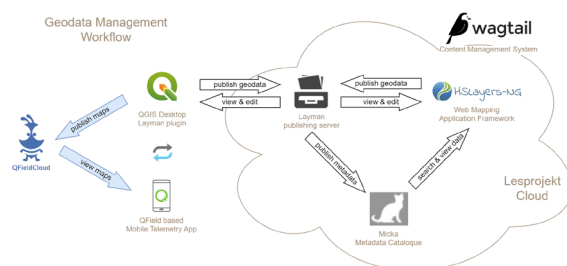
Figure 5: SIEUSOIL Rostenice Pilot.

Main problems and limitations

The previous experiences demonstrate that the main difficulties for broader utilisation of the current Hub is the Liferay CMS framework. It is too complex and too difficult to understand, and it brings challenges for non-expert users. Non-expert users had problems generating content and also combining spatial and non-spatial data. This was the reason why we started to look for new solutions, which will enable easier content publishing, and which will be more user-friendly for non-experts. Another topic, which we found important, was a better support for mobile users and usage of data in terrain. This was the reason why we started to develop a new generation of CMS. This fact was mainly visible on PoliRural and SIEUSOIL hubs in preparation of pilot presentation and also on SmartAfriHub, where complexity was a big limitation.

Hub4Everybody

Hub4Everybody is based on previous experiences and is presented to the user as a single and complex solution and workflow for managing geo-data. But it is built upon interlinked multiple separate components. The basic architecture of the whole system is depicted in the schema (Figure 6).



Source: Charvát et al.

Figure 6: Hub4Everybody general architecture.

The main improvements are linked with usage of Wagtail CMS and Implementation of Mobile Support. Both were done as part of Agrihub INSPIRE Hackathon (Plan4all website: Agrihub INSPIRE Hackathon 2022).

Content Management System (CMS)

The Editorial system represents a basic unifying element for geodata processing. This component allows for the creation of web portal content and also represents a natural junction for other parts of the system. Hub4Everybody uses Wagtail CMS (<https://wagtail.org>) Platform, extended by CodeRed Extensions (<https://www.coderedcorp.com/cms/>). It is one of the leading open-source CMS used by small as well as large organisations (Google, NASA, British NHS). Wagtail is based on the Django system and the main programming

language is Python. It enables very easy extension of the functionalities in the forms of widgets, web page templates, or extending of authorization and other system parameters. It is, therefore, possible to integrate it with other systems used within the organisation (e.g., geoportal of a city), if such demand occurs. There is a huge community of developers behind the system, where more complements and extensions can be developed.

The default set of features has been extended to offer a larger set of web page elements including an interactive map application (see Figure 7).

A web portal built by the content management presents the gateway for the user and unifies the rest of the system on the level of user identity. That means the user has one account to access all the components no matter if it is on a web platform or desktop application. Single Sign-On is ensured this way.

Mobile support

HSLayers web application naturally supports mobile devices and is convenient to use. But that is not enough in today's mobile world. That is why the mobile apps based on QField (<https://qfield.org/>) have been recently adopted into our solution pipeline. It is an exaggeration to say that QField is a mobile QGIS, which also allows you to view published maps on your mobile phone and offers tools for data collection in the field. And all this can be extended according to users' requirements. The possibility to easily publish maps via the QGIS Layman plugin also to the QField Cloud (<https://qfield.cloud/>) is the newest feature

available. The next phase of development envisages incorporation of the QField Cloud directly into the hub which assumes the hosting of the cloud in the same infrastructure. That will allow better integration on the level of user identity as QField Cloud does not support any other authentication mechanism than its native one.

Used infrastructure

Hub4everybody is a part of internal cloud solution run on own managed and dedicated servers in a location of Prague, Czech Republic and as such is under full control of Lesprojekt - služby company. It is built on OpenStack software, based on Linux operating systems and other open-source technologies. OpenStack enables optimal usage of hardware resources joining standalone servers in a seamless cloud under a single management. It provides a vast number of services including virtualisation, block device sharing, distributed computing, support to various docking technologies, etc. A very strong network stack allows for low level network isolation including VLAN support, NAT and integrated firewall. Fine grained user management enables logical segmentation of OpenStack instances into standalone independent instances as if they were running on separate physical servers. Administrator has a very good overview of current use of hardware resources due to strong reporting capabilities and a web dashboard. Backup is done at least weekly, for critical infrastructure even more frequently. Own backup infrastructure is managed by Lesprojekt - služby company. New virtual servers are rapidly deployed within minutes

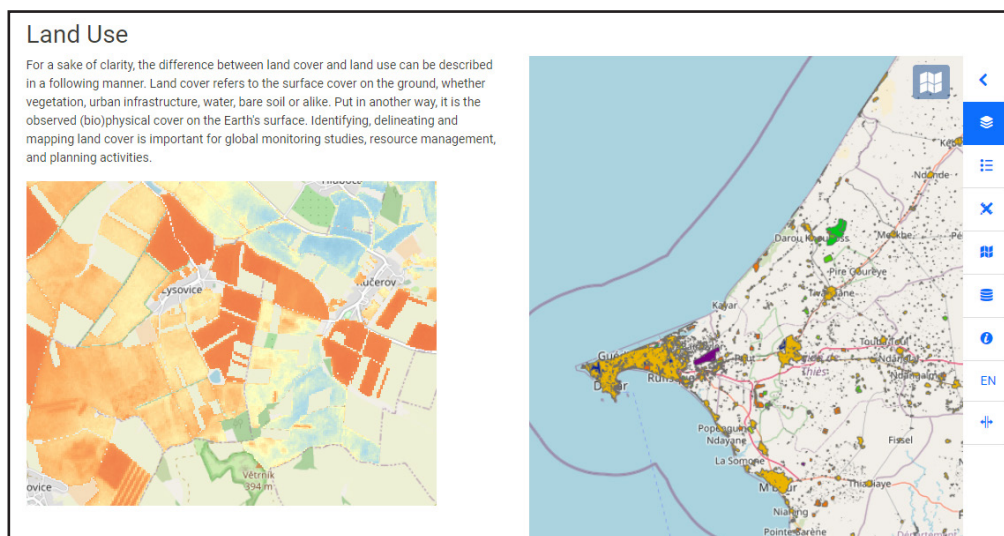
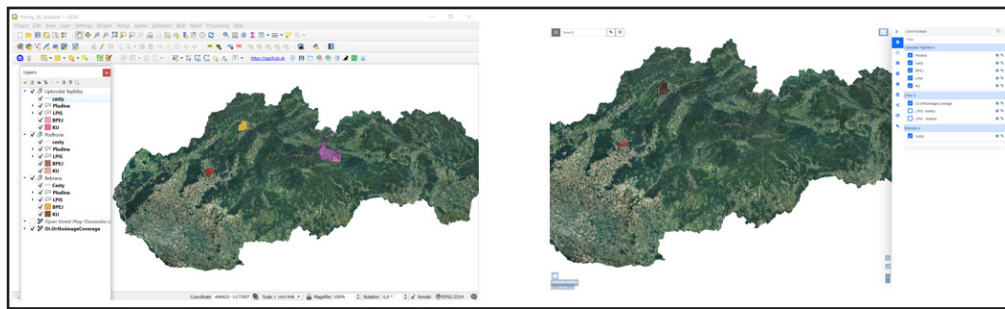


Figure 7: Example of a web page created by Hub4Everybody CMS including a map.

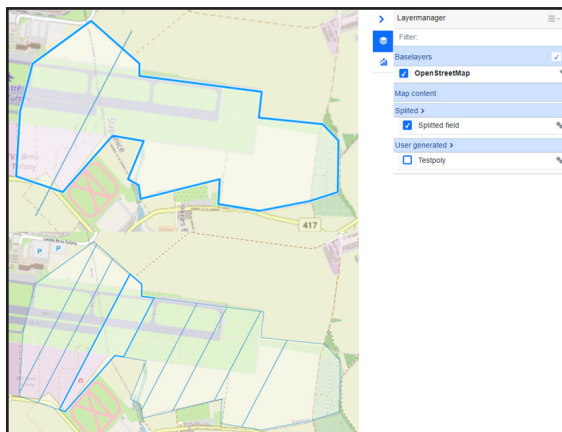


Source: Charvát et al.

Figure 10: Example of publishing complex QGIS project with pilot farms to the webmap UI.

Based on this experience, further implementations were supported during the following Agrihub INSPIRE Hackathon 2022 with the main focus on support for farmers, utilising the potential of desktop linkage to the QGIS as well as advanced web processing served via web GIS client application (Figure 10).

In connection with the solution of farmers' needs, a tool has been developed that will serve farmers for the quick division of land blocks into smaller units. Next Figure 11 presents the proposed solution.



Source: Charvát et al.

Figure 11: Outcome of custom developed webgis application offering farmers to calculate and visualise specific field areas based on current legal and practical requirements.

SmartAfriHub

During the Hackathon, we were able to organise a couple of overall meetings, 1 large webinar dedicated to Hub4Everybody technology, with an audience of registered 120 participants geographically covering countries throughout the whole Europe, Africa, South America as well as Asia.

Above that, we have organised two specific training sessions on using the SmartAfriHub portal, where we showed step-by-step how

the new content can be created and uploaded on-line. Both training sessions were recorded and uploaded on the YouTube channel of Plan4all, as was the Hub4Everybody webinar.

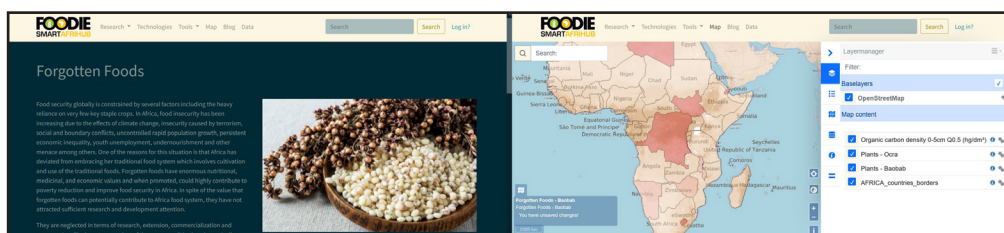
- https://youtu.be/_t5mtReGjN4
- <https://youtu.be/3oHpxXFYeU>
- <https://youtu.be/G1VFv6MKkEE>

A discussion with stakeholders in Africa was led on what are the needs for attracting people to use the new Hub and also to contribute with new content. It was discussed that we need to show the possibilities to build information content in attractive form. It is necessary to demonstrate interesting content possibilities of presentation of different problems. On the basis of discussion, a FARA document: Africa Manifesto and Plan of Action (Forum for Agricultural Research in Africa websites) was selected as an example. A demo presentation of two forgotten crops of Africa - Ocra and Baobab was prepared (later we plan to prepare a presentation of all crops).

At the first stage, interactive maps of countries, in which these crops are growing, were prepared, and published on the Hub (Figure 12).

Testing of new solutions on Environmental Atlas of Liberec

In the beginning, the Atlas of the Liberec Region website was only a supplement to the printed book with AR elements Environmental - Atlas of Liberec (Figure 13). But it soon began to serve as a platform for communicating our maps and educational games for young people. The atlas is also a background for the 3-day annual Map Around Us educational event.



Source: Plan4all website: Agrihub INSPIRE Hackathon 2022: Final reports, Challenge 12

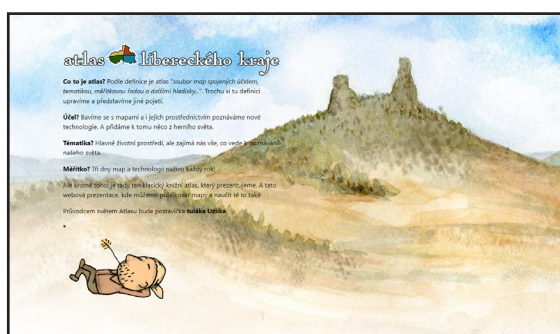
FFigure 12: Forgotten Food of Africa demo.



Source: Charvát et al.

Figure 13: Atlas of the Liberec Region publication.

Because the originally used CMS Liferay has ceased to suit, we are currently transferring the entire atlas website (<https://atlas.kraj-lbc.cz/>) under the new Wagtail CMS (Figure 14, temporarily at <https://atlas2.kraj-lbc.cz/>) system, which is the basis of the Hub4Everybody.

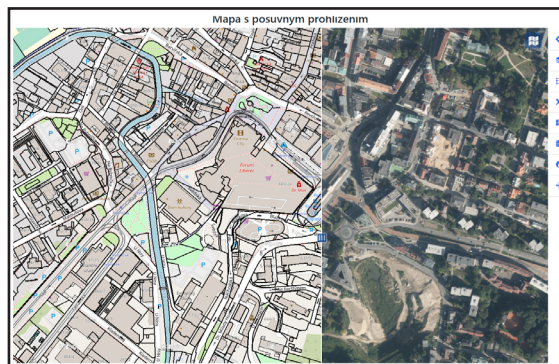


Source: Charvát et al.

Figure 14: New title page of the Atlas of the Liberec Region.

Local content developers expect the development of new functionalities (Figure 15), especially with the support of interactive story maps or extension of the functionality for independent user mapping. In this regard, the authors of the atlas are experimenting with the use of the Layman system to convert maps created

in the open QGIS program.



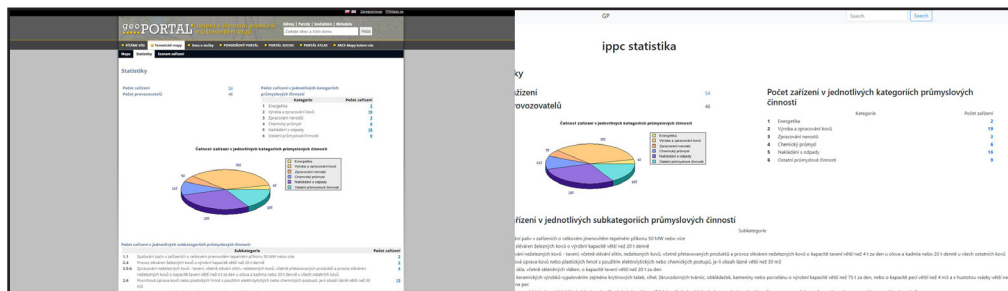
Source: Charvát et al.

Figure 15: New possibilities of the web towards the creation of story maps - slider.

Possibilities to migrate existing data from hubs and portals

The possibility to provide migration of content from existing Hubs and Web Pages into new solution based on Wagtail was also important for successful transfer from previous version to new solution. Due to the idea for future integration of existing web pages and Hubs, we have tested migration of new technologies from two platforms WordPress and Liferay. For Wagtail, the Wagtail WordPress Import module (<https://github.com/torchbox/wagtail-wordpress-import>) is being developed, allowing content to be converted from WordPress CMS with varying degrees of success. For small amount of content items (pages, blog entries, ...) manual conversion seems to be the fastest and easiest. There is currently no possibility to directly import content from Liferay to Wagtail. So, we focused on developing our own approach. User database transfer should be feasible using the following procedure:

- export from Liferay (either via API or SQL dump from database)
- rewrite of exported data
- import of data using Wagtail's built-in mechanisms



Source: Charvát et al.

Figure 16: Migration of content from Liferay to Wagtail.

Conclusion

Hub4Everybody is based on Agile continuous development and improvement of solution for publishing of spatial and non-spatial data and building attractive content, which can be used in different solutions. Hub4Everybody can be used by whoever wants to publish and present their data, while there is no need to invest into professional GIS or into developers programming and updating their own solutions. Hub4Everybody is designed for SMEs, high schools and universities, research organisations as well as public authorities, NGOs, and many others. We are delivering the results of our development – a unique and adaptable solution based on open sources, which can easily be used in any kind of organisations (from national institutions, over different type of schools and universities, up to SMEs or public authorities), that needs to manage and publish geographical data.

Hub4Everybody comprises of following elements:

- *geoportal*
- *social communication*
- *storyboard*
- *communication with desktop as well as mobile solutions*
- *tool for creating and editing of maps*
- *data management*
- *support of legislative measures, incl. the INSPIRE directive*
- *supporting GEO/GEOSS*

Currently we are transferring previous Hubs and Web pages into this new environment, but also preparing the first implementation for our customer, where this solution will be used for Environmental Atlas.

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