

Agroforestry usage, building Knowledge Databank for Agroforestry training and education

László Várallyai¹, Miklós Herdon², Charles Burriel³, Szilvia Botos⁴

¹University of Debrecen, Business and Economics Faculty, Applied Informatics and Logistics Institute, Hungary, e-mail: varallyai.laszlo@econ.unideb.hu

²University of Debrecen, Business and Economics Faculty, Applied Informatics and Logistics Institute, Hungary, e-mail: herdon.miklos@econ.unideb.hu

³Agrosup Dijon, Institut national supérieur des sciences agronomiques, France, e-mail: charles.burriel@educagri.fr

⁴University of Debrecen, Business and Economics Faculty, Applied Informatics and Logistics Institute, Hungary, e-mail: botos.szilvia@econ.unideb.hu

Abstract. The AgroF-MM Erasmus+ project reinforces the AgroFE project that ended in 2015. The objective of the AgroF-MM project is to train European agricultural stakeholders in agroforestry practices. The project will give them the opportunity to familiarize themselves with agroforestry, and to improve their knowledge of it, in order to work towards the development of agroforestry in the Mediterranean and mountain regions of Europe. Thus it widens the geographical scope and improves the level of training of the AgroF-MM project, as well as addressing new stakeholders from 15 partners. The paper describes the knowledge databank system prototype for Agroforestry training and education. The knowledge databank is a component of the project training system. It aims to gather and share a set of documents, resources that partners can use and which will have been accessed by learners and the public users. These resources are under different forms: Mono document objects and Composite materials.

Keywords: Agroforestry, Knowledge Databank, Education, Training.

1 Introduction

In last decades regional growth of arable land has a significant effect in global and European land use, thereby reducing the percentage of natural forest area. In Europe are 29% croplands, and in Central and Eastern Europe in Hungary arable land ratio is near to 50%, which is much higher than the European average. The global environmental problems justify the necessary of forestation in each country. However, this causes conflicts of interest between the agricultural and environmental sectors. Solution of the conflict management may increase the agroforestry land use, which means ecologically mixed land use. The European Stakeholders has accepted that agroforestry has special ecological system.

Copyright © 2017 for this paper by its authors. Copying permitted for private and academic purposes.

Proceedings of the 8th International Conference on Information and Communication Technologies in Agriculture, Food and Environment (HAICTA 2017), Chania, Greece, 21-24 September, 2017.

The aim of the AgroF-MM (Agroforestry Education, Mediterranean and Mountains areas) project is to play an important role in Agroforestry trainings. Depending on the European countries, states or professional organizations and training actors try to reintroduce Agroforestry in the course of training and qualification in initial training and in adult education.

The aim of the AgroF-MM project is to involve farmers, future farmers, advisors and stakeholders in Agroforestry. This agricultural system has experienced a strong abandonment in the 20th century, to count today only a few million ha in Europe (Nair, 2005). Following the work of scientific research, development structures and the experiments of some professionals in recent years agroforestry has met a true national and European recognition.

Depending on the countries, states or professional organizations and training actors reintroduce Agroforestry in the course of training and qualification (Jamnadass et al., 2014) in initial education (Vocational Education Training) and in adult training (Jongmans, 1996). Based on the results of scientific research, development structures and those of the "farmer-researchers", experimental courses were conducted in different countries, including France, in the United Kingdom or in Italy, on a small scale, as resources, trainers and available skills are scarce. It is on these four components: the results of scientific research, professional practice formalized training based on business situations (Gunn, 2010), innovative teaching resources, the transfer from past AgroFE project (the AgroF-MM project is based on the AgroFE). In the partnership countries, the need for conversion and development is between 25,000 and 30,000 farms (Price, 1995) in the next 5 to 7 years (Gregorio et al., 2015), which means training 25,000 to 30,000 farming managers (L4 to L6 level by country) as well as the same number of workers and "small farmers", on L2-L3-L4 level by country.

1.1 Organized trainings in the project

The core of the EQF (European Qualification Framework) concerns eight reference levels describing what a learner knows, understands and is able to do (learning outcomes). Levels of national qualifications will be placed at one of the central reference levels, ranging from basic (Level 1-L1) to advanced (Level 8-L8). This will enable a much easier comparison between national qualifications.

But in order to achieve, to support these conversions, these profound changes in modes of practical production, we need counsellors-advisors, trainers, specialists and unfortunately the level of human resources is low. The partners have identified training needs in the short term (Ghirardini, 2011): These needs are on the one hand farmers and future farmers, adults and pupils (Kuhn, 1996) - students, on the other hand, middle managers and teachers-counsellors-specialists (Mbow et al., 2014). These requirements therefore relate to two levels of qualification L2-L3-L4 L5+/L6 and 3 types of learners (target groups) (Várallyai and Herdon, 2013):

- students (in VET - Vocational Education Training) and adults, small farmers, future farmers and workers in farming on the one hand, mainly L2-L3 level, sometimes L4 level,

- the farmers and future farmers (in larger farms) and middle management, mainly L3-L4-L5 level, sometimes L5 level,
- the advisors-teachers-specialists, mainly level L5+L6,

In the short term, the project will address these 4 needs / three publics through an AgroF-MM training system established by the partners, partly based on the AgroFE Leonardo project, the development of the EU AgForward RTD (AGroFOREstry that Will Advance Rural Development, Research and Technological Development) 7th research, the EURAF (European Agroforestry Federation) EU research association and its working groups, and the outcomes from the French RMT and Casdar (Fertilisation and Environnement- Frnch acronym) programme. The project would be built on innovative teaching and training practices (Gamboa et al., 2010), France, United Kingdom, Italy, Greece, for instance on professional situations providing (training and certification at the workplace), access to recognized qualifications (NQF - National Qualification Framework, EQF - European Qualification Framework, ECVET - European credit system for vocational education and training, ECTS - European Credit Transfer and Accumulation System), a process based on "russian dolls" (Bustos et al., 2007; Herdon and Lengyel, 2013; Herdon and Rózsa, 2012), the certified and accredited inferior level giving access to the superior one.

1.2 Knowledge Databank overview

Supporting the agroforestry development (training on different levels (Mbow et al., 2014; University of Missouri, 2015), extension activities, farming) in Europe one important aim of the AgroFE (<http://agrofe.eu>) and the AgroF-MM (<http://agrofmm.eu>) European projects is to build a knowledge databank to help the players with agroforestry knowledge. A knowledge base or knowledge bank is a special kind of database (Glick, 2013) for knowledge management. A knowledge base is an information repository that provides a means for information to be collected, organized, shared, searched and utilized. It can be either machine-readable or intended for human use. Behind a Knowledge DataBank (KDB), there is, at least, a back-end which is based on a special DBMS. Due to the high level of enrichment, a KDB is more than a documentary base or a document management system.

The knowledge management (KM) is used to describe the creation of knowledge repositories, improvement of knowledge access and sharing as well as communication through collaboration, enhancing the knowledge environment and managing knowledge as an asset for project partners and public. The central element of the KM is the KDB. For building and using the KDB knowledge engineering is needed. Organizing and storing the knowledge (represented in different content and forms: documents, videos, photos, etc.) it is need to classify them by using knowledge representation technologies. In the project the Dublin-Core (Weibel, 2005; Lubas et al., 2013), LOM (Learning Object metadata), Technical metadata and the Agroforestry thesaurus are used (Castro-García and López-Morteo, 2013; Manouselis et al., 2010).

The very important part of the development to define the AgroF-thesauri in very detail because the word in this vocabulary links to different object (document, lecture, presentation, videos, etc.) in the KDB. This thesauri system has been

developed by a working group in the project using ontology. Unfortunately the AGROVOC Multilingual agricultural thesaurus and other system don't contain terms for agroforestry in details (Rajbhandari and Keizer, 2012).

2 Objectives and development methods

The main objectives are to make a synthesis of needs and expectations. The work based on the present existing training actions and to set up a common framework. Within this framework the target is to build an innovative training system (contextualized, modularized trainings, use of ICT (Information and Communication Technologies), professionals participation), to create a technical collaborative support for the implementation of the project with communication tools (information of partners and promotion) and providing access to the resources and training services during and after the project (knowledge databank, interactive services). To achieve these objectives the following main activities had to be carried out (Dosskey et al., 2008):

- Exploitation of the tools and services;
- Building a collaborative working environment;
- Planning the architecture for development, teaching and training;
- Implementing the e-learning environment (Lengyel and Herdon, 2009);
- Designing the multimedia tools to make the system accessible for learners and trainers.
- Based on different methods we have built a collaborative working environment for the project partners and players who will join to this knowledge database and information service. We used the following methods (do the following activities):
 - Using the experiences from former project and practice;
 - Studying new technologies and methods;
 - Developing Agroforestry courses;
 - Evaluating them;
 - Selection.

3 Results

3.1 Knowledge Databank System architecture (KDB)

A knowledge base or knowledge bank is a special kind of database for knowledge management. A knowledge base is an information repository (Beddie and Halliday-Wynes, 2010) that provides a mean for information to be collected, organized, shared, searched and utilized. It can be either machine-readable or intended for

human use. Behind a Knowledge DataBase (KDB), there is, at least, a back-end which is a DBMS.

The developed system architecture can be seen on the Fig. 1.

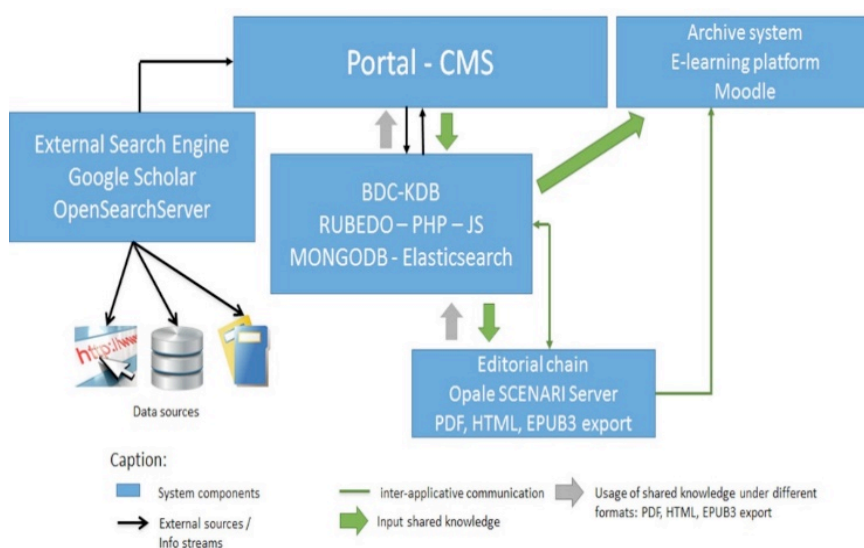


Fig. 1. Knowledge Base System architecture

In the context of the AgroF-MM project, the used Information and Communication Technologies (ICTs) include four components: the collaborative tools, the Knowledge DataBase, the tools for training and archiving and a portal that integrates the tools.

The KDB, is to enable the sharing, access and consultation in the use of certain resources for training. These resources are under different forms:

- Mono document object, like a photo, a text, a diagram.
- Composite materials, for example an html web page with images, “pdf” files with pictures and diagrams, a video clip, with images and sounds, etc.

Under the project, these documents are identified, selected, proposed by partners and included into the KDB for the evaluation of their potential use in training, by one or more partners. A fact sheet originally written by the proposer, the institution, who proposed it to project partners, often accompanies, completes this document.

At the end of the evaluation phase, the KDB can be extended to other contributors, for other uses, such as exchange supports between different actors of Agroforestry.

3.2 Objectives of the KDB

There are more objectives of the KDB, which are the followings:

- Storing elements of knowledge, sources of technical and professional information in relation with the domain, elements, components that could be usefully used in education and training;
- Making professional experiences accessible to learners, students, adults in training, experiences under the form of documents, videos, evidences, keynotes;
- Allowing the diffusion of knowledge under the form of apprenticeship modules, together or linked to education and training platform;
- Being one of the support tools for the curricula and trainings established, developed by the project, proposed to students, to adults, target;
- Allowing to professors, trainers, instructors to develop innovative curricula, educations pathways, new types of pedagogical activities;
- Being, in the project, one of the support tools of the collaborative and interactive working, especially as a mean to help the production of new education and training and professional targeted knowledge;
- Bringing and bridging the other related KDBs (Agronomy, Agro ecology, Environment, Water, Organic) and Agroforestry sources wherever they are located on Earth;
- In mid-term, enlarging the domains of agroforestry which are covered by the KDB, for instance knowledge from Mediterranean, African, Asian, experiences, professional practices;
- In mid-term, making this knowledge accessible to other people as learners, to other learning organizations, institutions like universities, training centres, in respect with intellectual property;
- In long-term, for the “public part” of the KDB, making this knowledge accessible to large public, in respect with intellectual property.

3.3 Needs in education and training - requirement of KDB

We need a place to store and structure the information and sources gathered by the project. This place can be divided into 2 parts:

- Private part
- Public part, which means not restricted to partners but, for instance, open to trainers and learners.
- The project needs to build the curricula and trainings, especially the technical / professional components, which stored in a repository for the information:
- A repository to store the “objects”, the documents, the resources, the components of the modules the project is producing and will produce;
- A place to, possibly, store some “objects”, documents, which are involved in working tasks, in conjunction with the collaborative working system;
- A set of tools to identify the KDB components (indexation) and tools to make this information easily accessible, search engines for instance;
- We can review some aspects of technical needs:
- Amount of data to be stored, we have to define technical constraints;
- Number of users, number of access, in short term and in midterm;

- Related parameters like quantity of information by user, duration of connection, bandwidth.

The issue of private data (linked to restricted access for instance) must be specifically treated in the second step of the project in conjunction with the access by learners, students in relation with LMS (Learning Management System).

3.4 Selection criteria of CMS software to the KDB development

In computing, a database is gathering highly structured data, a well-defined organization, based on different types of structures: relational, hierarchical. This is absolutely not the case in a databank in which we store structured tables of numbers as well as illustrated text or video or emails, external knowledge or those from the project in their various forms. But it should be noted that the knowledge databank in the prototype of the AgroF-MM project is based on a software, RUBEDO developed in PHP and it is built on different components:

- a database management software (DBMS), type 'NoSQL', MongoDB;
- the user interface uses the ElasticSearch search engine.

Why we chose MongoDB as a database server. From one side the Rubedo system is an open source software tool framework to develop websites and it contains this type of database. From the other side MongoDB is an open-source document database and leading NoSQL database. The benefits of using a document database like MongoDB means that we can work with JSON-style documents across our entire development process.

In this type of database is possible search based on text or in case of pictures videos and other objects based on taxonomy (description text to the given object).

3.5 Development and implementation of the KDB system based on the RUBEDO CMS

The Rubedo platform brings the advanced functions of content management together with the power of e-commerce, all being based on Big Data (Webtales, 2017).

The Rubedo system can be accessed on three different platforms (Linux-RedHat or Debian and Windows):

We use a yum based distribution, which name is: CentOS. The first step is installing the MongoDB, then the Elasticsearch and Apache webserver and PHP server side script language and finally the Rubedo system.

If the installation was correct you can add different kind of users with different rights to the system.

If the given username and password were correct can be seen the Backoffice part, where the appropriate pages for the users can be designed. These pages can be seen by users on the FrontOffice part in different kind of browser programs (Fig. 2).

There can be seen more possibilities to choose. The visitors, learners, trainers, the access is by means of the address newkdb.agrofmm.eu without further specification. This version is open to the public. The opening welcome page is displayed in English, with a brief introduction, (picture below – Fig. 2.). The choice of language

of the interface is done by clicking on the language button, pull-down menu, select language and redisplay the page in the selected language. The general menu Welcome, Overview, Trainings, Resources, Content types, Search tool and Wiki and a knowledgebase DVD from the former AgroFe project results is present on every page. The logo AgroF-MM repeats on every page with a click (on the logo) from any page. Site map levels and a breadcrumb used to be located and to move without necessarily go back to the Home page.

3.6 KDB menu and content introduction

The KDB has documents and links with training. Users access Digital Assets Manager contents.

- a) The choice “Trainings” provides access to “Trainings needs” and “Trainings objectives” of the KDB.
- b) The choice Resource opens a submenu in a dedicated page. The route tree in the resources of the KDB continues with the choice: - Gallery: the selection of choice provides access pictures, where number of thumbnails are in the bank. By clicking on a thumbnail, the image in full size is obtained. Video: click on the video option causes the access to video stored in the DAM (Digital Asset Manager) or the recorded videos and identified on public servers, such as YouTube, etc. Some videos can be viewed online, others have to be downloaded. Document: offers a sub-menu distinguishing between general information and agroforestry techniques. A click on the document product logo to download the document and its display in the user's browser if a necessary application was installed.
- c) The content types menu is a description about the usable types of content in the Rubedo system.
- d) Selection Search provides access to the integrated search engine has the knowledge bank. In this application, the search can be performed on the entire contents of the bank by entering a keyword may be presented in an object or an associated content. Here can be used the object associated taxonomy for better performance searching.
- e) AgroF-MM wiki is work in progress, in line with the taxonomy “agroforestry” of the bank.
- f) A knowledgebase DVD from the former AgroFe project results in html format.

4 Taxonomy and Thesaurus

One of the most important part of the development to define the AgroF-MM-thesaurus (Fig. 2) in very detail because the word in this vocabulary links to different object (document, photos, presentations, videos, etc.) in the KDB. This thesaurus system has been developed by a working group in the project using ontology. Unfortunately the AGROVOC Multilingual agricultural thesaurus and other system do not contain terms for agroforestry in details.

For designers and developers, the design and developments associated with the management and use of the KDB covers more extensions. The "professional domain" extension composed of Vocabulary, Thesaurus, Taxonomy of agroforestry. The "training" extension is dealt the question of the enrichment of documents. In relation with KDB access, different modes and levels of enrichment have been developed and implemented.

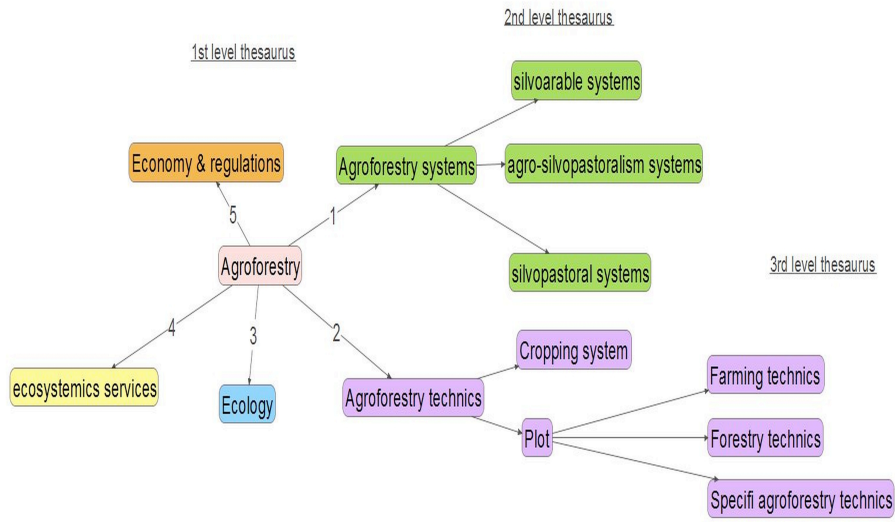


Fig. 2. Used thesaurus in different levels

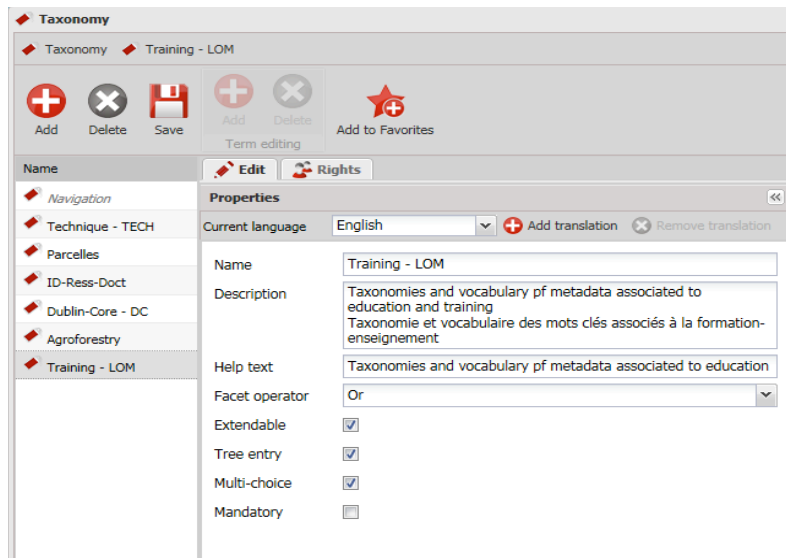


Fig. 3. Taxonomy handling window in Rubedo system

The first step to identify the internal objects of KDB. In the second step we can enter keywords (metadata) to the objects (photos, graphics, videos) to help searching process. We use 4 taxonomies (Domain, Dublin Core, Learning Object Metadata, Technical definition of metadata). Finally we can associate these keywords to the appropriate objects in the KDB (Fig. 3).

The aim of the AgroFE project is to play an important role in Agro-forestry trainings. Depending on the European countries, states or professional organizations and training actors try to reintroduce Agro forestry in the course of training and qualification in initial training and in adult education.

5 Conclusion

The Rubedo platform brings the advanced functions of content management, all being based on Big Data. We use a yum based distribution, which name is: CentOS 7. The first step to install the MongoDB, then the Elasticsearch and Apache webserver and PHP server side script language and finally the Rubedo system. The visitors, learners, trainers, the access is by means of the address newkdb.agrofmm.eu without further specification. This version is open to the public. The choice of language of the interface is done by clicking on the language button, pull-down menu, select language and redisplay the page in the selected language.

During the development work of the KDB, an evaluation of the interface and the organization of the access will be organized with the participation of master students, Hungarian and French consultation conducted by students in Master AgroSup Dijon. A first phase resulted in proposals for interface and aspects. The thesaurus and taxonomy are very important part of KDB, it can be the base on the search strategy.

The KDB has documents links with training. Users access Digital Assets Manager contents.

The knowledge database (knowledge data bank) is very new innovative solution for harvesting, storing and delivering contents in agroforestry. It was used in different training programs with good feedback. The knowledge database will serve the AgroF-MM partners in the next years.

Acknowledgments. This publication was supported by the EU Erasmus+ Programme Key Action 2: Strategic Partnership. “ Agroforestry – Training – Mediterranean and Mountain” Ref. Number: 2015-1-FR01-KA202-015181 project.

References

1. Beddie, F., and Halliday-Wynes, S. (2010) Informal and Non-Formal Learning in Vocational Education and Training. International Encyclopedia of Education (Third Edition). p. 240-246.
2. Bustos, E. S., Zazueta, F. S. and Howard, H. B. (2007) Rapid prototyping of learning objects and their implementation using ontology editor. In Conference on

- Agricultural Economics, Rural Development and Informatics, 59-60. Debrecen, Hungary.
3. Castro-García L., López-Morteo G. (2013) An international analysis of the extensions to the IEEE LOMv1.0 metadata standard, *Computer Standards & Interfaces*, 35(6) p. 567-581
 4. Dosskey, M., G. Bentrup, G. Wells. (2008) Indicators and guidelines for landscape assessment and planning for agroforestry. *Agroforestry notes AF note 40*.
 5. Gamboa V.G., Barkmann, J. and Marggraf R. (2010) Social network effects on the adoption of agroforestry species: Preliminary results of a study on differences on adoption patterns in Southern Ecuador. *Procedia - Social and Behavioral Sciences*. (4), p. 71–82.
 6. Ghirardini, B. (2011) *E-learning Methodologies: A Guide for Designing and Developing E-Learning Courses*. Rome: Food and Agriculture Organization of the United Nations.
 7. Glick J. 2013. Chapter 8 - Ontologies and Databases – Knowledge Engineering for Materials Informatics. *Informatics for Materials Science and Engineering*, pp 147-187.
 8. Gregorio, N., Herbohn, J., Harrison, S. and Smith C. (2015) A systems approach to improving the quality of tree seedlings for agroforestry, tree farming and reforestation in the Philippines. *Land Use Policy*, (47), p. 29-41.
 9. Gunn C. (2010) Sustainability factors for e-learning initiatives. *Research in Learning Technology*, 18 (2), p. 89–103.
 10. Herdon, M. and Lengyel, P. (2013) Building and Using Knowledge Repositories for Agriculture: An Innovation Case Study. In: *EFITA WCCA CIGR 2013 Conference: Sustainable Agriculture through ICT innovation*, p.180-187. Torino.
 11. Herdon, M. and Rózsa, T. (2012) Knowledge dissemination on innovative information technologies in agriculture. *Journal of Ecoagritourism* 8:(1), p. 301-306.
 12. Jamnadass, R., Langford, K., Anjarwalla, P. and Mithöfer D. (2014) Public–Private Partnerships in Agroforestry. *International Journal of Educational Development* 16(1), p. 544-564.
 13. Jongmans C. T. (1996) In-service teacher training for agricultural education in the Netherlands: From supply to demand.
 14. Kuhn, G.A. (1996) *Agroforestry for Farms and Ranches: An introduction to using tree and shrub practices in sustained agricultural systems* NRCS Agroforestry Technical Note No. 1.
 15. Lengyel, P. and Herdon, M. (2009) Implementing learning design by LAMS to improve teaching and learning. *APSTRACT - Applied Studies in Agribusiness and Commerce* 3:(5-6), p.21-24.
 16. Lubas R.L.; Jackson A.S.; Schneider I. (2013) Using Dublin Core: With information from the Dublin Core Metadata Initiative, *The Metadata Manual A Practical Workbook*, p.45-65.
 17. Manouselis N., Najjar J., Kastrantas K., Salokhe G., Stracke C.M., Duval E. (2010) Metadata interoperability in agricultural learning repositories: An analysis, *Computers and Electronics in Agriculture*, 70(2) p. 302-320

18. Mbow, C., van Noordwijk, M., Prabhu, R. and Simons T. (2014) Knowledge gaps and research needs concerning agroforestry's contribution to Sustainable Development Goals in Africa. *Current Opinion in Environmental Sustainability*. (6), p. 162-170
19. Nair, P.K.R. (2005) Agroforestry. *Encyclopedia of Soils in the Environment*. p. 35-44.
20. Price C. (1995) Economic evaluation of financial and non-financial costs and benefits in agroforestry development and the value of sustainability. *Agroforestry Systems*, 30, p. 75–86.
21. Rajbhandari S., Keizer J. (2012) The AGROVOC Concept Scheme – A Walkthrough, *Journal of Integrative Agriculture*, Volume 11(5) p. 694-699.
22. University of Missouri (2013) Training Material for applied agroforestry manual 2013 Edition, p. 1-385.
23. University of Missouri (2015) Training Material for applied agroforestry manual 2015 Edition, p. 1-385.
24. Várallyai, L. and Herdon, M. (2013) Reduce the Digital Gap by Increasing E-Skills. *ELSEV SCI* (8), p. 340-348.
25. Webtiles - <http://www.rubedo-project.org/en/homepage/rubedo-dream-team> (15.05.2017)
26. Weibel S.L. (2005) The Dublin Core Metadata Element Set ISSN: 1041-5653, *World Spatial Metadata Standards*, p. 493-513