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PREFACE

Information technology is an everyday means that is found in all walks of life today. This is also true for almost all areas of agricultural management. The aim of this Journal is to improve scientific knowledge dissemination and innovation process in the agri-food sector. The Journal of Agricultural Informatics has been established in 2009 by the HAAI within a project of the Hungarian National Development Plan Framework. The peer-reviewed journal is operating with international editorial and advisory board supported by the EFITA (European Federation for Information Technology in Agriculture Food and the Environment).

Agricultural informatics serves not only the development of the management systems of the industry but also obtaining and publicising information on production, organisation and the market for the producer.

Technologies into network based business systems built on co-operation will ensure up-to-date production and supply in food-industry. The sector-level approach and the traceability of processed agricultural products both require the application of up-to-date information technology by actors of domestic and international markets alike.

This journal serves the publication as well as familiarization the results and findings of research, development and application in the field of agricultural informatics to a wide public. It also wishes to provide a forum to the results of the doctoral (Ph.D) theses prepared in the field of agricultural informatics. Opportunities for information technology are forever increasing, they are also becoming more and more complex and their up-to-date knowledge and utilisation mean a serious competitive advantage.

These are some of the most important reasons for bringing this journal to life. The journal “Agricultural Informatics” wishes to enhance knowledge in the field of informatics, to familiarise its readers with the advantages of using the Internet and also to set up a forum for the introduction of their application and improvement.

The editorial board of the journal consists of professionals engaged in dealing with informatics in higher education, economists and staff from agricultural research institutions, who can only hope that there will be a demand for submitting contributions to this journal and at the same time there will also be interest shown toward its publications.

Prof. Dr. Miklós Herdon

Chair of the Editorial Board

Content

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Development of a new software application for supporting research of thermo-mechanical behavior of agri-food and forest products

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A B S T R A C T

Development of applications and services conforming to recent standards and perspectives of ICT is important for increasing productivity in agri-food and forestry sectors to deliver desired quantities of safe and quality products to end-users. Therefore a field of study combining two national curricula: informatics and agricultural engineering was developed by the Department of Applied Informatics of the Poznan University of Life Sciences. The scope of studies corresponds to the area of research conducted in the Department and focuses on development of Web-based advisory systems for agriculture and information systems supporting research in the agri-bio-engineering. In the paper two exemplary systems are presented. They support analysis of thermo-mechanical behavior of agri-food and forest products subjected to heating, cooling, drying and storing operations. Development of the systems resulted in a significant increase in accuracy and efficiency of estimating properties of biomaterials and in more accurate predictions of the processes investigated.

1. Introduction

For farmers and industries involved in operations of drying, handling and storage of agricultural products it is essential to have an access to relevant and reliable information to make better decisions and maintain quality standards. To attain it the decision support software should be kept up to date, especially by taking the advantage of recent opportunities of the Future Internet technologies. Such technologies are available for developing Web-based applications and can increase functionality, reliability, usability, maintainability and performance of decision support systems (Weres et al. 2013). Integration of information from diverse Internet sources used to enhance traditional advisory systems, by adoption of the Semantic Web technologies, has been recently a strong trend for future system development (Janjua et al. 2013, Blomqvist 2014). New perspectives for developing Semantic Web-based systems have also been opened by integrating software for traditional platforms and for smartphones (Esposito 2012, McWherter & Gowell 2012, Weres et al. 2014).

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A serious difficulty appears, however, in performing computer simulations for heat and water transport processes occurring in biomaterials, and this is due to a lack of sufficiently reliable values of material properties. Traditional approaches used to estimate such properties related to shape, size and thermo-mechanical coefficients, necessary to simulate heat and water transport processes, are insufficient for adequate representation of the material behavior by the simulation models. The shape is usually different from the basic 3D solids and the biomaterials are non-homogeneous and often anisotropic. Moreover, the properties are highly dependent on temperature and moisture content.

In earlier works the authors proposed procedures to solve the difficulties (Olek & Weres 2007, Weres et al. 2009, Olek et al. 2011), but the algorithms required improvement and essential functional integration. They are embedded in measurement of complex 3D object geometry by taking images of object sections, processing the images, detecting required object edges, and mapping the investigated product geometry to a form of the 3D finite element model (Gonzalez & Woods 2008, Frey & George 2008, Frączek & Wróbel 2009, Shih 2010, Weres 2010). Such description of product geometry enhanced quality of mathematical modeling of heat and water transport (Weres 2010, Weres et al. 2014a). The original algorithms proposed to estimate the thermal and mechanical properties of agri-food and forest products were based on the inverse coefficient finite element analysis (Olek & Weres 2007, Weres et al. 2009, Olek et al. 2011). This approach improved predictions of heat and water transport in investigated biomaterials (Weres et al. 2014b) and was in turn a basis for further enhancements in computer procedures to ensure estimation of sufficiently reliable values of product physical properties.

The objective of the paper was to present results of development of software in cooperation with students of Informatics and Agricultural Engineering curriculum. The two information systems under continual development were selected: the Semantic Web advisory system supporting analysis, design and management of grain crop drying, handling and storage, and the integrated system supporting estimation and analysis of geometric, thermal and diffusive properties of selected agri-food and forest products.

2. Material and methods

2.1. Semantic Web advisory system for grain handling, drying and storage

The recent version of the Web-based advisory system, designed to support analysis and management of grain crop handling, drying and storage, was constructed according to software engineering standards (Sommerville, 2010). The problem domain was analyzed and documented in the UML 2.4.1 diagrams. The following programming environments and languages were used: Visual Studio 2013, Windows Phone SDK 8, Xamarin, .NET 4.5, ASP .NET 4.5, C++/CLI and C# 5.0 (Weres et al. 2013).

To provide interoperability and reusability of existing knowledge available on the Web (Kozłowski et al., 2011), the advisory system was embedded in the Semantic Web infrastructure (Janjua et al. 2013, Weres et al. 2013, Blomqvist 2014). Problem domain terms and relations were formally represented by ontologies to facilitate processes of inference essential in analyzing examined properties. The following tools supporting ontology development, storage and visualization were used: the RDF Triple Generator developed by our Department students, AllegroGraph as the triplestore, Gruff as the graphical triplestore browser, and SPARQL as the query language for RDF.

A development of a smartphone light version of the advisory system has also been initiated, and methods appropriate for developing smart apps have been used (Esposito 2012, McWherter & Gowell 2012, Petzold 2014, Weres et al. 2014).

2.2. Integrated system for estimation and analysis of geometric, thermal and diffusive properties of agri-food and forest products

The integrated system for estimation and analysis of geometric, thermal and diffusive properties of products of biological origin was developed and used to simulate heat and mass transport processes in biomaterials like corn kernels (hybrid variety Pioneer, FAO 280), wheat, segments of carrot roots, pine and beech wood, and wood-based panels. The examined materials were characterized by non-homogeneity and anisotropy, and their shape was irregular. The following properties were subjected to estimation in order to attain reliable values: 3D coordinates of the finite element mesh for representing geometry of a product, thermal conductivity, moisture transport coefficient and convective moisture transfer coefficient.

Product geometry modeling was performed by algorithms of image processing, edge detection for product outer boundaries and inner boundaries between its components, mesh generation for the finite element analysis, and computer visualization of a product and its changing properties (Gonzalez and Woods, 2008, Frey and George, 2008, Frączek and Wróbel, 2009, Shih, 2010, Weres, 2010, Weres et al., 2014a). The existing algorithms were enhanced for accuracy and performance, and integrated with respect to their functionality.

Detailed procedure comprised microtome cutting of a product sample embedded in a synthetic resin, acquisition and processing of digital photographs of sample sections, determination of product outer boundaries and boundaries between its components by one of the edge detection algorithms available, including modified Canny algorithm, design of the finite isoparametric element mesh, and determination of the 3D coordinates for all nodes in the finite element mesh. To visualize a product and changes in its properties a series of algorithms were developed. They were based on the 3D coordinates of the geometry model and comprised the NURBS enhancement, implementation of textures and illumination of a product. For better visualization of changes in product properties the following operations were implemented: moving, rotating, scaling, plane-cutting and time-stepping.

Estimation of sufficiently reliable data on product thermo-mechanical properties was carried out by original algorithms of the inverse finite element modeling. Procedures and experimental set-up for acquiring experimental data for the coefficient inverse problem approach were described in previous papers (Siatkowski et al. 2010, Olek et al. 2011). The algorithms were based on direct and inverse finite element modeling of heat and water transport problems in biomaterials (Weres et al. 2009, Olek et al. 2011, Weres et al. 2014b) and were improved in terms of accuracy, stability and efficiency. They were supplemented with algorithms for constrained local, global and hybrid optimization to minimize the objective function – the difference between values measured experimentally and predicted in simulation (Michalewicz & Fogel 2004, Nocedal & Wright 2006, Weres et al. 2009, Siatkowski et al. 2010).

The information system was designed to comprise common components like a graphical user interface, a database, and also integrated subsystems for estimating, predicting, analyzing and visualizing properties of agri-food and forest products during heat and water transport processes. The system was developed according to software engineering standards (Sommerville 2010, Gomaa 2011). The UML 2.4.1 notation, the Visual Paradigm 11.2 diagramming tool, the Visual Studio 2013 programming environment and the C# v. 5.0 language were used to model and code the software. The Intel Visual Fortran Composer XE for Windows with the IMSL set of mathematical libraries was used to code original finite element algorithms.

3. Results

3.1. Semantic Web advisory system for grain handling, drying and storage

Methods described in section 2.1. were implemented to develop a prototype of the advisory system embedded in the Semantic Web infrastructure and thus upgrading the Web-based advisory system “Ziarbit” designed to support analysis and management of grain crop handling, drying and storage (Figure 1).

Figure 1. The Web-based advisory system “Ziarbit” supporting analysis and management of grain crop handling, drying and storage.

The RDF Triple Generator was developed to create triples (subject, predicate and object) in the Resource Description Framework for describing Web resources corresponding to the problem domain under consideration (Figure 2).

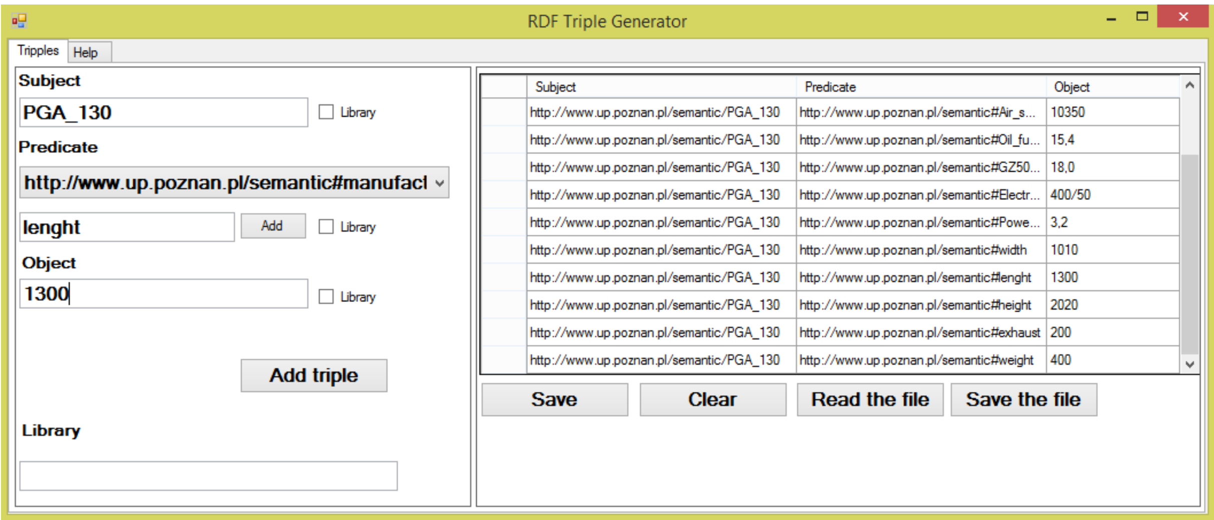

Figure 2. The RDF Triple Generator.

The Web-based advisory system was enhanced with ontologies. A fragment of the sample graph describing parameters and parts of dryer equipment is depicted in Figure 3.

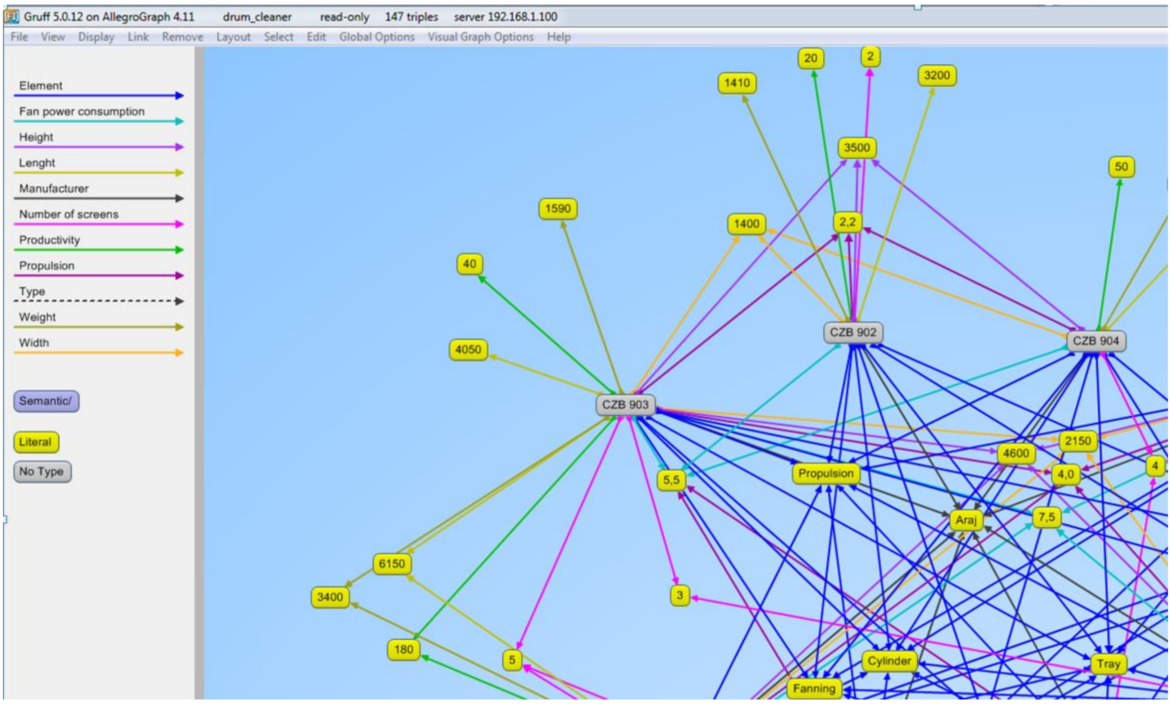

Figure 3. Sample ontology describing parameters and parts of dryer equipment.

Development of a light version of the Semantic Web-based advisory system for smartphones was also initiated (Figure 4).

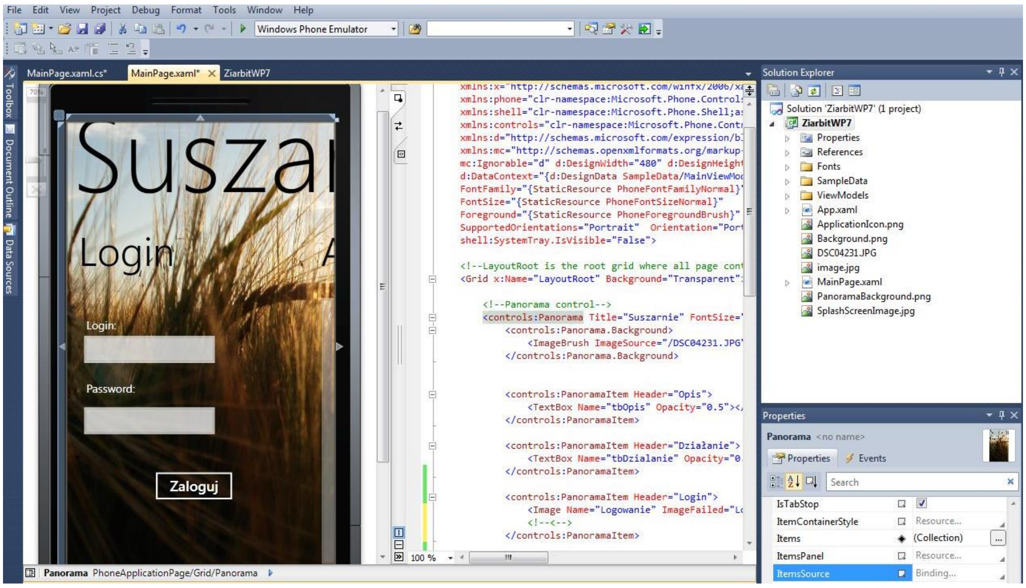

Figure 4. Development of the smartphone app supplementing the Web advisory system.

3.2. Integrated system for estimation and analysis of geometric, thermal and diffusive properties of agri-food and forest products

The integrated system was developed according to methods described in section 2.2. The system was used to construct geometrical models of products and to estimate those thermal and diffusive properties for which numerical values are dubious. Next, the system was used to predict temperature and moisture content distributions in time and space for investigated products subjected to heat and mass transport, and the estimated property values were used as the input data for simulation models. Quality of estimation of properties was assessed by a procedure in which results of predictions based on estimated data were compared to results obtained in experiments, and it was measured by the global and local relative errors. In the same way the computational accuracy and performance of algorithms were assessed, and the most accurate and efficient procedures were selected to perform all estimations and predictions with the use of the developed information system.

The integrated information system ***BioProcessSoft*** was designed as a set of the three following subsystems linked with a user interface and a database:

- ***3DMeshNode*** – ***3D Mesh Node*** *Generator*, 3D geometry data acquisition subsystem for image acquisition and processing, edge detection for object contours and boundaries of internal regions, 3D finite element mesh generation, and collection of coordinates of mesh nodes (Figure 5).
- ***BioVis*** – ***Bio****material* ***Vis****ualization,* 3D geometry modeling and visualization subsystem for presenting products constructed from coordinates of isoparametric finite element mesh nodes in 3D. The nodal coordinates and values of selected product properties in all the nodes and time instants of the investigated process are used as input data. Product geometry can be shown in a selected mode of a wire-frame, solid or a textured model, with enabled or disabled smoothing, illumination and reflection. Affine transformations – translation, rotation and scaling, and removing parts of a product by sectioning appropriate planes are provided to facilitate visualization and analysis of a product and its properties in space and time (Figure 6).
- ***IPS*** – ***I****nverse* ***P****roblem* ***S****olver,* estimation of thermal and diffusive properties and simulation of heat and water transport processes subsystem. Main functions are: acquisition of experimental data on moisture content and temperature of a product in space and time dimensions; inverse coefficient problem solving based on the finite element analysis of investigated processes and local (trust regions), global (tabu search, simulated annealing and genetic algorithm) and hybrid optimization procedures; direct finite element simulations based on estimated values of product properties; and finally– assessment of quality of predictions, and accuracy and performance of computations (Figure 7).

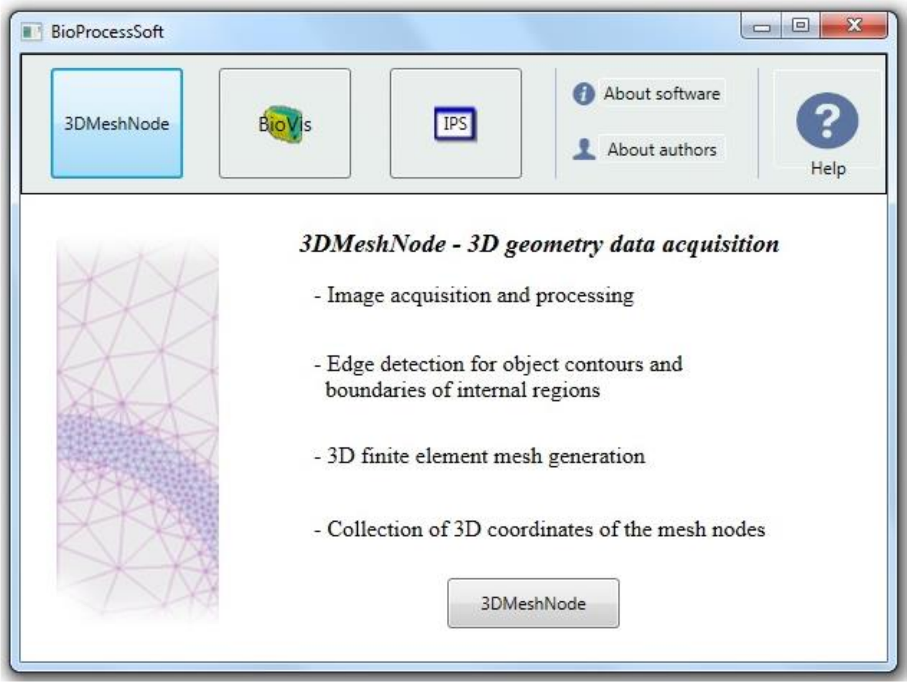

Figure 5. The integrated information system – the 3D geometry data acquisition subsystem.

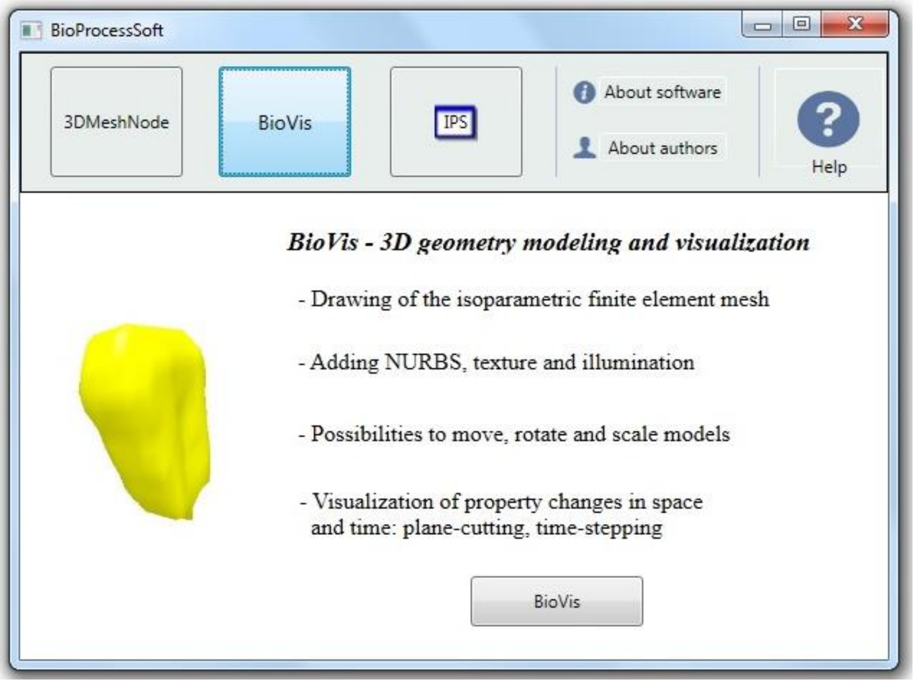

Figure 6. The integrated information system – the 3D geometry modeling and visualization subsystem.

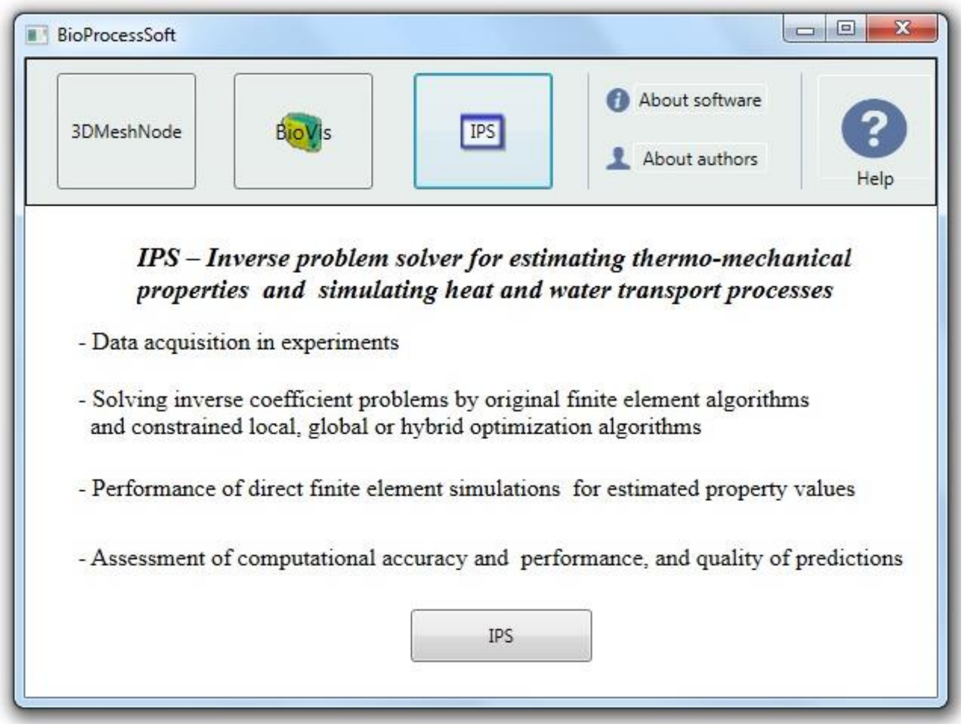

Figure 7. The integrated information system – the estimation of thermal and diffusive properties and simulation of heat and water transport processes subsystem.

Integration and enhancement of procedures for estimating properties of biomaterials, and next for predicting their behavior in heating, cooling and drying operations, resulted in more accurate and effective predictions, exemplified in Figure 8.

The enhancements were due to modifications in the Canny edge detector for finding object boundaries and boundaries between internal product components, improvements in algorithms for automatic construction of the finite element mesh, automatic measuring and storing 3D coordinates of mesh nodes, selection of efficient wrapping procedures for implementing the OpenGL in the .NET environment in C#, development of more accurate and efficient control procedures for solving inverse problems and for constrained optimization (tabu search, simulated annealing, genetic algorithm, trust regions, and hybrid procedures), and improvement of performance and accuracy comparison for optimization algorithms. Finally, the enhancement was due to adding terms to the convective boundary condition of the water transport mathematical model, and to functions representing estimated coefficients.

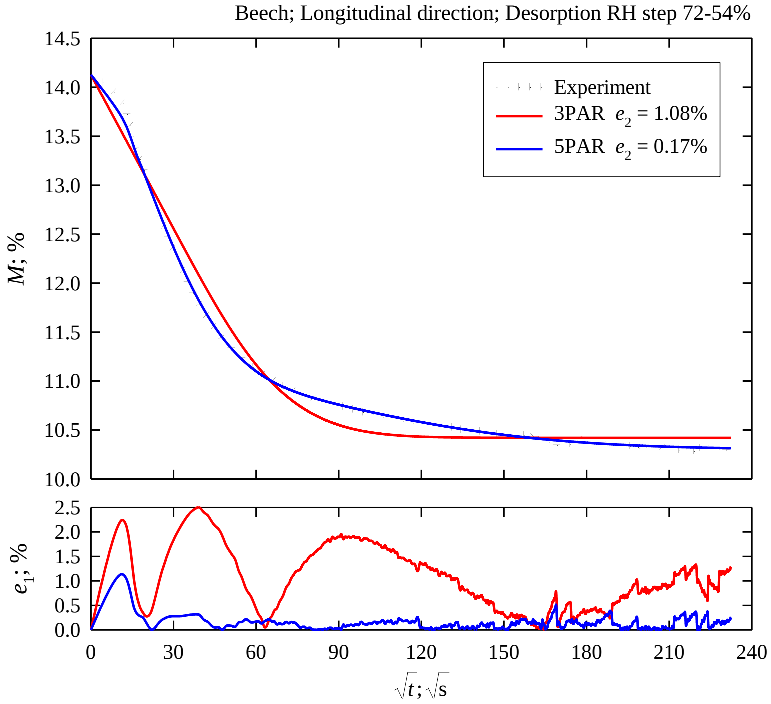

Figure 8. Improvement in accuracy of prediction of the bound water content *(M)* changes in square root of time *(√t)*. For the basic 3PAR version of the developed model the global relative error e_2 was reduced to 1.08%, and for the enhanced version of the boundary condition (5PAR) it was reduced to 0.17%.

4. Conclusions

Estimation of geometry and thermo-mechanical properties of agri-food and forest products was improved by modification and integration of original algorithms and software. Prediction of the heat and water transport processes based on the estimated properties was more accurate. The integrated information system manifested satisfactory functionality, usability, effectiveness and efficiency, and the functional requirements were fulfilled. The system offers an essential support in investigating heat and water transport in agri-food and forest products.

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Preparation of a dynamic simulation model to support decision making in a shallow lake area

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A B S T R A C T

This paper focuses on the demonstration of a conceptual framework and a dynamic simulation based tool, through the example of southern catchment basin of Lake Balaton. The objective is to support the sustainable and reasonable environmental management by model based investigation of various scenarios. In the developed hydrological model, the coherence is given by the compartmentalized dynamic network of water flows and water bodies. The completeness is solved by the complete and disjoint covering of the whole area by modeled patches, corresponding to the CORINE land cover database of natural and human built environment. The complexity of the large scale and long term processes is managed by evaluating detailed models only for one representative patch from each class, while the calculation of the similar patches is solved by simple multiplication rules. According to the first experiences, the developed framework is able to integrate the field experts' knowledge (data, relations, empirical knowledge, etc.) for the prediction of land use effects besides different climatic scenarios. It is noted, that continuous extension and refinement of the model and of the involved data is necessary, especially through more realistic case studies.

1. Introduction

1.1. Brief overview of the existing methods

Simulation based water assessment of catchment basins has been solved by sophisticated tools since many decades. Dynamic computational models intend to cover both natural and human-built processes, while complex investigations have to take into consideration the anthropogenic effects. This complexity and the highly multidisciplinary characteristics of problems require the involvement of integrated computer modeling frameworks for the analysis, design and operation of sustainable watershed management. The application of an appropriately identified and validated model, besides its prediction ability, can enhance the understanding of the hidden cause-and-effect relations (Knapen et al., 2013) and it can provide a sound basis for the communication between the experts of different disciplines. Because of the strong need, arisen from both researchers and decision makers, the availability of such modeling systems has been increasing in the last decades.

From the 1970-80's, environmental model based investigations basically focused on site-specific, isolated models (Duckstein et al., 1982, Alley et al., 1986) that are not easily modifiable and flexible enough to extend them for the investigation of processes in another spatial or temporal scale (Zagona, 2001). On that time an overview about complex environmental modeling methods, involving hydrological modules, was provided by Melli and Zannetti (1992). Another comprehensive work

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introduced the attempt to connect geographic information systems with agent-based modeling methodologies to simulate ecological and even social processes dynamically (Gimblett, 2001).

After these relatively early started works, having recognized the need of multiscale problem solving, case-specific models were followed and replaced by the generally applicable modeling frameworks. These general frameworks, such as MIKE SHE (Butts and Graham, 2008), Soil & Water Assessment Tool (Neitsch et al., 2011), GISHydro (2013), TOPMODEL (USGS, 2005), ANSWERS-2000 (Bouraoui et al., 2000) or Watershed Analysis Risk Management Framework (WARMF, 2013) have the ability for the combined consideration of various hydrological processes in watershed scale, built in each other. Majority of these frameworks are studied in the paper of Borah and Bera (2005) in detail, mainly from mathematical point of views.

Hydrologic components of the six most commonly used tools, such as precipitation, potential evapotranspiration, infiltration and surface runoff and streamflow is analysed by Migliaccio and Srivastav (2007), in detail.

Most of these frameworks are still applied for the investigation of different watershed scale processes. According to our review, SWAT (Bosch et al., 2011; Baker and Miller, 2013; Bhuvaneswari et al., 2013) seems to be one of the most known and widely used tool.

Having overviewed the available computational model based systems in the literature; we can say that basically two kinds of tools are available. One of them are the detailed hydrological modeling tools that are difficult to combine with each other and with further models, describing human made processes. Others are the modeling frameworks (like OpenMI or OSM) that are able to combine models, built in different modeling platforms. However, these systems are mainly designed for computer modeling experts and require certain modeling/programming skills.

1.2. Previous investigations about Lake Balaton area

Due to the shallow characteristic of Lake Balaton, the vulnerability of its ecosystem, including the whole catchment basin, is high, so it can be considered and managed as a sensitive geographic area. Environmental impacts and human activity has a greater influence, consequently conscious engineering design is required to keep the balance of the ecosystem.

The modeling of this sensitive area has been in the focus of the national research for more than forty years. In the following, without the demand of completeness, we highlight some important issues.

A relatively early volume, prepared by the Institute for Computer Science and Control (Hungarian Academy of Sciences), collected several studies about modeling of Lake Balaton ecosystem (Csáki, 1979). In line with the actual problems on that time, main topic of the volume was the eutrophication, by the modeling of the relevant processes and possibilities, as well as the introduction of Balaton Eutrophication Model (BEM) and its sub-models.

One of the most comprehensive overview from the past decades is the volume of Virág (1998), which covers a range of scientific papers from the hundred years long period of 1896- 1995. On that time it was an overall bibliography with a comprehensive set of data.

Kovács and Clement (2008) dealt with the question of diffuse pollution and investigated the modeling aspects of the related processes, as its came into the limelight again in the first part of the 2000s. Authors highlighted that detailed enough load models are well applicable in this field. Consequently, they reviewed the available models and compared 16 of them in detail, characterized from various aspects (e.g. goal of development, spatial and temporal characteristics, hydrological components, etc.).

“Balaton” entitled thematic issue of the national scientific community was edited by Szlávik (2005). 19 papers of the volume focused on the problems of Lake Balaton, i.e. the question of additional water supply, as well as the possible solutions and their impacts on the water quality and on the environment.

Considering the large number of research works, it is a well discovered area, obviously. However, long term climatic, as well as short term extreme meteorological and rapid environmental changes require new perspectives and solutions to maintain the ecologic balance of the area. Furthermore, complex consideration of social needs and evaluations in the course of watershed management is also inevitable.

In our work, we basically focus on the southern catchment basin of the Lake (see Fig 2), while the effects of other catchment basins are taken into consideration with measured data of the inflows from the available time series.

2. The model building procedure

Compared with the previously introduced available methods, our Direct Computer Mapping (DCM) based simulation framework offers an intermediate solution with a medium complex, but extendable model. Although, Lake Balaton is one of the mostly studied shallow lake areas, according to our previous experience, the data demand of detailed watershed models (e.g. SWAT) is difficult to satisfy. Accordingly, in our framework we prepared and implemented a medium complex model with simplified (sometimes empirical, heuristic) expressions, considering the available data for the investigated area.

In the next part we describe how the GIS elements were transformed and used in the DCM modeling method to generate the basis of a dynamic simulation model for the investigated watershed. Figure 1 illustrates these steps of the model building procedure, starting from the GIS layers, through the simple graph transformation, until the model identification and validation.

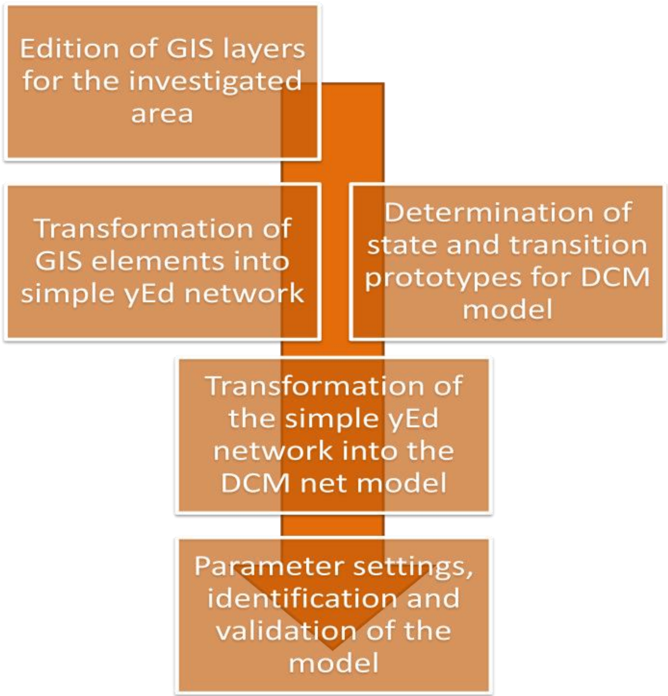

Figure 1. Steps of the model building procedure

2.1. GIS elements as the basis of dynamic simulation model

Description of water network in the studied area (left part of Fig. 2.) was started from the corresponding shape files on watercourses, water bodies and sub watersheds, developed by the

Environmental Protection and Water Management Research Institute (VITUKI). We applied QGIS software (http://qgis.osgeo.org) for the refinement and edition of the original shape files. Serious refinements and actualization had to be made mainly on the shape files, containing the lakes, fishponds, reservoirs and marshes of the watershed.

The sections of water network, transformed into model elements, were the followings:

- waterbody of Lake Balaton, compartmentalized into 20 sub-compartment for the detailed characterization of flows and mixing;
- selected main watercourses of the south-catchment basin, segmented by intermediate small fishponds, lakes; as well as by the boarders of subwatersheds;
- selected lakes, fishponds, reservoirs and marshes in the south-catchment basin.

For the segmentation of area we used the shape files, containing the subwatersheds of the catchment basin.

Nine main watercourses have been selected for deeper investigations in the southern part of the Lake. These nine watercourses were divided into 152 water sections, according to the sub-watersheds and the intermediate smaller waterbodies in the sub-watersheds. These lakes, fishponds or reservoirs were selected according to their size and their importance, considering also the measurement points. Accordingly, 56 small lake compartments were integrated into the model.

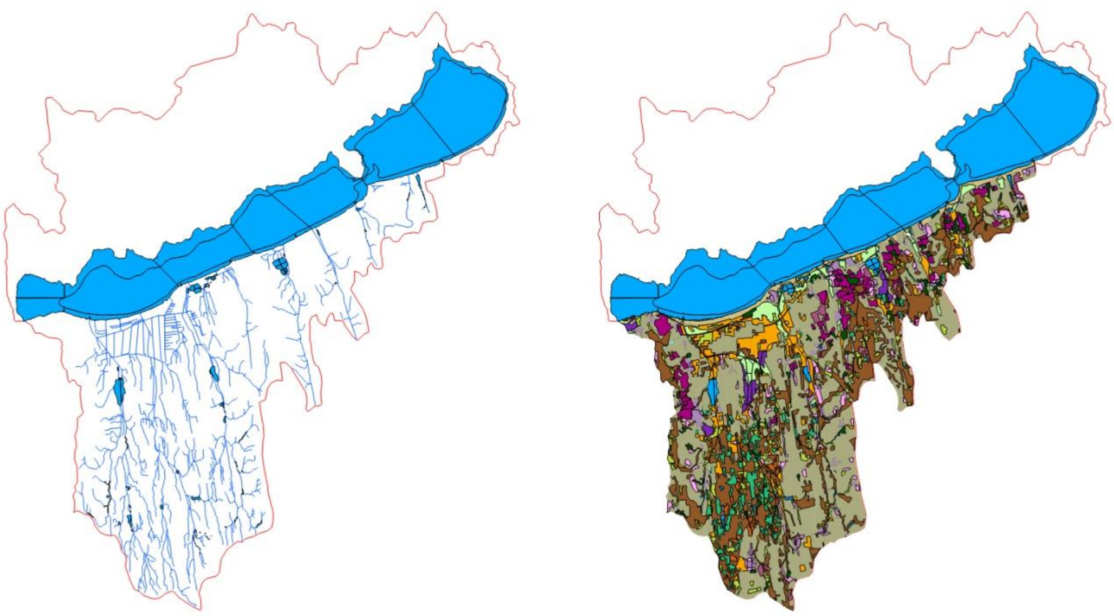

Figure 2. The investigated area: Lake Balaton and its southern watershed. Modeled water courses, lakes and lake compartments (left) and CORINE land patches (right)

Typically, to take into consideration the land use in a computational model, Corine Land Cover database (http://www.fomi.hu/corine/) is used. For the complete and disjoint covering of the whole investigated area, we also applied the vector data of the national data set in 1:100.000 scale (Corine Land Cover 2006 Hungary, right part of Fig. 2.). Data set was created by the Institute of Geodesy, Cartography and Remote Sensing, and it is refined in terms of the changes from 2000 to 2006. Regarding the 1:100.000 scale, minimum mapping unit is 25 ha (in the mapping of 2006 changes is reduced with 5 ha), as well as the minimum width of linear elements is 100 m. It is noted, that 1:50.000 scale dataset (Büttner et al., 2004) is also available for Hungary, however, the granularity of our model doesn't require this detailedness. Polygons were identified with the general three-level CLC nomenclature.

In the composition of the flow structure, built from the above described water flow segments and from the lakes of the watershed, we applied the Digital Elevation Model (DEM) to determine the water network. We described a "From-To" structure, having indicated the continuing water section for each element in the attribute tables of the various layers. It is to be highlighted that in all cases we determined the connecting one and only one water section of the watershed, to which the area provide the water supply, as well as the possible various impurities.

2.2. Direct Computer Mapping of the investigated problem

Nowadays complex, multidisciplinary and multiscale models claim for clear and sophisticated coupling of structures and functions. Multiscale, hybrid processes in biosystems and in human-built process networks contain more complex elements and structures, than the theoretically established mathematical constructs. Moreover, the execution of the hybrid, discrete/continuous and optionally multiscale models is a difficult question, because the usual integrators do not tolerate the discrete events, while the usual representation of the continuous processes cannot be embedded into the discrete models conveniently (Meier-Schellersheim et al., 2009). Another challenge is the effective combination of quantitative models with rule-based qualitative knowledge.

Having recognized these difficulties, our approach, called Direct Computer Mapping of process models (Csukás, 1998, Csukás et al, 2011), is based on the principle of "let the computer know the very building elements and the very structure of the process to be modeled". Accordingly, the complex structures and functionalities are mapped onto quite uniform state, transition and connection elements, associated with locally executable programs.

State elements characterize the actual state of the invesstigated process, while transition elements describe the transportations, transformations and rules of the time-driven or event-driven changes in the process. Four kinds of edges are applied to determine the connections between the state and transition elements. Increasing and decreasing connections determine the transport of the additive measures of the state elements; while signaling connections carry the new values of the overwritable signs. An illustrative example for two state and one transition elements with a locally executable program (a flow between water two sections) is explained in Chapter 3, in detail.

So the various process models can be built from the toolbox of these unified building elements.

In parallel with the determination of the state and transition model prototypes, we transformed the various water sections and land patches of the GIS layers into a simple yEd network. In this step, we use the feature of yEd graph editor tool, which allows importing files from spreadsheets. Accordingly, from the "From-To" description of the attribute tables of water network and land patch layers we generated a simple graph.

As a next step, we developed further this simple graph in line with the principles of DCM, with the replacement of simple nodes to state elements (ellipses in Fig 3, corresponds to flow sections, lake compartments, marsh compartments, fishponds and 17 kind of land patches), as well as adding transition elements (rectangles in Fig 3., corresponds to inflows, outflow, flows, mixing, pumps and the patch to water elements) between them.

An example part of the process model, built from this toolbox can be seen in Fig. 3. For the graphical representation of the model elements, as well as to edit the model structure in line with the DCM principles, we use the freely available desktop application of yEd graph editor (http://www.yworks.com).

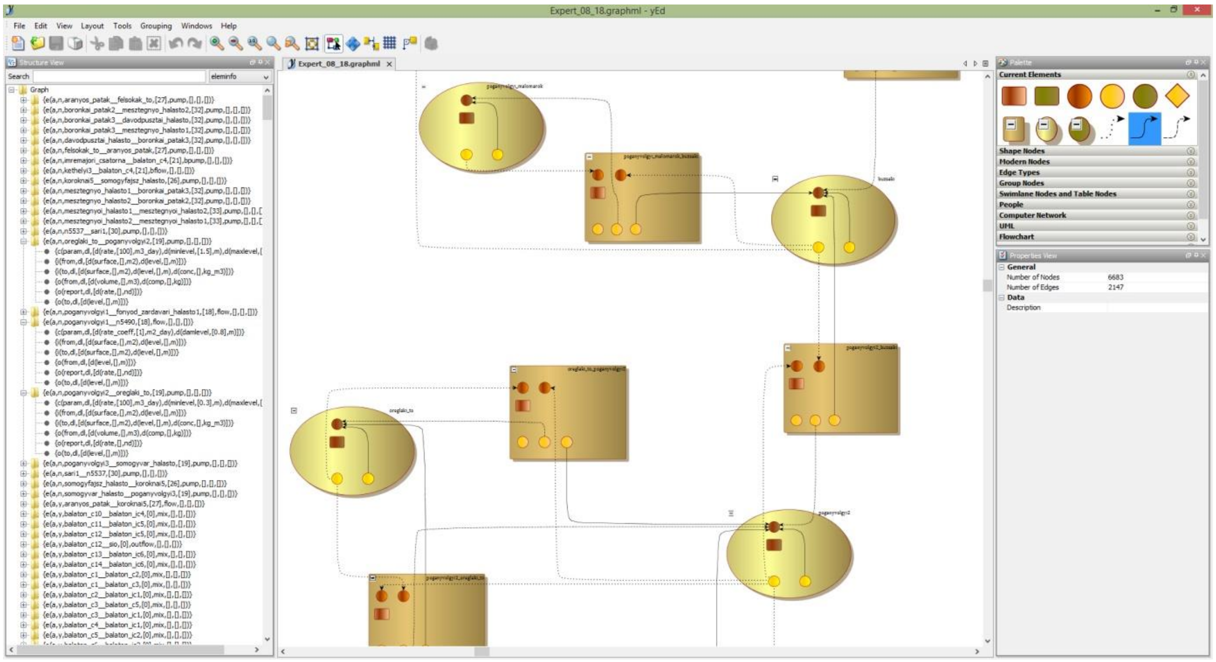

Figure 3. yEd based edition of the structure and parameters

The simulation and the model based problem solving are organized by the execution of these local programs with a general purpose, operating-system-like kernel. Direct Computer Mapping makes possible the unified representation of the natural building blocks of a (model specific conservation law based) balance process and a rule based "informational" process. In this way, the discrete or continuous, as well as quantitative or qualitative functioning can also be interpreted in the same structure.

3. The implemented hydrological model and the utilized data

Model building starts with the determination of the general state and transition prototypes, which are contain the formulas to describe the hydrological model. These prototypes were determined as follows. **State prototypes,** that describe the water networks, are the followings:

- flow sections;
- lake compartments;
- marsh compartments;
- fishponds;
- 17 kinds of land patches (according to CORINE land cover).

Following **transition prototypes** were determined to describe the water transition between the various water sections and from the various land patches to the connected water elements:

- inflow;
- outflow;
- flows;
- mixing;
- patch to water;
- pump.

All of the state and prototype elements contain their own executable program, as well as the necessary inputs and parameters to calculate the water balance for the investigated area.

In the formulation of the hydrological model, we used a simplified model, started from SWAT.

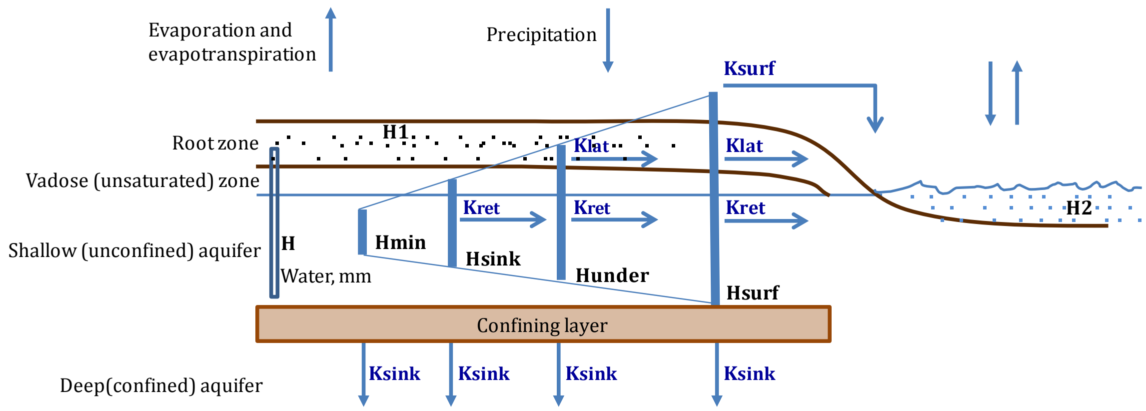

Figure 4. Simplified hydrological model, based on SWAT2009 Theoretical Documentation (http://swat.tamu.edu/media/99192/swat2009-theory.pdf)

According to SWAT, in the simulation of a hydrological model, two kinds of phase (the “land phase” and the “water or routing phase”) can be distinguished. In the formulation of **land phase processes**, we started on the basis of the SWAT land phase description. Accordingly, initial water content of the soil (signed with H in Fig 4), compared with the limit levels (H_{min}, H_{sink}, H_{under}, H_{surf} in Fig 5) and with the next section level (H_2 in Fig 4) determine the various flow coefficients (K_{sink}, K_{ret}, K_{lat}, K_{surf} in Fig 4).For the detailed parameterization of water sections, lakes and lake compartments, we get the various data (average depth, length, average width, elevation) from the GIS layers.

Detailed daily meteorological data were available in the calculations for the period 2009-2013. In addition, we use some heuristic expressions for the calculation of evaporation and evapotranspiration on the basis of primary meteorological data.

Keep at the SWAT terminology, for the formulation of **water (routing) phase processes**, we considered the existing or fictitious dam levels (see Fig. 5), that represent the driving force, determining the amount of flow from a section to the next one.

This simple model can be described by the following Equations:

$$(1)\quad Rate\ is\ A1 * (H1 - Hk)/DT,$$

where

Rate is the amount of water flow from a section to the next one, m^3/dayA1 is the surface of the starting water section, m^2

H1 is the level of the starting water section, m

H_k is the dam level, m

DT is time step of the simulation, actually day

$$(2)\quad DH2\ is\ Rate * DT/A2,$$

where

DH2 is the change of level in the receiving water section, m

DT is time step of the simulation, actually day

A2 is the surface of the receiving water section, m2

and

$$(3)\quad DH1\ is\ (-1) * Rate * DT\ /A1,$$

where

DH1 is the change of level in the starting water section, m

DT is time step of the simulation, actually day

A2 is the surface of the starting water section, m^2

This small part of the model is represented by the following program code associated with the respective prototype (written in the declarative Prolog syntax):

```
v(y,flow,[c(param,dl,[d(rate_coeff,[K],m2_day),d(damlevel,[HK],m)])],
        [i(from,dl,[d(surface,[A1],m2),d(level,[H1],m)]),i(to,dl,[d(surface,[A2],m
        2),d(level,[H2],m)])],
        [o(from,dl,[d(level,[DH1],m)]),o(to,dl,[d(level,[DH2],m)])]
        )
        :-
        H1>HK,
        g(dt,DT),
        Rate is K*A1*(H1-HK)/DT,
        DH2 is Rate*DT/A2,
        DH1 is (-1)*Rate*DT/A1, !.
```

We edit all of the imported GIS elements according to the state prototypes, and extend the network with the actual transition elements, edited according to the transition prototypes.

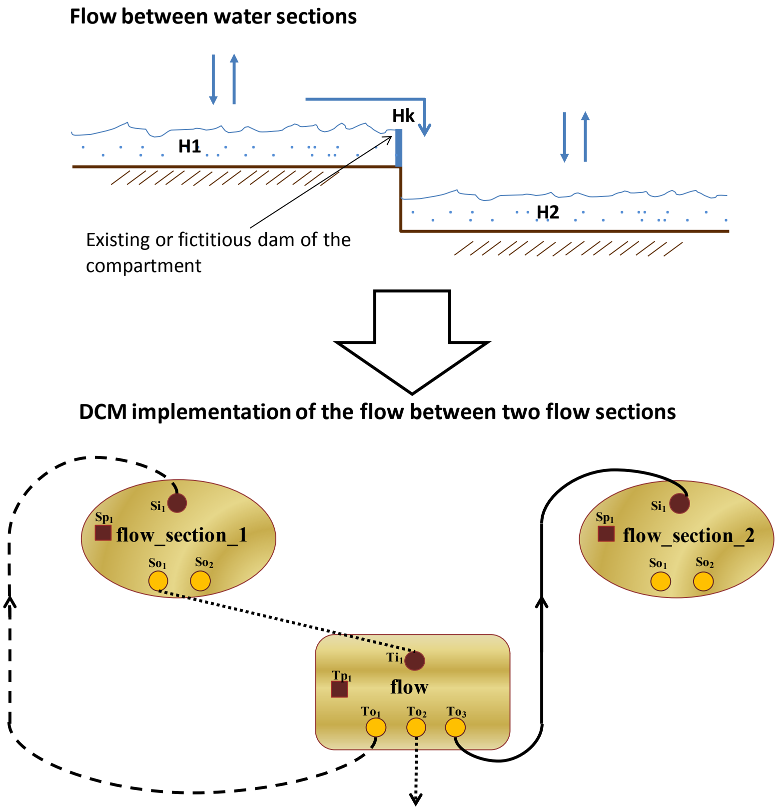

Figure 5. Simplified hydrological model for the water (routing) phase and its DCM implementation

4. An example case study: Hydrological effects of a possible forestation

The identified model is able to predict the effects of various meteorological scenarios or various human activities on the hydrology of the watershed. Figure 6 shows an illustration for the result of calculations (red) with the validated model (for one of the largest watercourse, Nyugati-Övcsatorna). Diagram contains also the measured flow rates (monthly average with blue, available unfortunately only for the second year). Accordingly, model calculations show an acceptable agreement with the measured data.

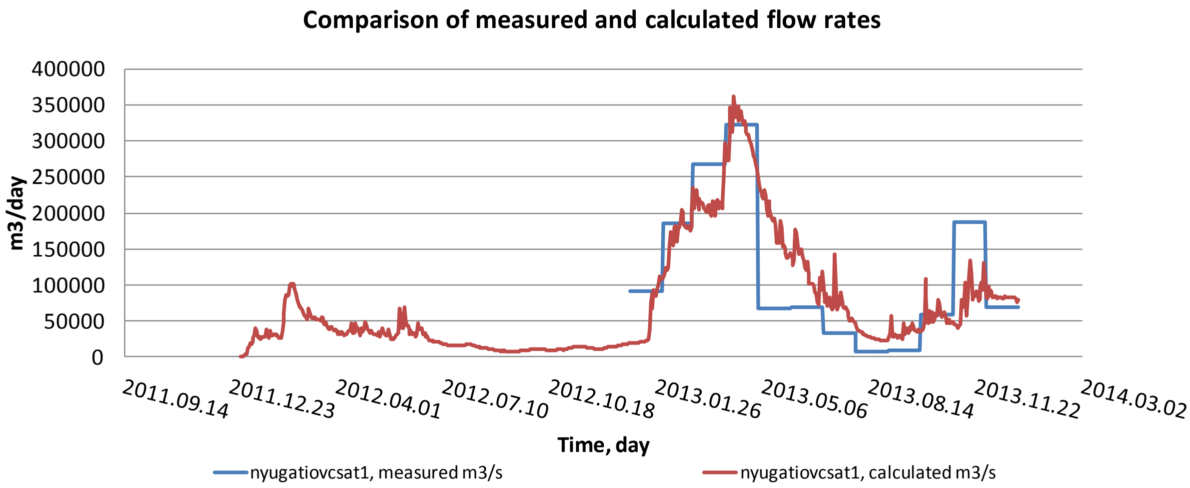

Figure 6. Comparison of measured and calculated data for the inflow Nyugati-Ovcsatorna

With the present state of the identified model, we studied the effects of a possible forestation process on the water balance in the southern watershed. In this hypothetical simulation, we replaced the identified parameters of some meadows and non-cultivated agricultural areas (signed with green in Fig 7) for the parameters of forests (signed with brown in Fig 7). It is noted that we consider the long term result of a hypothetical forestation; however, the methodology could support a longer simulation, accompanying the growing of the forest if the expert could give estimations for the changing plant constants.

It is noted, that although the ratio of the changed area is smaller than the forest areas, the effects on the water balance is observable. According to the calculations, flow rate of the Nyugati-Övcsatorna alone is less with an average value of 8000 m3/day in case of the forestation (Fig. 8 shows this difference). Compared with the original simulation case, difference is 6.7%. It is not significant (R^2 = 0.996) from statistical point of views, but it illustrates the sensitiveness of the modell well.

The decrease came from the fact, that forest patches have a greater evaporation/evapotranspiration capacity than meadows and non-cultivated lands. Peaks follow the meteorological changes during the year. Figure 9 illustrates the effect of the land use changes on the Lake Balaton level. Considering the shallow characteristics of the Lake, even small changes in meteorological situation (e.g. rainfalls) can cause remarkable fluctuation in the level. Effects of forestation cause slight decrease also in the average level of the Lake.

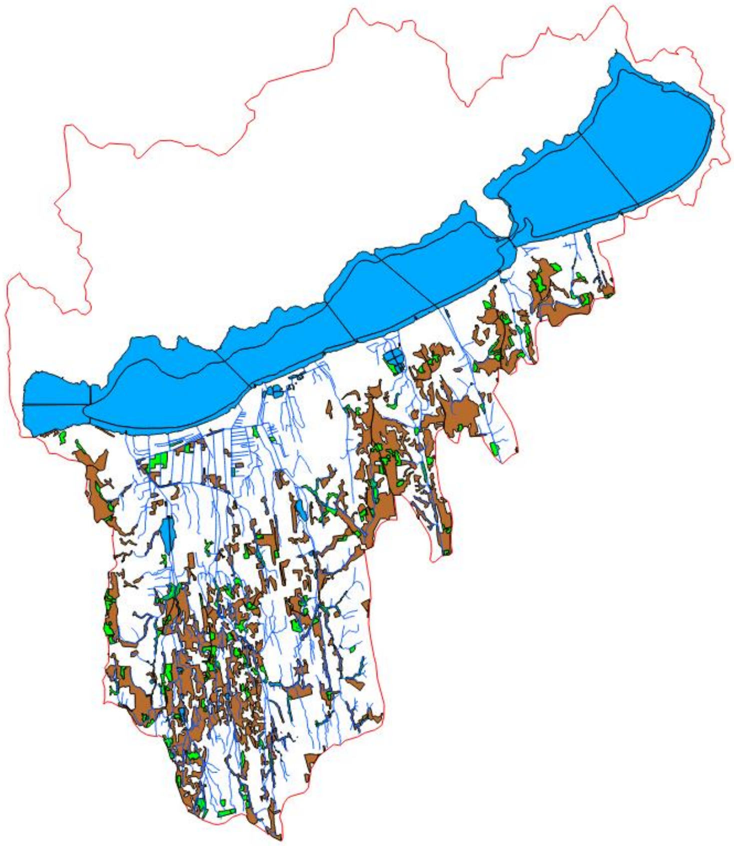

Figure 7. Meadows + non-cultivated agricultural (green), as well as forest areas (brown)

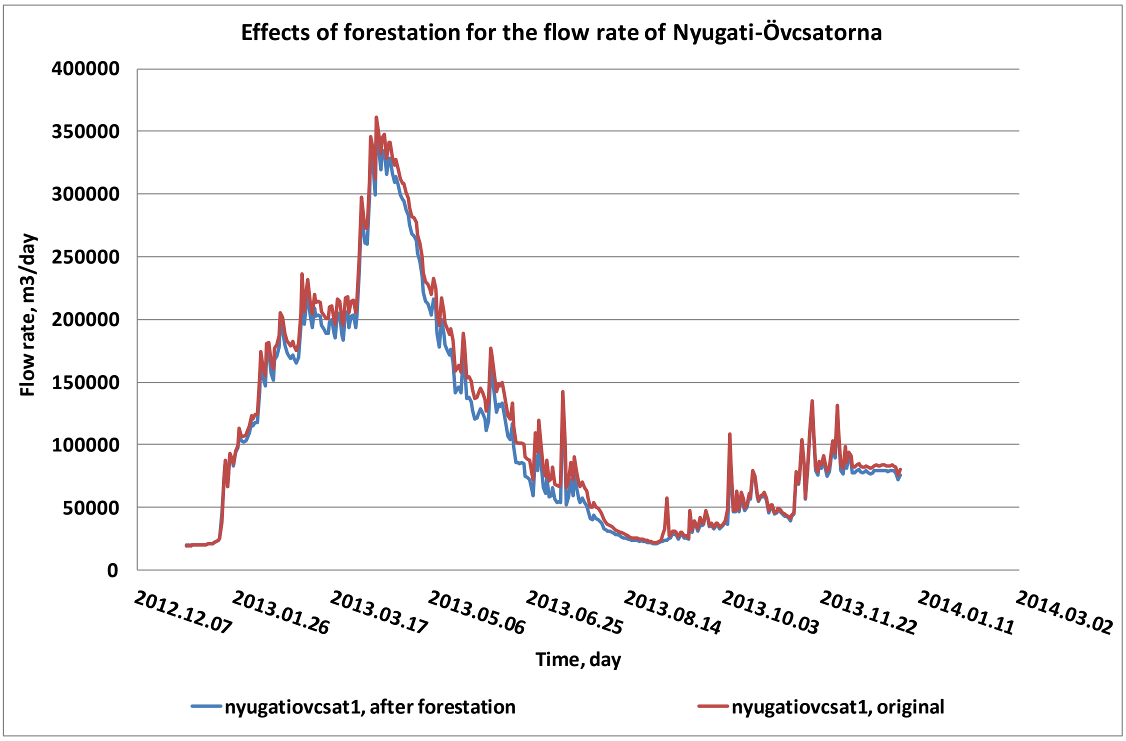

Figure 8. Effects of forestation on a watercourse

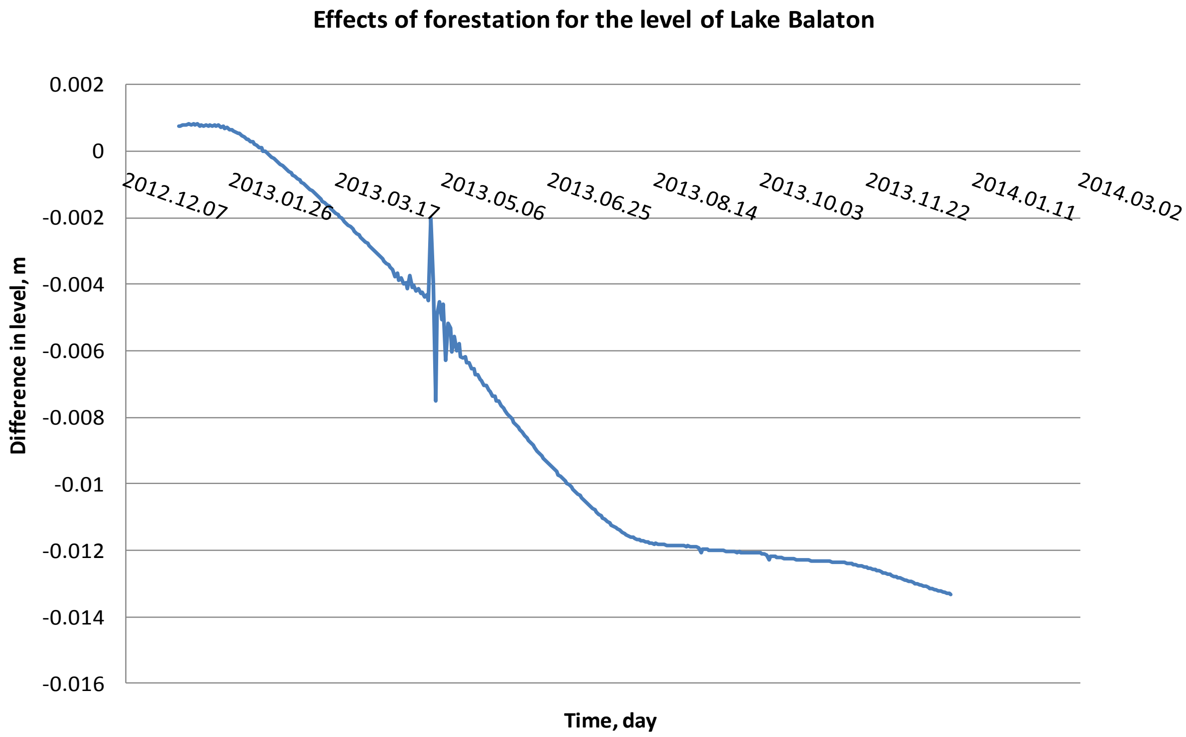

Figure 9. Effects of forestation on the Lake level

5. Summary

According to the experiences, we can say that the developed framework is able to integrate the field experts' knowledge (data, relations, empirical knowledge, etc.) for the prediction of land use effects beside different climatic scenarios, flexibly. It is noted, that continuous extension and refinement of the model and of the involved data is necessary, especially through more realistic case studies.

In summary, the main principles of the developed model were the followings:

- The coherence of the model is given by the discretized dynamic network of water flows and storages;
- The completeness is solved by the complete and disjoint covering of the whole area by modeled patches, responsible for the typical parts of natural and human built environment, associated with typical partial interests;
- The complexity of the large scale and long term process is managed by generating and evaluating detailed models only for one representative patch form each class, while the calculation and assessment of the similar patches is solved by simple multiplication rules.

As the core of the developed framework, we applied Direct Computer Mapping to generate dynamic models for simulation based solving of hybrid multi-scale models to support the decision making in rural development. In the generation of model structure, we combined DCM with GIS tools. Expert side availability is ensured by the yEd graph editor for both structural and parametrical edition of the model. Limited user side modification ability is solved by map based web interface.

In line with the developed case studies, we can highlight the followings:

- Prototype land patches linked to the compartments of water network can increase the usability of the distributed measurements for the evaluation of the complex situations (soft sensing).
- Patch model based dynamic simulation of the various past and future scenarios for a sensitive catchment basin (optionally combined with a genetic algorithm) can support decision making in rural development.

- The method can be developed further for a general tool for the development of large scale, long term sustainable processes (sustainable engineering).

Acknowledgement

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Greening the canned peach production

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A B S T R A C T

The paper proposes an approach for measuring the environmental performance of canned peach production based on Lean Thinking techniques. Among the various stages of a typical production line of canned peach, peeling and pasteurizing are the most energy consuming. In these stages specific actions have been suggested and applied. Considering the findings that were observed following the implementation of these actions, the research project provided viable evidence that Lean techniques a positive impact in the production and logistics operations.

1. Introduction

Lean thinking is a set of principles, techniques and tools all aimed at minimizing non-value adding processes, which are characterized by wastes of different forms. According to Emiliani and Stec (2004) wastes are classified as follows: Overproduction, Waiting, Transportation, Processing, Inventories: raw material, work-in-process, and finished goods, Moving: both operator and machine, and Defects: defective products or process outputs.

Lean thinking tools have recorded significant successes resulting in a worldwide and trans-sectorial recognition including both products and services. Some of the available and known tools used are: Takt Time, Kaizen, Statistical Process Control, Poka-Yoke, 5S, Value Stream Mapping (VSM), Total Quality Management, Kanban, and Jidoka, among many others. Plenert (2007), as well as, Abdulmalek and Rajgopal (2007), emphasize especially the significance and usefulness of the VSM as a key tool of Lean thinking while Singh, Garg and Sharma (2010) provide an extended literature review of the VSM in a wide range of sectors. VSM is a visual representation of processes within a pathway and can be considered as a visual map of all the activities, illustrating how they linked to each other, and information such as timing and resources. It aims identifying all the value-added and non-value-added (waste) activities, as an opportunity to remove non-value-add steps and eliminate waste through problem solving, to standardize and improve value-added processes but mainly to eliminate waste. Moreover, it includes two diagrams / value stream maps; the first value stream map records the current state of the process line and the future state map that shows what the process line would look like after improvements / elimination of wastes are made.

In this paper, the study is focused on the agrifood sector. This sector is characterized by real constraints on natural resources, as well as, high production costs, higher risks, and competition for resources by the producers (Beresford and Pettit, 2004; Chow, Heaver and Henriksson, 1994; Rothenberg, Pil and Maxwell, 2001). In the past managers in the examined sector aimed to minimize costs while enhancing the quality of the end product. There is always a high need for decreasing the lead time due to the nature of the products and this decrease could easily translate to lower financial costs and lower inventory management cost. Moreover, there is also the “consumers’ awareness need” ,accordingly consumers must be better informed and better educated in terms food quality, food safety and food nutrition issues. Today, one additional objective is added; to identify the factors that have environmental impacts in the targeted supply chain by decreasing waste. Referring to the value stream maps, in the past, the time it takes to produce a product and the proportion of that time that is value

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added - or the time spent actually working on the product was estimated; although today, the focus is also on the resources consumed and waste generated in making the product.

In the literature there have been empirical and theoretical researches about the deployment of lean methods in the agrifood sector having two general objectives: first, to reduce the operation costs and second, the environmental emission. The following table summarizes the research initiatives that refer to the second objective.

Table 1. Relative studies regarding the application of lean thinking techniques and practices for waste identification in the agrifood section

Author(s) / Publication year	Title	Research objective(s)	Supply chain stage
Venkat and Wakeland (2006)	Is Lean Necessarily Green?	Investigation of the environmental performance of lean supply chains using carbon dioxide emissions as the key performance indicator	Complete supply chain
Simons and Mason (2002)	Environmental and Transport Supply Chain Evaluation with Sustainable Value Stream Mapping	Examination of the emission characteristics of a generic food supply chain which includes both transportation and cold storage	Transportation / distribution of final products and storing in distribution centres
Cox and Chicksand (2005)	The limits of Lean Management Thinking: Multiple Retailers and Food and Farming Supply Chains	Investigation if there are limits to the application of lean management thinking in complex supply chains	Complete supply chain
Tanco et al. (2013)	Applying lean techniques to nougat fabrication: a seasonal case study	Discussion of the applicability of lean manufacturing’s knowledge to a different environment: a seasonal food industry	Complete supply chain

In the recent years a number of researches have focused on the application of Value Stream Mapping for supporting the greening efforts. A great work has been done by the United States Environmental Protection Agency (USEPA) when they first introduced the Environmental Value Stream Mapping (EVSM) method at 2007, which has all the characteristics of its parent -Value Stream Mapping- but additionally environmental issues and the usage of material or energy.

Another organization in US; the USA Environmental Protection Agency (or EPA), at 2007 proposed the Energy Value Stream Mapping (EnVsm) as a tool which has the information and data about energy usage of each process item as well as its regular lean data in the typical format (VSM). The aim of the above tool is to have both data from the value added action and process beside the energy usage or waste in a same picture. Therefore, the decision makers can improve the future state of the process in a way that has better and more efficiency in both ways; lean principle and energy saving (EPA, 2007).

Based on the above studies and initiatives this paper explores the application of the VSM tool so as to determine the waste that have environmental impact in a specific agrifood supply chain; the production of the canned peach. The main objective of this paper is to propose a four-step approach for measuring the environmental performance of supply chains in the food sector based on Lean thinking techniques so as to identify sources of waste in the selected supply chain. Each step aimed at eliminating non value adding steps in order to reduce on the length of the value stream which subsequently would contribute to the reduction of the total process, lead and customer query cycle times and consequently the energy consumption and emissions. Specifically, VSM is suggested for determining waste, in terms of measuring the water, energy and lead time of the production process.

2. Application of VSM in canned peach production

Value Stream Mapping (VSM) diagrams are used in order to develop visual representations of the canned peach production. First, the Current State Map (CSM) is developed to represent the production "as-is" in order to identify the highest sources of waste (non-value added activity) in the value stream of the examined process, as well as, to develop an implementation plan for lean techniques with the development of the Future State Map (FSM).

Based on Rother and Shook (2003) proposed methodology and following studies such as Lasa, Laburu and Vila (2008), Seth D., Seth N. and Goel, (2008), Belokar, Kumar and Kharb (2012) a four-step approach is proposed including the following steps:

- Step 1: Selection of agrifood supply chain processes to be value-streamed.
- Step 2: Development of the Current State Map (CSM) of the selected processes in the agrifood supply chain.
- Step 3: Development of the Future State Map (FSM).
- Step 4: Development of the Action Plan (AP).

2.1 Step 1: Selection of agrifood supply chain processes to be value-streamed

A typical process for the production of canned peach is illustrated at the Figure 1 (SuperPro Designer, version 9.0; Intelligen, Inc., Scotch Plains, NJ, USA was used, to document the examined canned peach production line) and consists of the following stages:

Initially, the fruits are delivered to the peach processing plants by lorries and are usually placed in crates, boxes or small punnets depending on their susceptibility to damage. After weighing, samples are taken from each load to ensure the quality is suitable for processing and determine the price of the raw material. Sampling also provides insight regarding the ripening stage of peaches and whether they should be stored (usually in a cool dry environment) or processed immediately by canning (Burrows, 1996). Once peaches are introduced in the production lines, they are immersed into high capacity holding tanks filled with warm water (20-30 ^{o}C). The residence time of peaches in warm water ranges from 10-15 min. This processing step aims at removing foreign materials, such as leaves, insects, debris etc. The washed fruits are then cut in halves using cutting machines, while the kernels are being simultaneously removed (Karagiovannis, 2014).

Peaches may be peeled by hand, as well as by chemical or mechanical methods. However, the most commonly employed method for peeling is the immersion of fruits in an alkaline solution (chemical method), using sodium or potassium hydroxide, at 95 ^{o}C for 4-5 min. A visual inspection is deemed necessary to remove any remaining skin from the fruit, once peeling is completed. Following peeling, the fruits are washed with abundant water to remove any residual chemicals from the flesh. Usually, the washing process is carried out at 25 ^{o}C for 1 min. The washed fruits are then sorted according to size. This is followed by cup-up and cup-down, in order to remove any residual kernels and improve quality of the product. Fruits that are undersized or damaged are rejected and destined for other types of products, such as peach puree. The cans are then filled with the peeled peach halves with a filling machine. Correct filling of cans is not only desirable for economic reasons, but also technically important (Burrows, 1996; Karagiovannis, 2014).

The syrup is prepared by dissolving sugar in water and maintaining the temperature of the resulting solution at 65 ^{o}C prior filling. The concentration of the solution, however, depends on the cultivar used for peach canning. Typically, cultivars with high soluble and total solids require less sugar to sweeten the product to the desired level (Sistrunk, 1985). The fruits are covered with syrup using a vacuum syruping machine and the mixture (peach halves and syrup) is subjected to degassing in order to remove air, which aims at reducing microbial growth and, therefore, extending the shelf life of the final product (Joshi and Bhutani, 1995).

The filled cans are then closed by placing a lid on top of each can and sealing it to the body (double seam formation). Afterwards, the product is pasteurized until the temperature at the center reaches 85 ºC and cooled down at room temperature. The final product is being held in a dry environment for 3 weeks, which allows the contents of the can to reach equilibrium. Can labelling takes place immediately after placing an order (Karagiovannis, 2014).

Gas emissions are produced practically exclusively by the combustion of gas/oil for heating up water during the initial washing, the alkaline solution during peeling and the syrup prior to filling the cans, as well as for steam generation and degassing. The liquid wastes that are formed during the canned peach production process include dilute aqueous solutions that contain sugars and alkali, whereas the solid wastes consist mostly of kernels and peels.

Based on the above description of the canned peach production the following discrete processes are identified: factory reception, washing, cutting in halves and removing the kernels, peeling (removal of residual chemicals), washing, sorting, cup-up, cup-down, filling with fruit, addition of syrup, degassing, closing, pasteurizing, cooling pelletizing and labeling. But, are all these processes potentially waste sources?

In order to identify the processes to be value-streamed we need to evaluate them based on specific criteria. This problem was the objective of many research initiatives in the past (Davenport, 1993; Dervitsiotis, 2006; Madison, 2005; Ioannou, 2005; Laguna and Marklund, 2004; Folinas, Kelemis and Manikas, 2011). Significant contribution was made by EPA (2007). In the 'The Lean and Energy Toolkit' a table was summarized in a straightforward manner the environmental impacts for every of the 7 typical types of waste (Over-production, Inventory, Defects, Transportation, Motion, Over-processing, and Waiting). Furthermore, in the next year Hanes et al. (2008) identified the corresponding causes and effects (Table 2).

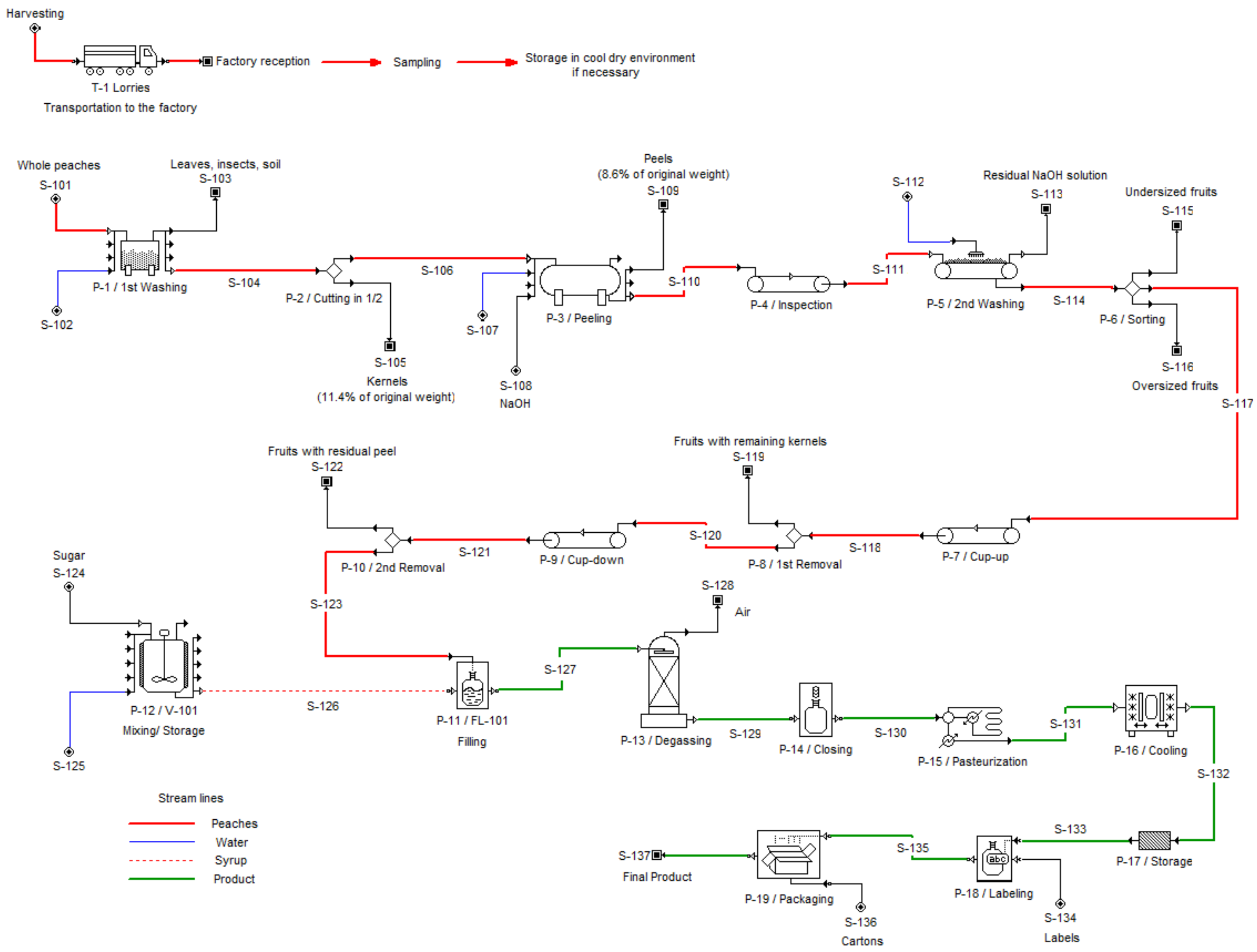

Figure 1. Canned production process

Table 2. Effect, cause and environmental impact of the seven wastes

Waste (Muda)	*Lean Management*		
	Environmental (EPA, 2007)	*General (Hines et al., 2008)*	
	Environmental Impact	Effect	Cause
Over-production	• More raw materials and energy consumed in making the unnecessary products • Extra products may spoil or become obsolete requiring disposal • Extra hazardous materials used result in extra emissions, waste disposal, worker exposure, etc.	Human movement not necessary, non-ergonomic work position, loss of tools	Wrong information flow, wrong production schedule
Inventory	• More packaging to store work-in-process (WIP) • Waste from deterioration or damage to stored WIP • More materials needed to replace damaged WIP • More energy used to heat, cool, and light inventory space	Increase of leading time, cost	Product or process inefficiency, long set-up times, push production approach, low customer service
Defects	• Raw materials and energy consumed in making defective products • Defective components require recycling or disposal • More space required for rework and repair, increasing energy use for heating, cooling, and lighting	Product with defects that require rework or disposal	Design error, machine setup wrong process production and quality protocol assessment
Transportation and motion	• More energy use for transport • Emissions from transport • More space required for WIP movement, increasing lighting, heating, and cooling demand and energy consumption	Human movement not necessary, non-ergonomic work position, loss of tools Increase of leading time, cost	Wrong layout of the facility and/or of the workplace Excess transport of WIP or products

	• More packaging required to protect components during movement • Damage and spills during transport		
Process	• More parts and raw materials consumed per unit of production • Unnecessary processing increases wastes, energy use, and emissions	Process steps not required to produce the item	Procedures and methods not designed to meet production requirements, machine set-up too long
Waiting	• Potential material spoilage or component damage causing waste • Wasted energy from heating, cooling, and lighting during production downtime	Delays with stock-outs, equipment downtime, capacity bottlenecks, information transfer	Inefficient information flow, work organization not efficient, maintenance program not adequate

After synthesizing the above studies we concluded to the following six criteria:

1. Processes that require significant amounts of inputs / resources, such as pounds of materials used, pounds of hazardous materials used, gallons of water used, gallons of water consumed, watts of energy used, etc.
2. Processes that emit significant amounts of outputs, such as pounds of solid waste generated, pounds of hazardous waste generated, pounds of air pollution emitted, etc.
3. Processes requiring environmental permits or reporting to environmental agencies, and
4. Processes that include special pollution control equipment and/or specialized infrastructure.
5. Processes that potentially affect the environmental consciousness and sensitiveness of the producers.
6. Processes that potentially affect the environmental consciousness and sensitiveness of the consumers.

Based on the proposed six criteria we used both primary and secondary data analysis to evaluate the level of the environmental impact of the processes that were emerged by the description of the canned peach production. These approaches were applied in one of the biggest canned production company in Northern Greece that follows the typical production of the targeting product (The main facts and assumptions are presented in the Appendix – Table 5). First, a number of interviews were arranged with key persons in the Production and Quality Assurance departments. Respondents took into account the effects, causes and environmental impact of the seven wastes as depicted in Table 1 and evaluated the processes using four values: Not significant, Low, Medium and High (significance). Data extracted from both departments and referred to the production line of the last 3 years were collected and analyzed. A number of reports were created and given to employees / respondents to make a more reliable evaluation. Table 3 presents and evaluates the processes that were identified with the above criteria according to the responses (modes values are presented).

Table 3. Identifying the processes to be value-streamed

Criteria / Process	*Inputs / resources*	*Outputs*	*Agencies*	*Equipment need*	*Producers consciousness*	*Consumers consciousness*
Receiving	M	M	M	H	L	L
Washing	L	M	L	L	L	L
Cutting	L	M	L	L	L	L
Peeling	H	H	H	H	M	M
Washing	L	M	L	L	L	L
Sorting	L	L	L	L	L	L
Cup Up	L	M	L	L	L	L
Cup Down	L	M	L	L	L	L
Filling (Fruit)	M	M	M	M	L	L
Syrup production	H	H	H	H	M	M
Addition	M	M	M	M	M	M
Degassing	H	H	H	H	M	M
Closing	L	L	L	L	L	L
Pasteurizing	H	H	M	M	M	M
Cooling	L	L	L	L	L	L
Palletizing/Labeling	L	L	L	L	L	L

According to the above findings all the above processes were selected for the development of current and future stream maps (Steps 2 and 3).

2.2 Step 2: Development of the Current State Map (CSM) of the selected processes.

In order to develop the CSM of the examined product, calculations were made in every process that was identified in the previous step. In general, through this step both qualitative and quantitative data were collected for the identification of waste. The data were categorized into two groups: 1) General information including the following issues: cycle time, change over time and up time, processing time for each of the production and logistics tasks performed, reliability of equipment used and availability of such materials as packaging, average waiting time for each order, number of operators, etc., and specific information, which can include the following: pounds of materials used, pounds of hazardous materials used, gallons of water used, gallons of water consumed, watts of energy used (watt-hour per pound of output), BTUS of energy used, pounds of solid waste generated, pounds of hazardous waste generated, pounds of air pollution emitted and gallons of wastewater treated. This study was focused on the environmental aspects of the targeted procedure and was referred to litres of water and energy used (electricity and steam).

Since, the production is already automated no further improvement of the total process time could be achieved. Additionally, since the last 5 years the company have successfully used the make-to-order policy there hasn't been any stock remaining. The company receives the orders from June to August and produces in September the required quantities. Much effort has been applied in practice by cooperatively working with the peach producers so as to establish a smooth deliver procedure.

Therefore the study focuses on CO2 emissions and water usage. First, regarding the water usage there are two stages where there is significant water consumption: washing for removing foreign materials (leaves, insects, etc.) and then (after the peeling) to remove any residual chemicals from the flesh. In both cases a fixed and predefined quantity of water based on the needs and it is estimated straightforwardly and in an ad-hoc basis. Manufacturer maintained and used a specialized instrument for filtering the water in the above two stages so as to clean the shop-floor areas.

Second, regarding the energy the following table presents the steam and electricity usage.

Table 4. Estimating water and energy used

	Electricity used (kWh/per production line)	*Steam used (% of the total use)*
Receiving	-	-
Washing	90	-
Cutting	90	-
Peeling	1650	30
Washing	1104	-
Sorting	1822	-
Cup Up	5520	-
Cup Down	5520	-
Filling (Fruit)	5520	-
Syrup production	2208	10
Addition	5520	-
Degassing	5520	60
Closing	5520	-
Pasteurizing	5520	-
Cooling	4968	-
Palletizing/Labelling	-	-

According to the estimations some processes that were measured have some of the environmental impacts that were presented in the Table 2 but all have time and labour inputs such as the number of employees / shifts, cycle time (c/t), operation time (o/t), set up time, scrap rate, rework rate, etc. Figure 2 in the Appendix presents the Current State Map (created with MSVisio).

In the bottom of the map there are three lines that represent: 1) Total lead time and value added time, 2) Amount (litres) of water used (top line) and amount (litres) of water needed (bottom line) per day and per process, 3) kWh's of energy used (top line) and kWh's of energy needed (bottom line) per day and per process: for measuring energy consumption a power measuring device (the power consumption of a machine for machining a part or a batch over a particular time in 24 hours) and a data logger were used. Since the examined production process is fully automated and especially from Storage to Packaging, Total Lead Time and Valued Added Time are not considerably different.

Therefore, and based to Table 2, Inventory, Transportation and motion waste, as well as, the Waiting waste are not critical. Furthermore, according to the historical data maintained by the Quality Control company's department, the Defect level (caused by scrap rate, design error, machine setup, wrong process production and quality protocol assessment) is very low (~0.5% per lot) so this waste is also not critical.

In contrast, there are two processes that have significant environmental impact in terms of water and energy used: Peeling and subsequent washing and pasteurizing. Moreover, one waste according to Table 2 (Process), has been selected for a more detailed examination. Based on the above the Current State Map (CSM) is created for the examined production process as depicted in the Appendix (Figure 2).

2.3 Step 3: Development of the Future State Map.

The main objective of this step is the identification of processes with main environmental, health, and safety opportunities on the CSM. But most of all, this step includes the identification of the appropriate practices, technologies and tools in order to minimize waste. According to the findings of the previous step, authors and the two managers of the manufacturer have focused on one waste: Process and specifically on two processing steps: peeling and subsequent washing and pasteurizing. Based on the above, the following practices were proposed (Figure 3 in the Appendix).

Among the various stages of a typical production line of canned peach, peeling and pasteurizing are the most energy consuming. Furthermore, the use of chemical compounds during peeling, such as potassium and sodium hydroxide, will increase the chemical load of wastes, as well as the production cost, since the alkaline solutions are further enforced by the addition of the above compounds due to dilution by the expelled fruit juice.

It is well established that peeling of fruits and vegetables can be achieved by steaming, provided that the steam used, is food grade. Peeling by steaming instead of chemical peeling, automatically minimizes the amount of water during the second washing for removing any residual chemicals, having great benefits regarding water consumption. Moreover, the condensed steam after peeling may be used for preheating the syrup, prior to filling the cans, making the whole process energy efficient. Another point to be made is that most of the holding tanks and piping, in the peach canning industries in Greece, are lacking insulation and this is of significant importance for minimizing the energy losses, especially in the stages where heating and cooling are involved. Finally, peach kernels may be exploited by the industries for energy production (biomass boilers) to cover the energy requirements of other small production lines, for products such as peach juice and puree.

Step 4: Development of the Action Plan (AP)

This step involved the design or drafting of an action plan based on the Future State Map that was created at the previous step. An AP in general includes the following information: 1) First, information regarding the project of the application of the suggested improvements, such as the title and description of the action, its goals and objectives, the responsible process managers / supervisors and the timeframe / scheduling, and 2) Second, information regarding the examined business (production and logistics) processes, such as the title, description, status (not started, in progress, completed), impact, and priority. Table 5 (Action Plan Management of actions) in the Appendix presents the above information.

3. Discussion - Conclusions

This paper provides an application of the Lean thinking tools to support the green supply chain and logistics management initiatives. Authors argue that the VSM analysis can be an effective and efficient tool for a number of improvements not only for the identification of the wastes but for the determination of the greening of the agrifood supply chain. It suggests a systematic (four-step) approach that consists of specific tasks and activities.

A number of to-do (improvement) practices are proposed. Each of the improvement activities aimed at either eliminating non-value adding steps in order to reduce on the length of the value stream which subsequently would contribute to the reduction of the total process, lead and customer query cycle times and consequently the energy consumption and water usage. The proposed systematic approach was deployed in the canned peach production. After the preparation of the Action Plan (AP) the following achievements have been realized:

Today, canned peach production is achieved by peeling with sodium hydroxide solution at 95oC. However, peeling by steam, which is an alternative peeling process, may have great benefits regarding water consumption and energy usage.

Insulation of piping and vessels, where heating or cooling is involved can further reduce steam consumption and therefore energy usage.

The kernels formed during the cutting in halves process can also be used for the production of energy, thus covering the energy requirements of other products that are produced on a small scale (e.g. peach puree and peach juice).

Finally, the wastes (peels) that derive after peeling can be used for animal feed and if steam peeling instead of chemical peeling is used, then no neutralization step is necessary.

Considering the findings that were observed following the implementation of the pilot project at the examined company, the research project provided viable evidence that these Lean techniques and principles have a positive impact on and that VSM was a workable technique in the production and logistics operations. There are also many challenges that need to be considered for future study regarding the examined sector. Introducing global supply chain management into the green and lean equation increases the potential conflict between the green and lean initiatives. So as companies begin to implement lean and green strategies in supply chains, especially large and complex global supply chains, manufacturers need to explore the overlaps and synergies between quality-based lean and environmentally based 'green' initiatives, and understand the various trade-offs required to balance possible points of conflict. Finally, there is a need to evaluate and possibly improve this tool, based on practice and the applicability in other sectors as well.

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Appendix

Table 5. Facts and assumptions

- Focus on canned peach production / There is no IT system for designing and managing the materials in the production line
- Start/End of canned peach production: July-end of September / Working hours: 23 h Appr. 10,500 cans/production line/h are produced. Each can weighs 1 kg
- Factory operates: 60 days x 23 h/day = 1380 h / Assuming that all engines have an average performance of 80% / Reception: 45 lorries / 21 tn on a daily basis / packaging materials are procured from local producers / 90% of the total orders are exported / no problems associated with over-production

Processing step	Number of employees	Processing time (min/tn)	Installed capacity	Energy consumption (per tn) Oil and electricity	Scrap (%)
1st Washing	5	10-15’		5% of total electrical energy	N/A
Cutting in halves/Kernel removal	3	1’		<5% of total electrical energy	Kernels
Peeling	1	4-5’	15kW motor	30% of total steam consumption 1650kWh/production line	N/A
2nd Washing		1’	10kW motor	1104kWh/production line	Peels
Sorting		0,5’	3x5.5kW motor	18216kWh (for all production lines) – 1821.6kWh/production line	N/A
Cup-up (residual kernel removal)	5/production line	2’	1x5kW motor	5520kWh	N/A
Cup-down	8/production line	3’	1x5kW motor	5520kWh	N/A
Filling with fruit	4/production line	-	1x5kW motor	5520kWh	N/A
Addition of syrup		-	1x5kW motor	5520kWh	N/A
Degassing		10’	1x5kW motor	5520kWh	N/A
Closing		0,5’	1x5kW machine	5520kWh	N/A
Pasteurizing		20’	15kW motor	5520kWh	N/A
Cooling		20’	1x45kW motor	60% of total steam consumption (4968 kWh/production line for pumps)	N/A
Palletizing/Labeling	1/prod. line	7-8’			N/A
Total	27	79’ - 86’		50391.6 kWh/production line	
Addition of syrup			1x2kW motor for stirrer	10% of total steam consumption 2208 kWh/production line	N/A

Figure 2. Current State Map

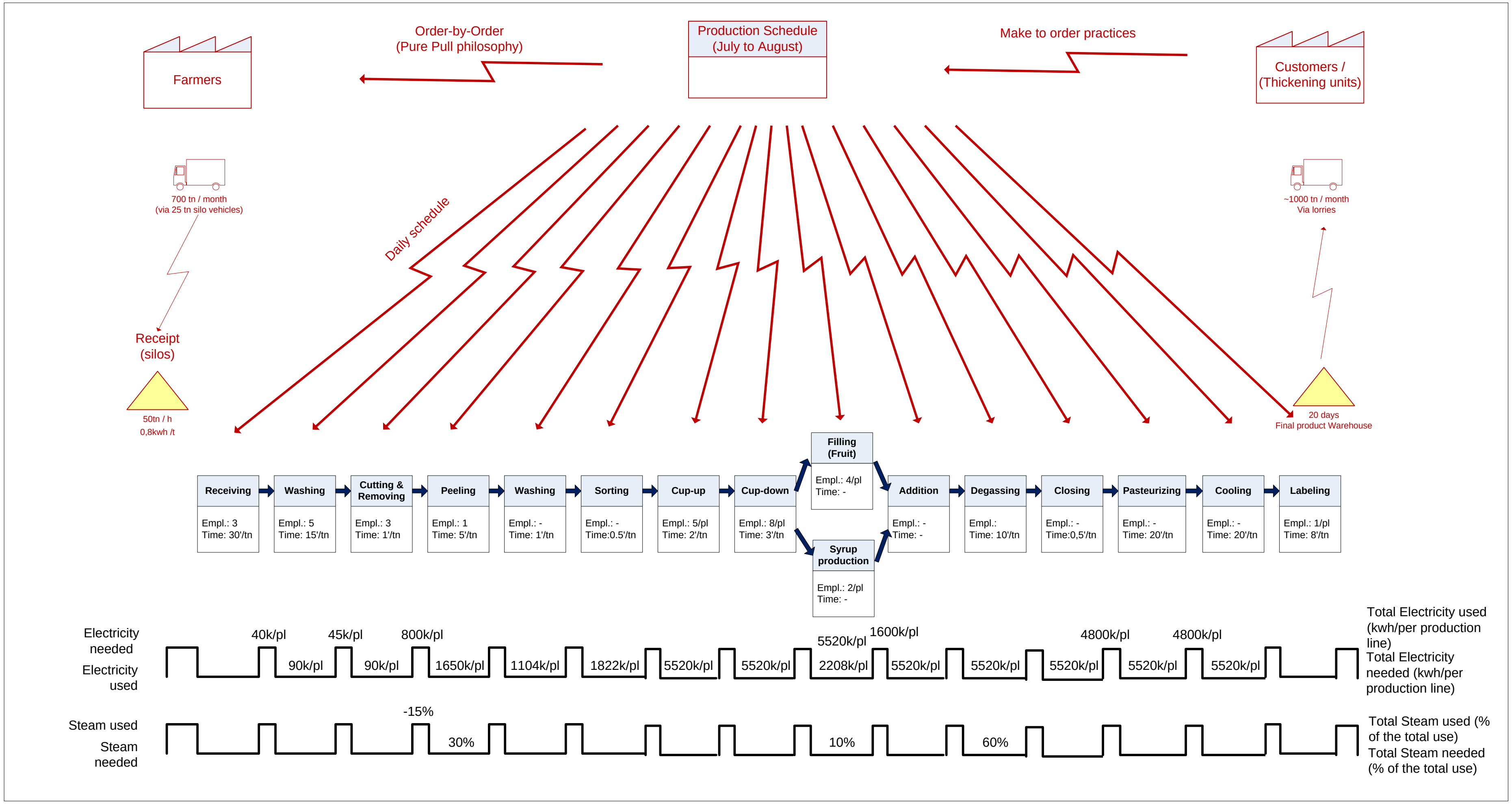

Figure 3. Future State Map

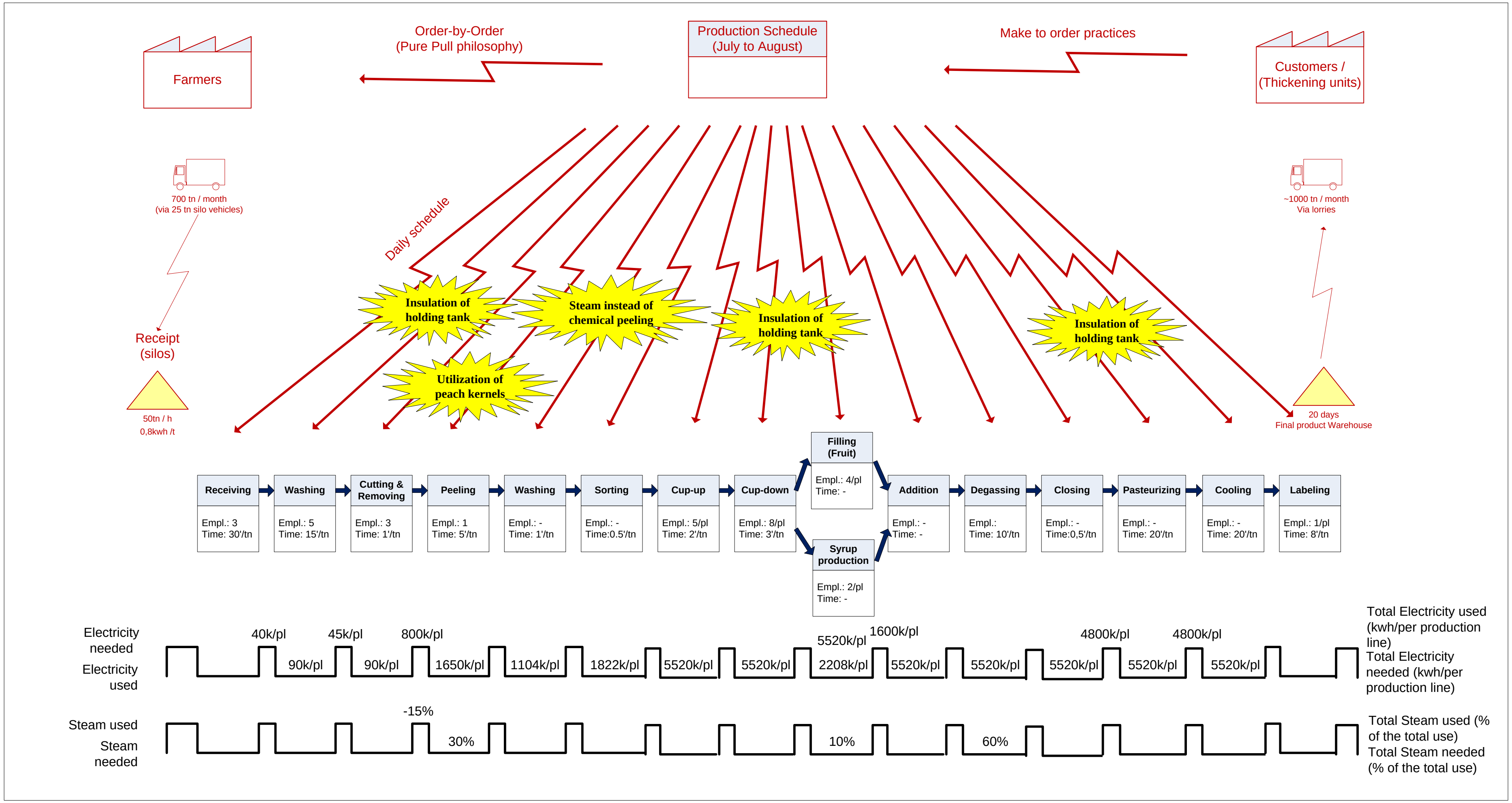

Table 6. Action Plan Management of actions

Title / Area	Description	Action	Impact L=Low M=Medium H=High	Priority 1=Low 2=Medium 3=High	Supervisor	Time scheduling	Status N=not started I=in progress C=completed
Production	Washing	Insulation of holding tank and piping	L	1	Production Manager		C
Production	Cutting in halves	Utilization of peach kernels for energy production	M	2	Production Manager		I
Production	Peeling	Substitute the current chemical peeling process with steam peeling	H	3	Production Manager		I
Production	Peeling	Insulation of holding tank and piping	H	3	Production Manager		C
Production	Syruping	Insulation of holding tank and piping	H	3	Production manager		C
Production	Pasteurizing	Insulation of holding tank and piping	H	3	Production Manager		C
Production	Cooling	Insulation of holding tank and piping	L	1	Production Manager		C

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Detecting invasive woody increment in agricultural areas with Earth Observation technology

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ABSTRACT

In the continental climate regions of the EU, one of the largest environmental and conversational problems is caused by the spread of invasive plant species, especially in agriculturally abandoned regions. Several species of the rapidly spreading and to the native vegetation supplanter plant can be a cause of ecologic and health risk. Some species change the physical structure and chemical composition of the soil, affect the microclimate, thereby contributing to climate change processes. Summing up, invasive species affect agricultural landscapes significantly. The common feature of the belonging species is that they spread rapidly and develop a significant amount of biomass in a short time. In the course of our research we worked out a remote sensing and GIS method, which localize efficiently the infected areas, and we utilized this method in the Northern Transdanubia, to extract the information of woody increment in agricultural regions.

1. Introduction

Curbing the spread of invasive plant species has a significant economic interest. The elimination of the invasive plant species – which endanger the biodiversity, the agricultural productivity and the health of the citizens – is an other important European interest. Since 1992, the EU have spent more than 38 million EUR within the framework of 180 projects to stop the spread of invasive species in natural and agricultural areas [1]. The USA, based on actual estimates, marked out 80 billion EUR resources (annually) for the combat against the biological intruders [2].

Nowadays, the decreasing stock of energy supplies endeavour the application of renewable and alternative energy sources. [3] Consequently, the interests of the energy sector can be set aside to the environmental protection, so an efficient environmental resolution can be drawn up, supporting productivity with environmental planning [4]. The importance of biomass resources has been declared formerly [5], and this importance is increasing from year to year [6]. Bioenergy stands for traditional biomass energy and for sustainable energy source [7]. The biomass volume – which is necessary for the operation of the bio-energy power-plants – is getting harder to be accessible, since the cultivated energy plantations destroy the topsoil [8]. For the previously built power plants, it is increasingly useful to operate with biomass-stock of invasive vegetation, which is causing environmental damage. However, this demand

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raise the yet unsolved question of biomass detection as input data for sustainable management [9]

Primarily, the woody, quickly renewable species came into the focus of interest [10-11-12], E.g. Tree of Heaven (*Ailanthus altissima*), Russian Olive (*Elaeagnus angustifolia*), Black Pine (*Pinus nigra*), Common Hackberry (*Celtis occidentalis*). Although, the non-indigenous herbs can cause serious environmental problems in the European landscapes [13]. In our study we worked out the methodology to detect the woody increment. Our aim – in compliance with the appropriate renewable energy directive – was to promote the excavation of such renewable energy directive control [14], which has no conservation or forestry value, but they threat the native vegetation and the ecosystem.

In order to achieve these objectives, it was necessary to examine the cost-effective Earth Observation (satellite remote sensing) and image information mining techniques, which can monitor the renewable production of woody incremental biomass stocks. The ongoing EUREKA labelled [15] T-BEA project [16] (Tool for Biomass Energy Accessibility with Earth Observation) is aiming to detect with Earth Observation tools efficiently the biomass stocks, which are sustainable to be utilized for bio-energetic use, and which mean significant danger for the natural and agricultural environment.

In the first phase of the investigation, we looked for the answer, how we can approach to the technical challenge by using exclusively freely available Earth Observation datasets. First, we tested the sufficiency of the quoted vegetation indices and the correction calculations with the freely available Landsat 4, Landsat 5 and Landsat 8 satellite images. Then with the set up methodology we extracted spatial information on woody increment sites in the Northern Transdanubia, to support future operative biomass quantity measurements by categorizing this region in a robust way in function of accessible biomass (agricultural sites with woody increment). We present the first test and validation results, which may draw up the frame for the future developments.

2. Data sources

The procurement of images came true across the website of USGS Earth Explorer. The Landsat 4 was operating between July 16, 1982 and December 14, 1993, while the Landsat 5 mission between March 1, 1984 and January 2013. Thematic Mapper functioning of the on-board (TM) sensor acquired the images in seven spectral bands (Table 1). The uncompressed images are georeferenced, and have mapping projection, they require for each channel an average 60 MB storage space, and they are more than 8000 x 7000 pixels in size.

Table 1. Bands of the Thematic Mapper (platform: Landsat 4-5)

Band	*Spectral range*	*Spatial resolution*	*Description*
1	0.45 - 0.52 µm	30 m	Blue
2	0.52 - 0.60 µm	30 m	Green
3	0.63 - 0.69 µm	30 m	Red
4	0.76 - 0.90 µm	30 m	Near-Infrared
5	1.55 - 1.75 µm	30 m	Near-Infrared
6	10.40 - 12.50 µm	120 m	Thermal
7	2.08 - 2.35 µm	30 m	Mid-Infrared

A Landsat 8 satellite entered service on May 30, 2013. The imaging bands of Operational Land Imager (OLI) sensor differ from the bands of TM sensor, therefore in case of the two different type of imagery respectively different calculations shall be done. The OLI sensor specifications are presented in Table 2.

Table 2. Bands of the Operational Land Imager (OLI) (platform: Landsat 8)

Band	*Spectral range*	*Spatial resolution*	*Description*
1	0.433 - 0.453 μm	30 m	Coastal / Aerosol
2	0.450 - 0.515 μm	30 m	Blue
3	0.525 - 0.600 μm	30 m	Green
4	0.630 - 0.680 μm	30 m	Red
5	0.845 - 0.885 μm	30 m	Near Infrared
6	1.560 - 1.660 μm	30 m	Short Wavelength Infrared
7	2.100 - 2.300 μm	30 m	Short Wavelength Infrared
8	0.500 - 0.680 μm	15 m	Panchromatic
9	1.360 - 1.390 μm	30 m	Cirrus

The uncompressed images are georeferenced, and have mapping projection, they require an average of 120 MB storage space at each channel, and they consist of more than 8000 x 8000 pixels. Since the satellite images are available in georeferenced form, after the uncompressing, sorting and methodizing, the adjustment process of the evaluation could be started immediately.

3. Methods

The set up methodology aimed to frame the servicing GIS infrastructure, which shall be used operatively in the near future to detect accessible, unused and sometimes even harmful biomass stocks with Earth Observation technology. The introduced solutions stand for only the first phase of the development chain, however, with the utilization of these results the information production could be optimized on an objective basis.

3.1. The applied vegetation indexes and the suggested software

The NDVI (Normalized Difference Vegetation Index) is a dimensionless value, which express the vegetative activity of a given area. The value of NDVI is supplied by the quotient of difference and the amount between the vegetation reflectance intensities of near infrared (NIR, usually 845 to 885 nm) and visible red (RED, usually 630-680 nm) range [17]. The described formula:

$$\mathrm{NDVI} = \frac{(\mathrm{NIR} - \mathrm{RED})}{(\mathrm{NIR} + \mathrm{RED})}$$

where:
NIR – Reflectance value of the near infrared band (Landsat 4,5: band 4; Landsat 8: band 5)
RED – Reflectance value of the red band (Landsat 4,5: band 3; Landsat 8: band 4)

If the measurement performing sensor is on airplane, or on space-based device, then the disruptive effects of the atmosphere must be taken into account during the measurement of solar radiation at given wavelength. The radiation passing through the atmosphere is subjected to the scattering and absorption, which can be induced by both molecular gas and aerosol particles. To reduce the radiation modifying effects of atmosphere – in order to reduce the dependence of the measured reflectance direction – a bidirectional reflectance distribution function model (BRDF) should be adapted [18]. This process is called atmospheric correction.

During the atmospheric correction four variables are necessary to be applied:

- Aerosol optical depth at 550 nm
- Quantity of total splillingable water vapour (vertically integrated water vapour)
- Quantity of vertically integrated ozone
- Surface pressure

The latter can be determined from MODIS data, which can be an alternative way of field data collection and purchase of archive meteorological data. MODIS is an ideal choice, since the data can be obtained from more than 150 crossings a year.

The determination of the vegetation index – in case of images, which have been normalized and undergone the atmospheric corrections – is supported by a number of different software. Calculation of NDVI from Landsat images is realized in the following way:

We can produce NDVI maps with the help of ArcMap, after the loading of appropriate bands from Landsat with the image analysis module (image Analysis): Select the Processing Toolbox NDVI 'maple leaf'. A new layer will represent the calculation.

Using the ENVI software package we can prepare our maps NDVI map also. In the toolbar (Toolbox), select the Spectral / Vegetation / NDVI option. So in the appearing NDVI window we can select the images will be analysed and we can narrow the calculation with a selection tool for the area of the image. We can select the type of image, if the sensor is on the list (TM, MSS, AVHRR, etc.), or you can give the appropriate red and near-infrared bands of opened image (in case of known sensor the software selects the appropriate bands). We need to decide that do we export the result into the computer's memory, or we specify the file format.

In the ERDAS 2011 software package can be found NDVI module, we can achieve this to click the Raster / Multispectral / Unsupervised tab, for the type of NDVI classification. Setting of this is similar to the ENVI NDVI panel. Of course, in this case, we gave values between -1 and 1 for each pixel and the positive integer means the healthy green vegetation.

NDVI calculation is also supported by the SPRING GIS. First, here we open the image also, and then we click to the Image tab and select the option of Arithmetic Operations. At the Operations button we select the "C = Gain * ((AB) / (A + B)) + Offset," option, then we give the A channel as the near infrared, while B channel is the red channel. By clicking the button of ColorPallet we can give hues for the outcome. You should choose colours from the often used in the international literature. For example, the White - Yellow - Green tone NDVI colour scale, which provides a good basis for comparison the graphic material of different publications.

The free MultiSpec software is able to perform the NDVI calculation. The images must be open, and then after selecting the Reformat option from the Processor menu, click the Change Image File Format. In the appearing dialog we can select the output format (you should use *.geoTIF), then we can load the Transform data box, which calls for a new dialog box. Here select the New Channel from General Algebraic Transformation opportunity. After we have accepted it, a new window appears, into which we can write the wanted formula, in this case:

$$\mathrm{NDVI} = 0 + \frac{1.0C3-1.0C2}{1.0C3+1.0C2} * 1$$

where: C1 and C2 mark the R and NIR bands.

To perform the calculations we can use the also free GRASS GIS with writing the "r.mapcalc" command. In the GRASS GIS Raster Map Calculator window, firstly we give the name of the layer, what we want to create and then we compile the formula. To do this, add the appropriate bands with the Insert existing raster map button. With click to the Run button we can prepare the new NDVI layer.

With the QGIS open source GIS software we also can calculate NDVI after installing the Measuring Vegetation or the Raster Calculator plugin. With at the GRASS software reviewed method gives the formula. The load time of the NDVI layer depends on the size of the used image. On the gray-scale layer, the dark parts of the areas are the less vegetation covered areas. We prepared own algorithm for vegetation index calculation and for the subsequent operations for partially automate the process.

3.2. The processing of NDVI maps

In order to retrieve a map from the vegetation coverage, we must give an identification threshold, for the classification of the vegetation and non-vegetation pixels by the software. Thus, we can determine the vegetation covered areas with a relatively simple classifications process. Ultimately, we get two categories: vegetation and bare surfaces.

The extraction of vegetation indexes can be achieved with the performed mathematical operations on the raster file bands, result a new raster band, a coverage map. Since the selection of the woody growth is our aim, after it we need to compare the coverage maps of different months, for that we can filter out the harvested plots covered with herbs and spring herbaceous weeds. In this way we get a woody cover overlay for every year, which from create vector, a digital map obtained, which can be compared with the forestry and conservational digital databases. So we can quickly and automatically mark the areas covered with woody weed increment with the taking into consideration the vegetation cover of previous years.

First, we give a threshold, where the higher NDVI values belong to the areas, which are interesting for us and which are covered by vegetation in the whole vegetation period. If at the NDVI calculation we did not apply atmospheric correction and normalization calculations, than this value will be empirically determined (Tab. 3). The difference between satellite datasets are arising from the spectral difference of the acquisitioned sensor bands, while between the seasons the atmosphere may cause the main difference.

Table 3. The applied NDVI thresholds in case of our working area

Satellite	*Images of the summer months*	*Images of early spring and autumn*
Landsat 8	NDVI 0.44	NDVI 0.35
Landsat4 and 5	NDVI 0.53	NDVI 0.44

Then, we give the cover of biomass areas in a given year from the cutaway of the given acquisition dates of the characteristic plant biomass cover maps (Fig. 1). Where a rapid growth of biomass can be observed in the consecutive years, there appear likely invasive, but at least R-strategist species. We can detect the largest plant infections efficiently with this monitoring system.

Figure 1a. Test area (illustration background source: Google Earth)

Figure 1b. Woody biomass cover map of the year 2011 controlled with GeoEye space images (illustration background source: Google Earth)

3.3. In situ validation

During the test process we found that the created monitoring system digest the fast-growing photosynthetic biological production with 60 meters resolution. The areas infected by *Ailanthus altissima* can be detected very well (Fig. 2).

Figure 2. The area is infected by *Ailanthus altissima* presented in the Google street view service. The red line is the boundary of polygon from our monitoring system

The smallest detected increment areas are 3600 m2 (Fig. 3). Due to the limitation of Landsat images resolution, the mapping output may not be accurate at the desired level, however it is adequate for detection, thus the necessary interventions can be performed. The method application is useful for local and national environmental protection, since it calls attention to the large increment areas, which – literally – are the bad seeds in the landscape.

Figure 3. Increment areas in the Google Earth service. The red line is the boundary of polygon from our monitoring system.

4. Results

We applied the described methodology in the region of Northern Transdanubia (north from Lake Balaton) with the utilization of Landsat 8 imagery (Figure 5). Our aim was to define the regions, in which it is the most cost-efficient to start more detailed remote sensing based measurements (Copernicus Sentinel-1 data PolInSAR technology and sampling with MS VHR imagery) in order to estimate the quantity of invasive biomass (ton/ha).

In the region of interest we have detected 3439 (administratively) agricultural sites with invasive woody increment, which are occupying 8133 ha. We categorized these sites into three groups according to land use categories. The distribution of the sites can be seen in Figure 4 a-b.

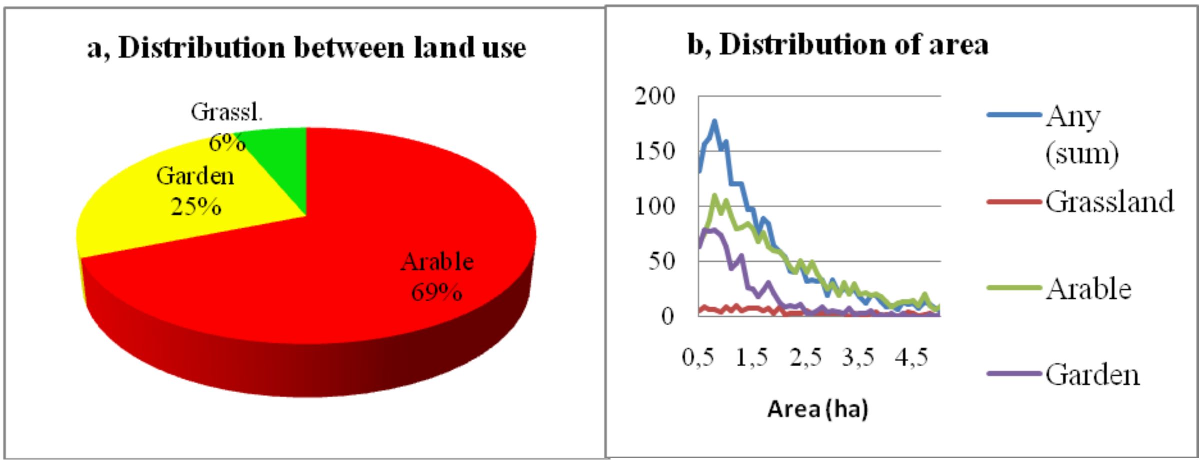

Figure 4 a-b. Distribution of detected invasive woody increment sites

The average size of the detected sites is 2,37 ha (deviation 2.55, median: 1.60); understandably, the biggest sites were detected in areas, which are used as grasslands (average area: 2.96 ha, deviation: 2.58, media: 2.05 ha); then the following largest ones are under arable land use (average area: 2.69, deviation: 2.84, median: 1.80 ha); and finally the sites with agricultural-gardening land use are the smallest ones (average area: 1.36 ha, deviation: 0.95, median: 1.10).

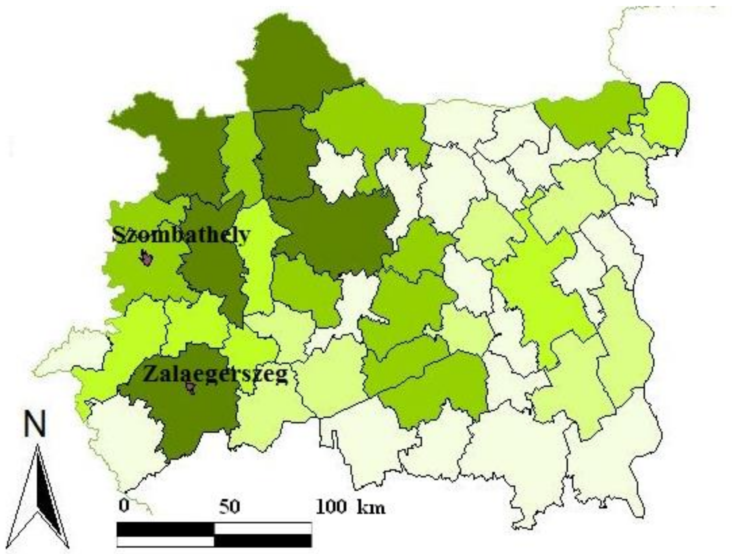

Figure 5. Spatial distribution of the detected invasive woody increment sites between the townships

In order to prepare spatial overview of the distribution of the detected sites, we have created categorical maps with the use of ~LAU 1 scale administrative regions ("járások" ~townships), presenting the summarized area (Figure 5), the number and the distribution of the detected sites.

If we weigh the townships with the average area and number of detected invasive woody increment sites and with the reciprocal of the township area (density) we find a quite interesting ranking order. The first two townships (Szombathelyi járás and Zalaegerszegi járás and) are organized around cities, which are also seats of counties (Vas and Zala county) (NUTS 4) – and not as suspected, regions, where villages dominate. The possible explanation of this phenomenon could be dual. The experiment was focusing on agricultural areas, and in regions, where the effects of urbanisation has a significant impact, more agricultural areas are abandoned. The other explanation can be that invasive species often turn up due to activities, which are related sub-urban land use (logistic and industry areas, heavy transportation) and they are spreading from there in the direction of agricultural areas.

In situ validation took place in the townships of Győr and Komárom. The validation process was carried out by a stakeholder partner from biomass industry. The validation results are described in Tab 4.

Table 4. Validation results of EO detection of biomass sites

Number of detected sites	130
Cumulated area of sites	261 ha
Number of in situ validated sites	73
Cumulated area of validated	169,4 ha
Number of well-detected	66 (90 %)
Number of false detection	6 (10%)
Number of efficient to exploit	41 (56%)
Area of efficient to exploit	91 ha
Estimated attro ton (valuable material)	4575 ton

5. Conclusions

Although the 30-m spatial-resolution HS and MS images is not allowing the racial and association-level vegetation mapping in diverse environment, they are suited for building a rapid and cost-effective biomass monitoring system. With the Landsat images, which are available for free we can achieved the annual monitoring of woody plant biomass with 60 m detail. So the created IT system indicates that somewhere R strategist species appear suddenly and in great crowd. Due to the control of such areas, the plant infections can be localized, and at the same time the most infected areas can provide the greatest output of invasive species – and related biomass stock. With the utilization of the set up methodology the optimization of the processing chain can be started in an iterative manner, providing a strong basis for developing an operatively adequate technology in order to serve the energy-efficiency and the nature protection aims in a synergetic way.

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Aspect regarding the use of renewable energy into vegetable farms of agritouristic pensions

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A B S T R A C T

The main goal in the agritouristic pension design is that tourists can consume organic plant products produced in the guest house farm or its immediate neighborhood. This paper aims are on one hand to design a vegetable farm based on the necessity of specific products needed for the operation of a medium pension with 9 rooms, and secondly to assess the possibility of using photovoltaic energy for powering the micro-drip irrigation system. Starting from the amount of vegetable needs for tourists from an average agritouristic pension, it was calculated the number of plants, the required surface for the plants and the amount of water needed. Based on daily and monthly needs there were established technical and constructive parameters of the solar drip irrigation installation (diameter and length of hoses, flow, pressure and pump power and solar panel characteristics). The model can be easily adapted to other size pensions or to different climatic conditions.

1. Introduction

Climate change, coupled with concerns about high oil and energy prices, is driving a global trend towards the increased use of renewable energy. Unlike fossil fuels which are rapidly being depleted, renewable energy sources such as sunlight and wind are naturally replenished and therefore sustainable. Indeed, it is the perceived notion of sustainability that is driving governments around the world to introduce legislation promoting the use of renewable energy. [1]

Agritouristic pensions currently attract an increasing numbers of tourists because of the possibilities to consume organic plant products, acquired in own farms. [9]

Achieving high quality vegetable products require intensive irrigation activity in most parts of Central and S-E of Europe. Therefore, in the particular case of an agritouristic pension with vegetable farm, irrigation is essential for achieving enough vegetable quality to support catering activities.

For economic efficiency of vegetable productions on irrigated land areas, the issue is set on reducing energy consumption, together with the use of renewable energy sources.

Integration of modern drip irrigation while using photovoltaic solar energy to drive the water pump in the vegetable farm of a pension produces effective social and economic challenges

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by promoting the concept of "Green Economy" to the masses, by reducing costs and increasing the farm independence rank of utility networks in rural areas.

2. Problem statements

The study proposed in this paper focuses on designing solar drip irrigation system at a vegetable farm of a pension with a capacity of approx. 18 beds, consisting of 2 single rooms, 5 double rooms and 2 suites. The vegetable farm will be irrigated with a micro-drip irrigation system, water supply being achieved by using a submersible pump powered by a photovoltaic panel.

Calculation method involves the following steps: calculation of raw materials (vegetables) in the kitchen; of ground surface and water quantity needed for each vegetable species; of drip irrigation installation; of the water supply pump; calculation and selection of solar panels.

2.1. Calculation of raw materials in the pension kitchen

Considering a suggestion of a menu based on traditional recipes with specific diets rich in vitamins, minerals and natural fibres, it was obtained the final gross amount of raw materials by adding elements used in each preparation, taking into account the losses that occur after cleaning and thermal processes.

Tabel 2.1. Balance of raw materials required for preparing the main menus (required for 1 person /day)

Vegetables and fruits	Appetizer	Salad	Soup	Main dishes	Steak	Garnish	Desert	Total
Potato	100 g	150 g	100 g	450		800 g		1600 g
Onion	10 g	30 g	50 g	100		30 g		210 g
Tomato	160 g	160 g		40 g				360 g
Eggplant	500g			50 g				550 g
Zucchini			30 g	30 g				60 g
Cucumber		50 g						50 g
Peas				400 g	10 g			410 g
Salad		50 g						50 g
Pepper		15 g	20 g	20 g		25 g		80 g
Carrot			60	40 g	10 g			110 g
Parsley			10 g	15 g				25 g
Celery			15 g					15 g
Beans			20 g					20 g
Spinach	150 g	100 g	150 g					400 g
Mushrooms	250 g			60 g				310 g
Corn					10 g			10 g
Dill	3 g		3 g					6 g
Garlic	10 g							10 g
Apple							300 g	300 g
Quince							150 g	150 g
Nuts							50 g	50 g

The menu consists of: 4 types of appetizers; 4 types of salad; 3 types of soups; 4 main dishes; 4 types of steaks; 3 types of garnish; 3 types of desert. In order to obtain the necessary raw materials per day, the 25 menu portions are divided to the daily average client number, namely to 10. Thus, there was obtained 2.5 items. Next, is calculated:

Daily requirement: $Y = Item \times X\ kg$ *(1)*, where: Item – 2.5; X – product.

Monthly requirement: $Z = Y \times 30$ *(2)*, where: Y necessary product/day

Annual requirement: $W = Z \times 12$ (3) where: Z – Necessary products/month, W - Necessary products /year;

In table 2.2. is presented synthetically the calculated amount of vegetables needed for: raw materials necessary for the menu – daily, peeled raw materials (2nd column); quantity of raw vegetables (including losses due to initial processing – peeling, seed removal, etc. 3rd column); quantity of raw vegetables – required monthly amount – 4th column; quantity of raw vegetables – required annual amount – 5th column.

In the case of potatoes for example, Pmm = Product mass to use in menu; L = Loss %; Rpm = Raw product mass; Rpm =Pmm+L*Pmm = Pmm*(1+L)

Table 2.2. Overall material balance for pensions cuisine

Vegetables and fruits	Required daily amount (kg)	Percentage losses in primary processing (%)	Required daily raw vegetables	Required monthly raw amount (kg)	Annual raw amount required (kg)
Potato	4	15	4,6	138	1656
Onion	0,5	12	0,6	17,6	211,7
Tomato	0,9	5	0,945	28,35	340,2
Eggplant	1,4	20	1,68	50,4	604,8
Zucchini	0,15	30	0,195	5,85	70,2
Cucumber	0,05	25	0,06	1,87	22,5
Peas	1,1	10	1,21	36,3	435,6
Salad	0,125	20	0,15	4,5	54
Pepper	0,08	10	0,088	2,64	31,7
Carrot	0,275	25	0,34375	10,3125	123,8
Parsley	0,063	25	0,07875	2,3625	28,4
Celery	0,038	30	0,0494	1,482	17,7
Beans	0,05	10	0,055	1,65	19,8
Spinach	1	25	1,25	37,5	450
Mushrooms	0,775	25	0,96875	29,0625	348,75
Corn	0,025	10	0,0275	0,825	10
Dill	0,015	25	0,01875	0,5625	6,7
Garlic	0,025	22	0,0305	0,915	10,9
Apples	0,75	27	0,9525	28,575	342,9
Quince	0,375	28	0,48	14,4	172,8
Nuts	0,125	35	0,16875	5,0625	60,7

2.2. Calculation of the area of land and water requirement for each vegetable species

Based on the demand of vegetables in the kitchen there are made calculations for each species separately, as following: required annual gross in kitchen, [kg] (Rak); required annual gross in vegetable warehouse, [kg] (Raw); minimum area required for each species [m²] (Amin); adopted surface for each vegetable layer [m²] (As); actual production [kg] (Ap); quantity of water needed for each vegetable species [m³] (Q). In the table 2.2 it can be established that the needed amount of potato in the kitchen is Rak = 1656 kg. Knowing the average losses during storage (L = 20%), results:

$$Raw = Rak \times (1+L) = 1656 \times (1+ 0,2) = 1987,2 \text{ kg}, (4);$$

Knowing Yha =16000 kg/ha, it is calculated the minimum area needed for the potato layer:

$$Amin=Raw/Yha * 10000 = 1987,2/16000 * 10000 = 1242m^2 \ (5);$$

Adopted area will be Aa = 1500 m², respectively a plot with the following size of 30 x 50 m; from the adopted area, the actual production (Ap) will be:

$$Ap = Aa \times Yha/10000 = 1500 \times 16000/10000 = 2400 \text{ kg} \ (6);$$

From the table of irrigation rules [5], [6], for potatoes are recommended watering of 600-1000 m³/ha between April...July. Are chosen monthly irrigations of 600 m³/ha in April....May, 300 m³/ha in June and 150 m³/ha in July. Therefore the adopted area (Aa), requires a monthly amount of water of: $Q = Aa \times Ir / 10000 = 1500 \times 600/10000 = 90\ m^3$ *(7) - for April....May;*

$$Q = Aa \times Ir / 10000 = 1500 \times 300/10000 = 45\ m^3 \quad (8) \text{ - for June;}$$

$$Q = Aa \times Ir / 10000 = 1500 \times 150/10000 = 22{,}5\ m^3 \quad (9) \text{ - for July;}$$

Where: Q - Quantity of water needed for each vegetable species, [m^3]; Ir – Irrigation rate, [m^3]. Results from similar calculations made for all the other vegetables, can be found in table no. 2.3. These amounts are averages values, specific for Romanian geo-climate conditions. [2], [7], [8].

Table 2.3. Calculation of surface and needed vegetables

Vegetables and fruits	Required annual gross in kitchen [kg]	Losses during storage %	Required annual gross in vegetable warehouse [kg]	Yield per ha [kg]	Minimum area required for each species [m²]	Adopted surface for each vegetable layer [m²]	Actual production [kg]
Potato	**1656**	**20 %**	**1987,2**	16000	**1242**	1500 (30 x 50 m)	2400
Onion	**211,7**	**20%**	**254,0**	40000	**63,5**	80 (8 x 10)	320
Tomato	**340,2**	**30%**	**442,3**	55000	**80,4**	100 (10 x 10)	550
Eggplant	**604,8**	**5%**	**635,0**	40000	**158,7**	180 (10 x 18)	720
Zucchini	**70,2**	**5%**	**73,7**	20000	**36,8**	40 (4 x10)	80
Cucumber	**22,5**	**35%**	**30,4**	35000	**8,7**	25 (5 x 5)	87,5
Peas	**435,6**	**5%**	**457,4**	10000	**457,4**	460 (10 x 46)	460
Salad	**54**	**15%**	**62,1**	17000	**36,5**	40 (4 x 10)	68
Pepper	**31,7**	**10%**	**34,8**	34000	**10,2**	20 (2 x 10)	68
Carrot	**123,8**	**25%**	**154,7**	25000	**61,9**	64 (8 x 8)	160
Parsley	**28,4**	**15%**	**32,6**	30000	**10,8**	10 (2 x 5)	30
Celery	**17,7**	**20%**	**21,4**	25000	**8,5**	10 (2 x 5)	25
Beans	**19,8**	**5%**	**20,8**	7000	**29,7**	35 (5 x 7)	24,5
Spinach	**450**	**5%**	**472,5**	22000	**214,7**	220 (10 x 22)	484
*Mushrooms	**348,75**	**5%**	**366,1875**				
Corn	**10**	**5%**	**10,5**	3000	**35**	35 (5 x 7)	10,5
Dill	**6,7**	**15%**	**7,7**	20000	**3,8**	8 (2 x 4)	17,6
Garlic	**10,9**	**5%**	**11,5**	5000	**23**	25 (5 x 5)	12,5
**Apple	**342,9**	**35%**	**462,9**	60000	13 trees = **77,1**	80 (8 x 10)	
**Quince	**172,8**	**30%**	**224,6**	50000	8 trees = **44,9**	50 (5 x 10)	
**Nut	**60,7**	**10%**			3 trees = **60**	18 (2 x 9)	
Total					**2663,6**	**3000**	**5517,6**

* Mushrooms will be purchased from the nearest mushroom place mushroom farm and are not subject to the calculation of the surface;

** 1 tree = 6mp. Fruit trees do not need extra water for irrigation, the wastewater stored in deep layers at 1-2 m from the nearby vegetable crops being sufficient. [8].

The amount of water was calculated using data from the table of irrigation rules multiplying the amount required to ha with the number of days in the three months of irrigation Ex. Potato: 400 m^3 at 5 days; 90/5=18 days x 400 m^3=7200.

Considering the data from the literature [3], for the classical irrigation rules and taking into account the significant reduction in water demand for irrigation by using micro-drip system, for the main vegetables data has been gathered, and it is presented in the table bellow:

Table 2.4. Irrigation rates

Vegetables	**Micro-drip irrigation rates (Ir), m³**						
	March	April	May	June	July	August	Total m^3 of water/species/whole period
Potato		90	90	45	22,5		**247,5**
Onion	2,4	2,4	1,2	1,2			**7,2**
Tomato	3	3	1,5	1,5	0,75	0,75	**10,5**
Eggplant	5,4	5,4	2,7	2,7	1,35	0,67	**18,22**
Zucchini	1,2	0,6					**1,8**
Cucumber	0,75	0,75	0,75	0,37	0,37	0,18	**3,17**
Peas		1,38	0,69	0,34			**2,41**
Salad		1,2	0,6	0,3			**2,1**
Pepper	0,6	0,6	0,3	0,15	0,15		**1,8**
Carrot	1,92	1,92	0,96	0,48			**5,28**
Parsley	0,3	0,15	0,07				**0,52**
Celery		0,3	0,15				**0,45**
Beans		1,05	0,5	0,25			**1,8**
Spinach	6,6	3,3	1,65	0,8			**12,35**
Corn		1,05	0,5				**1,55**
Dill	0,24	0,12	0,12				**0,48**
Garlic	0,75	0,37					**1,12**
Total	**23,16**	**113,59**	**101,69**	**53,09**	**25,12**	**1,6**	**318,25**

2.3. Calculation of micro-drip irrigation installation

2.3.1. Calculation of pipelines

From literature [11], [12], [13], [14] for pipelines with flows of 100-300l/h for lengths of up to 100m it is recommended a diameter of 19 mm.

According to image 2.1 there were defined 3 pipelines A, B, C with lengths of 50m for: A – potato; B - peas, zucchini, eggplant, tomatoes and spinach; C - salad, onion, pepper, carrot, beans, cucumbers and other spices.

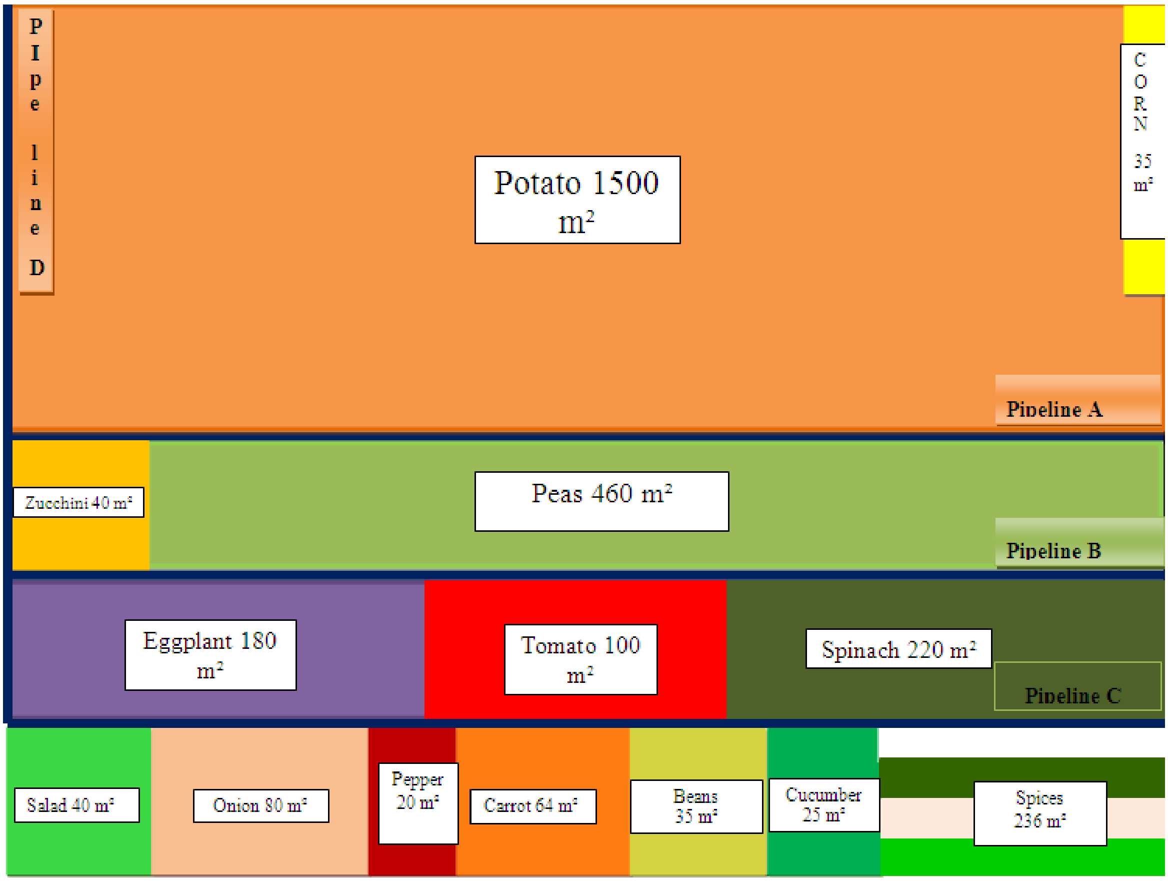

Figure 2.1. Pipelines layout and vegetable layers in the farm

Power for the 3 pipelines A, B and C, is made through the D water pipe with a length of 55 m and diameter of 55mm, which is connected to the water tank from the vicinity of the vegetable farm.

2.3.2. Hose sizing of vegetable layers

For potato rows, given the distance between two rows must be between 50 and 70 cm, and between nests along the line between 35-50cm, [13] for a surface of 1500m², with a length of 50 m and width of 30m, the number of rows (Nrp) is calculated using the formula:

Nrp = L/d = 50/0,5 = 100 rows (10), where, L = lenght of potato row – L = 50m; d = distance between two rows– select d= 0,5m;

Results a number of 3000m of hose, 100 connectors and 100 plugs, as shown in the micro-drip installation diagram, figure 2.2. The hoses diameter is adopted from the literature, for a flow of one l/h at a value of 10mm. The number of potato nests (Npn) will be calculated with the following formula:

*Npn = l/dn * Nrca = 30/0,5 * 100 = 6000 nests (11)*, where: dc – distance between nests; l – row width.

In similar ways are made calculations for the other rows of other vegetables and synthesis calculations are presented in table 2.5.

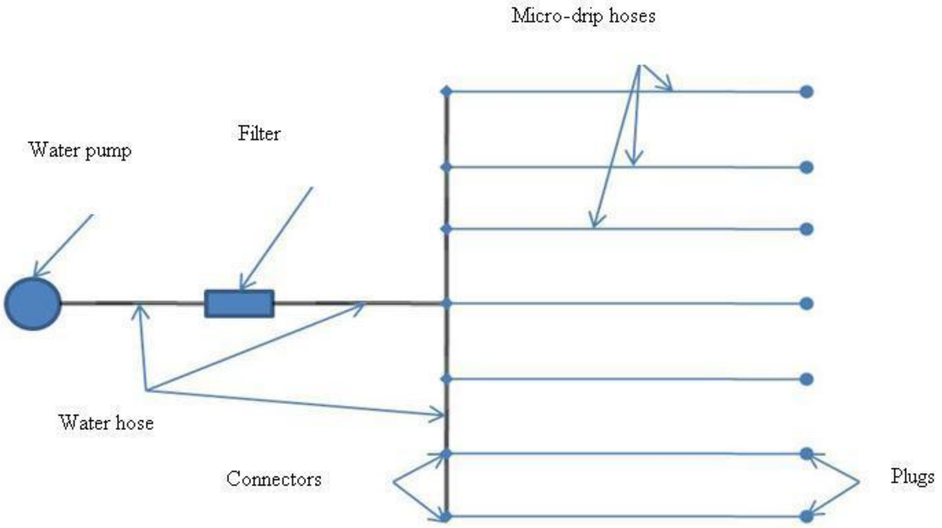

Figure 2.2. Micro-drip installation diagram [18]

Table 2.5. Irrigation accessories needed

Vegetables	**Plot surface** (m^2)	**The total length of used hose** (m)	**Connectors and Plugs** (pcs)
Potato	1500	3000	100
Peas	460	1530	153
Zucchini	40	40	4
Eggplant	180	300	30
Tomato	100	400	40
Spinach	220	1100	110
Salad	40	200	20
Onion	80	200	20
Pepper	20	50	5
Carrot	64	160	16
Beans	35	70	7
Cucumber	25	50	5
Spices	236	1180	118
TOTAL	**3000**	**8280**	**628**

2.4. Calculation of water supply pump

The water pump is chosen taking into account the pressure and the flow needed to supply. [4], [5], [18]. The pump debit is deducted from the maximum monthly consumption, which is in April, with an amount of 113,59 m^3 (Qm), resulting the daily water flow:

$Qm/30= 3,78\ m^3$ *(12)*, where: Qm- Monthly debit value.

The pressure required is calculated taking into account the maximum depth at which the pump can work well in the worst case of declining groundwater levels. In most cases the ground water is found at 20m depth, during dry periods can descend to a maximum depth of 25m. At this height it is added the distance between the ground and the upper part of the water basin, which is adopted to be equal to 5m. Drilling depth HD is 25m (drill height), HB is 5 m (basin height) and HT=25+5=30m (total height).

For the micro drip irrigation systems using photovoltaic energy, on market were imposed Lorentz series pumps with different pressure and flow characteristics. [19]. Given the parameters calculated above, the pump PS 200 is choosen, the LPP00028 model with the following technical characteritcs [17].

Table 2.6. Technical characteristics of pump PS 200 HR 204 (LPP00028) [20]

Characteristics, unit measure	Value	Presentation
Pumping capacity [m]	50	
Debit [m^3/h]	0,8	
Efficiency [%]	60	
Solar operation [VCC]	24	
Open circuit voltage [VCC]	100	
Solar energy source [Wp]	80-300	

Since the flow is 0.8m^3 per hour, results the minimum operating time equal with Qal/qp= 3,78/0,8= 4,7 h/day

2.4.1. Electronic pump controller

Lorentz pump model LPP00028 is acquired with:

Controller PS200, has the following characteristics: Electrical protection IP 54; 88% efficiency (motor and controller); Reverse polarity protection; Operating system MPPT (Maximum Power Point Tracking).

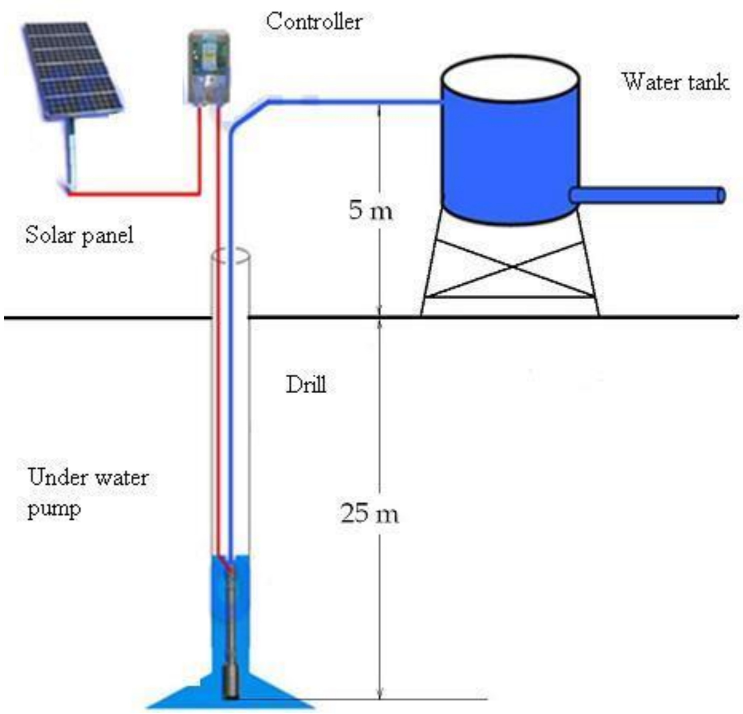

Figure 2.3. Diagram of solar pump type installation used for micro-drip irrigation

2.4.2. Solar panel selection

Given that the maximum height of the pumping flow needs an electrical power of 300W, there are selected 3 solar panels, polycrystalline photovoltaic, model ET-P636120-120W with the following characteristics:

Table. 2.7. ET-P636120-120WSolar panel characteristics [15]

Maximum power	120W
Voltage	24V
Cell number	36
Operating temperature	45,3°
Dimensions	156mm x 156mm

Total power delivered by the solar panels is 3x120W =360W, fulfilling the needs of pump consumption.

2.4.3. PV installation

In synthesis the micro-drip irrigation installation powered by a photovoltaic panel is composed from the components presented in table 2.8. The total investment of the installation including VAT is **8192,7 lei (1862 euro).**

Table 2.8. Value of inventory objects for the irrigation installation

No.	**Name**	**Required material** (pcs)	**Unit value** (lei/pcs)	**Total value** (lei)
A. Irrigation installations				
1.	Artery terminator	5	2	10
2.	Row terminator	628	0,5	314
3.	Timer	1	160	160
4.	Voltage stabilizer	1	150	150
5.	Water filter	2	40	80
6.	One way valve	2	25	50
7.	Water tank	3	500	500
8.	Tank support	3	100	300
9.	Valve for artery	5	9,72	48,6
10.	Connectors	650	0,56	176
11.	Curves	10	3,5	35
12.	Solar panel ET P636120-120W	3	1000	3000
Total A.				**5823,6**
B. Hoses		**m**	**lei/m**	**Total value**
13.	Hose for artery	255	0,26	58,5
14.	Hose for rows	8280	0,15	1242
Total B.				**1300,5**
Installation total value				**7124,1**
Transportation and installation expenses (15 % from installation value)				1068,6
Total value of irrigation installation under assembling				**8192,7**

Conclusions

1. The study on the concept of a micro-drip irrigation system of a vegetable farm, using solar photovoltaic energy, constitute a constructive approach, of efficient use of renewable energy, in the context of the global promotion of the GREEN ECONOMY concept.

2. Starting from an example menu typical for the studied geographic area, were calculated daily, monthly and annual vegetable needs for the pension kitchen.

3. From the existing irrigation systems the micro-drip method was selected because of its advantages (low water consumption, easy maintenance, reduction of the number of crop maintenance works), but also beacuse of the possibility of water supply through equipments like solar pumps.

4. Among the studied technical solutions it was selected the Lorentz type solar pump (with brushless motor and high efficiency), powerd by a nomber of 3 photovoltaic panels, with a total power of 360W. For carrying water up to the plant, there were studied different micro-drip systems; the most suitable for the agritouristic vegetable farm was the Gardena system, distributed through 3 pipelines to the entire vegetable farm surface.

5. Integrated analysis of the agritouristic pension concept with a vegetable farm shows the viability of the idea, sustainability of the micro-economic environment model and not least business profitability and positive social impacts.

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A survey of computer-based vision systems for automatic identification of plant species

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ABSTRACT

Plants are unavoidable for the existence of most living things on this planet. There are many needs of both humans and animals that are satisfied by materials from plants. These needs include food, shelter, and medicine. The ability to identify plants is highly important in several applications, including conservation of endangered plant species, rehabilitation of lands after mining activities and differentiating crop plants from weeds. This paper reviews several applications and works that have been made towards computer-based vision systems for automatic identification of plant species. It shows the various techniques alongside their descriptions. It portrays how future researchers in this field (especially precision agriculture or agricultural informatics) may move the knowledge domain forward.

1. Introduction

Traditional recognition of plant species is carried out by manual matching of the plant's features, relating to components of the plant, such as leaves, flowers, and bark, against an atlas (Meeta, 2012). Attempts to automate this process have been made, using features of plants extracted from images as input parameters to various classifier systems (Cope, 2011). Since plant leaves are often more available than the fruits and flowers, and because leaves are also mostly two-dimensional (2D) in shape, most of the existing work on computer-based plant recognition are based on the leaves of plants. This work examines existing systems of computer-based automated system for identification of plant species and various techniques used therein.

2. Leaf Characteristics in Manual Identification

The shape of a leaf is an important feature of plant development that depends on genetic, hormonal and environmental factors Weight (2008). The shape and structure of leaves often vary from species to species of plant depending on the adaptability to climatic conditions and as well as availability of light. A normal leaf of an angiosperm consists of a petiole (leaf stalk), a lamina (leaf blade), and stipules (small structures located to either side of the base of the petiole). According to Pat (2000), leaves can be categorized in many ways. For instance, a leaf can be classified as either broad or narrow. A broad leaf has a wide blade, having a visible vein alignment, as in the Northern Catalpa, shown in Figure 1(a). Slender leaves on the other hand have narrow, needle-like leaves, as with the Norway spruce, shown in Figure 1b. The full range of leaf categories documented by Pat (2000), is reproduced in Table1. Information about plants' nomenclature can be obtained from

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http://oregonstate.edu/dept/ldplants/Plant%20ID-Leaves.htm. Cope (2011) asserts that the most discriminative feature of a plant's leaf is its shape.

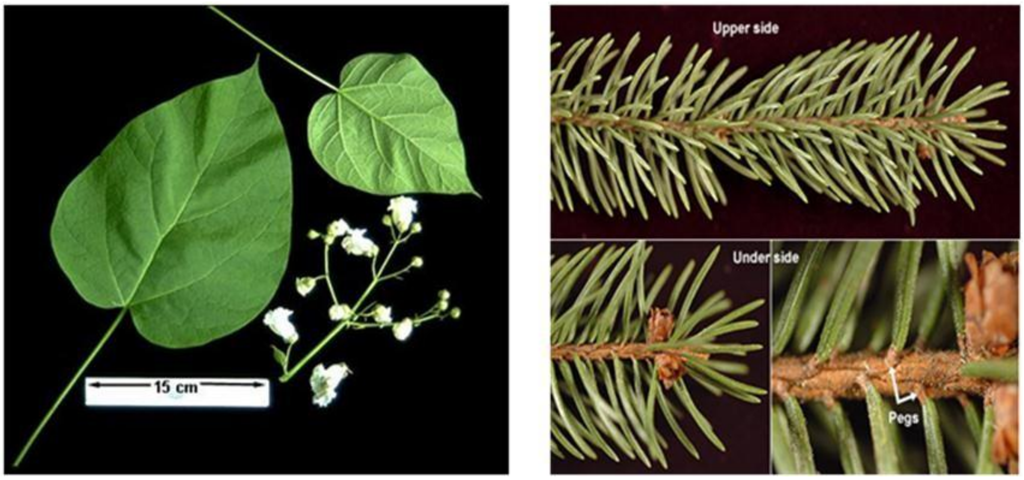

Figure 1. (a) Broad Leaf Image of Northern Catalpa (b) NarrowLeafImage of Norway spruce (Pat,2000)

Table 1. Categorizing Leaves by their shape and structure (Pat, 2000)

LeafType	**Definition**	**Example**
Broad	Leaf with wide blade,often with visible network of Veins.	Northern Catala
Alternate	Slender leaf without a wide blade.Oftencalledneedle orscale-like	NorwaySpruce
Opposite	Two leaves on the same stem but in opposite direction	CommonBoxwood
Whorled	More than two leaves from the same location onatwig	Red vein Enkianthus
Simple	Have only one blade divide dintoparts	White Alder
Compound	More than one blade and may have a complex leaf stalk Structure.	Paper-bark Maple
Palmate	Have three or more leavelets attached at the end of Stalk (petiole).	Horse chest nut
Pinnate	Have a number of leavlet attached along acentral stalk.	American Yellowood
Lobed	Have a curved or rounded projection.	Hedge Maple
Unlobed	Doesn't have any curved or rounded projection.	Western Catalpa
Entire	Have smooth edges or small notches or teeth along the Margin.	White Forsythia
Toothed	Have teeth at the base, at the tip,or along margin	Paper-bark Maple
Clusters	At least 5leaves together	Deoder Cedar

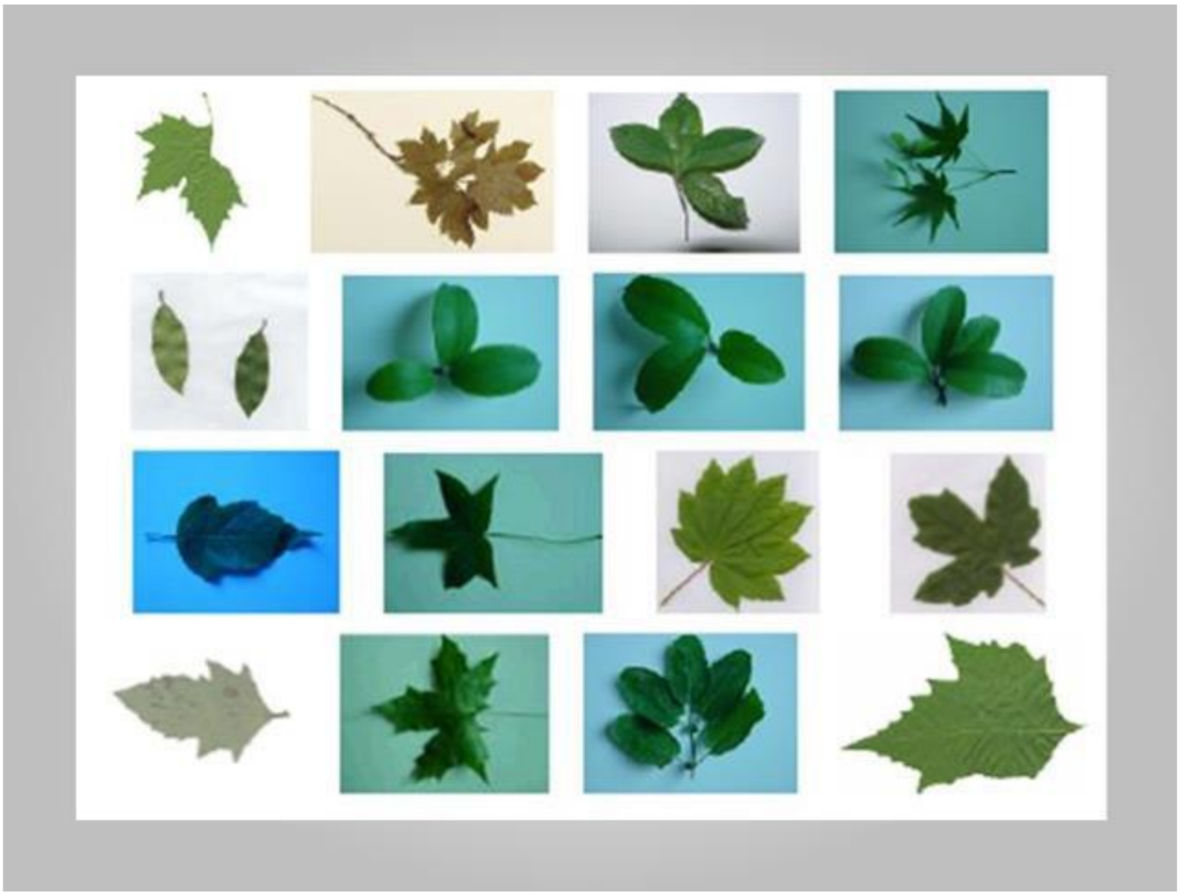

Figure 2. Some leaves with different shapes taken from (Ji-Xiang,2005)

Table 2. Geometric and Morphological Features of Leaves

S/N	Feature (Name)	Definition (Explanation)	Formula (Symbol)
1	Diameter	This is the longest distance between any two coordinates on the margin of a leaf. (Wu etal., 2007).	d
2	Physiological Length	This is the distance between the two terminals (apex and stalk point) (Russ, 2011; also see Figure 3)	l
3	Physiological Width	This is the perpendicular distance across the physiological length of a leaf (Wu etal., 2007; also see Figure 3)	w
4	Leaf Area	This is the total number of pixels that constitute an image.	$a = \int_x \int_y I(x, y)dxdy$
5	Aspect Ratio(A.R)	This is also called eccentricity and is defined as ratio between length of the leaf minor axis and the length of the leaf major axis (Abdul, Lukito, Adhi, & Santosa, 2012).	$\frac{w}{l}$
6	Circularity	This is a measure of similarity between a 2D shape is and a circle. It is the ratio between area of the leaf and the square of its perimeter (Russ, 2011)	$\frac{a}{p^2}$
7	Irregularity	This is the ratio between the radius of the maximum circle encompassing the region and the minimum circle that can be contained in the region (Kadir, 2011 and	$\frac{\max(\sqrt{(x_i - \bar{x})^2 + (y_i - \bar{y})^2})}{\min(\sqrt{(x_i - \bar{x})^2 + (y_i - \bar{y})^2})}$

		Nixon, 2002)	
8	Solidity	This is defined as the ratio between the area of the leaf and the area of its convex hull (Russ, 2011)	$\frac{a}{ConvexHullArea}$
9	Convexity	This is the ratio between the convex hull perimeter of the leaf and the perimeter of the leaf (Russ, 2011)	$\frac{ConvexPerimeter}{p}$
10	Form Factor	This feature describes the difference between a leaf and a circle (Wu, 2007)	$\frac{4\pi a}{p}$
11	Rectangularity	This describes the similarity between a leaf and a rectangle. (Russ, 2011).	$\frac{lw}{a}$
12	Narrow factor	This is the ratio of the diameter and length of the leaf. (Wu, 2007)	$\frac{d}{l}$
13	Perimeter ratio of diameter	This is the ratio of perimeter to diameter of the leaf (Russ, 2011)	$\frac{p}{d}$
14	Hydraulic radius	This is derived by dividing the leaf area by the leaf perimeter (Russ, 2011).	$\frac{a}{d}$
15	Perimeter ratio of physiological length and width	This feature is the ratio between the perimeter of a leaf and the sum of its physiological length and physiological width (Russ, 2011)	$\frac{p}{l+w}$

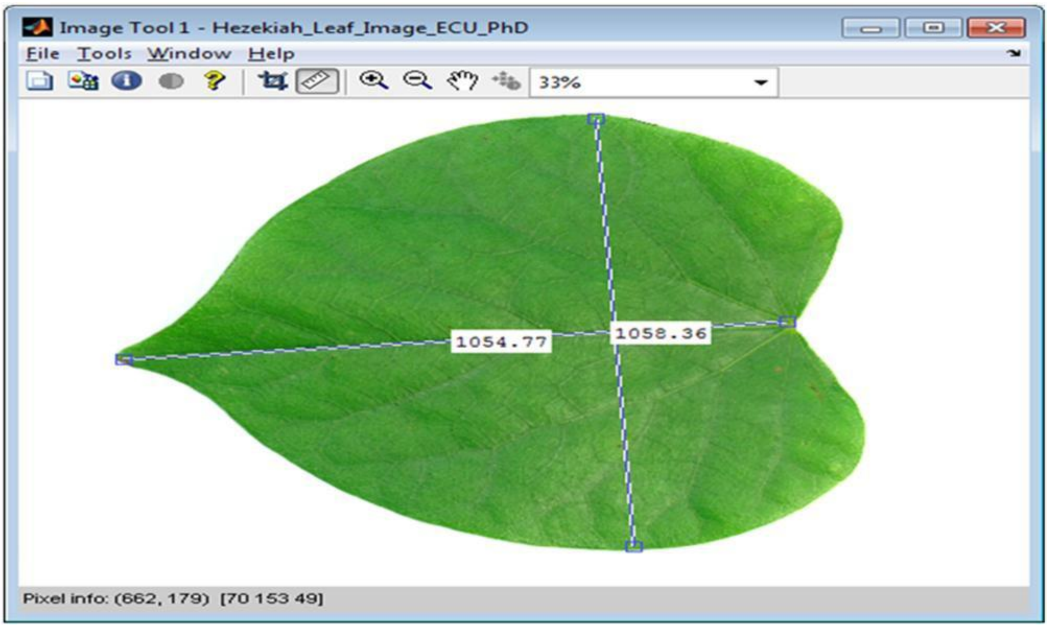

Figure 3. Image showing the length and width of a leaf's image

3. State of the art on computer-based plants leaves recognition systems

Several plant species recognition systems have been developed based on various features and classifiers. This section provides a summary of work reported in the literature, along with classification accuracy (where reported).

Zalikha et al. (2011) compared the effectiveness of Zernike Moment Invariant (ZMI), Legendre Moment Invariant (LMI), and Tchebichef Moment Invariant (TMI) as descriptor features of leaves. The data set consisted of images of 10 different plant species, with different sized leaves. Using grayscale conversion followed by thresholding, the images were converted into binary images, from which the descriptors could be derived. Scaling and rotation of the images was used to produce many variants of the images at different sizes and orientation. The incorporation of variant images allowed the system to be tested for rotation and scale invariance. A Generalized Regression Neural Network (GRNN) was used for the classification, with classification results showing that features from the TMI were the most effective.

Another similar work involving the use of moments as features was reported by Abdul (2012), where Zernike moments were combined with geometric features, color moments and gray-level co-occurrence matrices (GLCM). The classifier used was Probabilistic Neural Networks (PNN) while the Euclidean distance was used to measure the similarity index of the leaf of query (vector 1) to every leaf in the database (vector 2). The investigation showed that Zernike moment performs better when they are combined with other features in leaf classification systems. An optimum accuracy of 94.69% was reported by using Zernike moments of order 8.

Wu et al. (2007) also applied the PNN for plant leaf classification, attempting to differentiate between 32 different plants in Yangtze, China. Twelve features (geometrical and morphological) were used. These features were: diameter, length, width, area, perimeter, smooth factor, aspect ratio, form factor, rectangularity, narrow factor, perimeter to diameter ratio, and length to width ratio. Principal Component Analysis (PCA) was used to reduce the feature vector to 5 principal components. In this project, called the Flavia project, the classifier (PNN) was trained using 1800 leaves. Ten leaves sample were taken from each plant, implying that the test data set contained 320 leaves. The average accuracy was recorded to be 90.312%.

In a study carried out by Sandeep (2012), leaf color, area and edge features were used for identification of Indian medicinal plants (Hibiscus, Betle, Ocimum, Murraya, Leucas, Vinca, Ruta, Centella, Mentha). The method in this work involves reading the test image and comparing with the database images. The images were segmented through grayscale conversion followed by binarization via thresholding and comparison of edge histogram, colour histogram, and difference in area of test and database image were carried out between a candidate image and those in the database. The candidate image was classified based on the class of images stored in a database using Euclidean distance. Results showed all the plants were correctly classified except Tulsi menthe species which was wrongly identified as mint ocimum and vice-versa due to similarities in leaves veination.

Jyotismita and Ranjan (2011) combined a thresholding method with H-Maxima transformation Gonzalez (2007) to extract veins of 180 leaves taken from a website source Jyotismita (2011). The data set was divided into three classes, Pittosporum Tobira, Betula Pendula and Cercis Siliquastrum, each consisting of 60 images. Moment-Invariants (Geometric Moments) and centroid-radii approaches were then used to extract features needed for classification. The first four normalized central moments M1, M2, M3,M4 of each image of the trained and test datasets were computed and individual features from (any of M1, M2, M3, M4) and (combinations of features from M1, M2, M3, M4) were fed into multilayer perceptron (MLP) to find the best combinations. The 180 dataset was divided into two parts where 90 images were used as training dataset (T) and the remaining 90 images as the test dataset (S). For the computation of recognition rates, comparisons between training and test datasets were done using a MLP with feed-forward back-propagation architecture which gave Mean Squared Error (MSE) of 0.005 and reached convergence in 38280 epochs. The results showed that individual moment values M1 provided the best results of 88.9%. The feature combinations M1-M3 and M1-M3-M4 provided classification results of 95.5% and 93.3% respectively.

Chomtip, Supolgaj, Piyawan, and Chutpong (2011) developed the Thai Herb Leaf Image Recognition System (THLIRS) using k-Nearest Neighbor (k-NN) as the classifier. A digital camera was first used to take the pictures of leaves, together with a one-baht coin as a size gage, against a white background. The second phase in THLIRS involved image pre-processing and segmentation (resizing, black-and-white conversion (grayscale conversion followed by thresholding), image enhancement, juxtaposition of photographed images of leaf and one-baht coin for the purpose of comparison, cropping of leaf image, and boundary tracking). The discriminative measure in the leaf-coin images on the background is that the leaf's image was assumed to be the largest object in the image, while the coin is the second largest object in the same image. In the third stage, 13 features (leaf and coin ratio, aspect ratio, roundness, ripples counting, ripples pixels counting, half-leaf area ratio, upper leaf area ratio, lower leaf area ratio, colour features, vein features (at threshold of 0.05, 0.03, and 0.01 respectively) were extracted. The dataset in THLIRS was divided into training and testing data. With a value k = 6 in the k-NN classifier, THLIRS achieved classification accuracy of 93.29%, 5.18%, and 1.53% for match, mismatch, and unknown, respectively for the training dataset, while that of test dataset was 0%, 23.33%, and 76.67% for match, mismatch, and unknown, respectively.

The work of Kadir (2011) involved the use of the Polar Fourier Transform (PFT) and three geometric features to represent shapes of leaves. Color moments consisting of the mean, standard deviation, and skewness were computed to represent color features. Texture features were also extracted from Grey-Level Co-occurrence Matrix (GLCM) by counting the co-occurrence pixels with grey value i and j at the given Euclidean distance. The classifier scheme used was Probabilistic Neural Networks (PNN). In testing this system, two dataset (Foliage and Flavia, were used in comparing the proposed method with the work of Wu (2007). The overall classification result was stated by the author to be 94.687%.

A hybrid approach involving a combination of Wavelet Transform (WT) and Gaussian Interpolation was proposed together with k-NN and Radial Basis Probabilistic Neural Network (RBPNN) for leaves recognition by Xiao (2005). Following image acquisition, the image was converted to greyscale and decomposed by the WT. The essence of decomposition by WT and Gaussian Interpolation was to produce low-resolution images and a series of detailed images. The wavelet features extracted by WT and Gaussian Interpolation were then used to train the k-NN and RBPNN for classification. The reported accuracy in this work was 95%.

A fuzzy selection technique based on morphological features was used in Panagiotis (2005). After the image capture and image preprocessing, a parameterized thresholding depending on the lighting conditions was performed, followed by calculation of the centre of gravity of the leaf's image. Next, the image of the leaf is rotated to have vertical orientation. Morphological and geometrical features such as diameter, length, width, perimeter, area, aspect ratio, smooth factor, form factor, rectangularity, narrow factor, perimeter to diameter ratio, length to width ratio, and vein features were then computed. A fuzzy surface model was finally used to select images from feature database before they were fed into the RBPNN for classification. It was found that the proposed system was able to correctly classifying even deformed leaves. This paper did not state the actual quantified classification results.

Rashad (2011) used a combined classifier consisting of learning vector Quantization (LVQ) and Radial Basis Function (RBF) for plant classification based on the characterization of texture properties. A digital camera was used to capture plant's images at 128 × 128 resolution. The acquired RGB images were then converted into grayscale images. Texture features were extracted from the grayscale images and using random sample of 30 blocks of each texture as a training set, and another 30 blocks as a test dataset, it was shown that the combined classifier method outperformed other methods (PCA, k-NN, RBPNN), with the least MSE and accuracy of 98.7%.

Belhumeur (2008) developed a working computer vision system for identification of plant species. The e-botany (database of leaves) was made from (a) the flora of Plummers Island containing 5,013 leaves of 157 species, (b) Woody Plants of Baltimore-Washington DC containing 7,481 leaves of 245 species, and (c) Trees of Central Park containing 4,320 leaves of 144 species. From this collection all the images were cropped and later converted to binary images through grayscale conversion followed by thresholding. Shape distances were computed from the binary images using chi-square, while shape matching (classification) was done via Inner Distance Shape Context (IDSC). The purpose of IDSC was to retrieve coordinates of the boundaries of a shape, and establish a 2D histogram at each point. This histogram is a function of the distance and the angle from each point to all other points along restricted path lying entirely inside the leaf shape. The classification accuracy reported by the authors was 85.1%.

A system called the LeafSnap was developed by Kumar et al. (2011) for identifying tree species using the photographed images of their leaves (see Figure 4). The image database consists of 5972 images taken from 184 trees in the North eastern United States. There were no needs for any color-to-grayscale conversion in this work since color segmentation was used by estimating foreground and background color distributions. The segmentation problem was solved using Expectation-Maximization (EM). The images were then resized into 300 x 400 and rotated by 90 degrees. After this, the histograms of curvatures along the contour of the leaves at multiple scales were extracted from the images of the leaves and finally, species matching was performed through 1-nearest neighbor classification. The classification accuracy as reported in this paper was 96.8%. Being a web-based application, the backend server is a 2quadcore processors Intel Xeon machine with configuration of 2:33 Ghz speed and 16 GB of RAM. The recognition engine of the LeafSnap consists of a backend server which accepts input images from various front-end clients. There is currently, a front-end application of LeafSnap for the iPhone and iPad devices.

Andreas (2010) developed LEAFPROCESSOR- a software package which provides a semi-automatic and landmark-free method for the analysis of a range of leaf-shape parameters, combining both single metrics and PCA. Bending energy was employed as a tool for the analysis of global and local leaf perimeter deformation. The bending energy is a descriptor that provides a global measure of the curvature of the leaf perimeter and it's obtained via integration of the square of the contour's curvature along the perimeter.

Gebhardt (2006) developed a digital image processing system for Identification of broad-leaved dock (Rumex obtusifolius L.) on grassland. The authors of this study focussed on the identification of one of the most invasive and persistent weed species on European grassland. The total image samples used were 108 digital photographs obtained through a field experiment under constrained environment (i.e constant recording geometry and illumination conditions). Image segmentation in this work was done through transformation of the {R,G,B} components of the colored images to grayscale images. Binary images were then derived from the grayscale images by applying local homogeneity threshold of value 0.97. Following this, morphological opening was performed. The features extracted were shape, color and texture-based. The learning system was based on maximum-likelihood estimation (MLE) . Furthermore, rank analysis was used for feature analysis to obtain optimal classification accuracy. The accuracy x reported with the given training set was in the range $71 \le x \le 95$.

Babatunde (2014) developed a computer-based vision system based on genetic probabilistic neural networks (PNN) and cellular neural networks (CNN). The approach in this work was **Image acquisition** $\rightarrow$ **Image pre-processing** $\rightarrow$ **Image segmentation** $\rightarrow$ **Feature extraction** $\rightarrow$ **Feature selection**. The parameter of the underlying machine model (PNN) was optimized using genetic algorithm (GA) for performance improvement. The overall results shows that the combination of GA, PNN and CNN is good for building computer-based vision systems. The screen shot for this work is given in Figure 4.

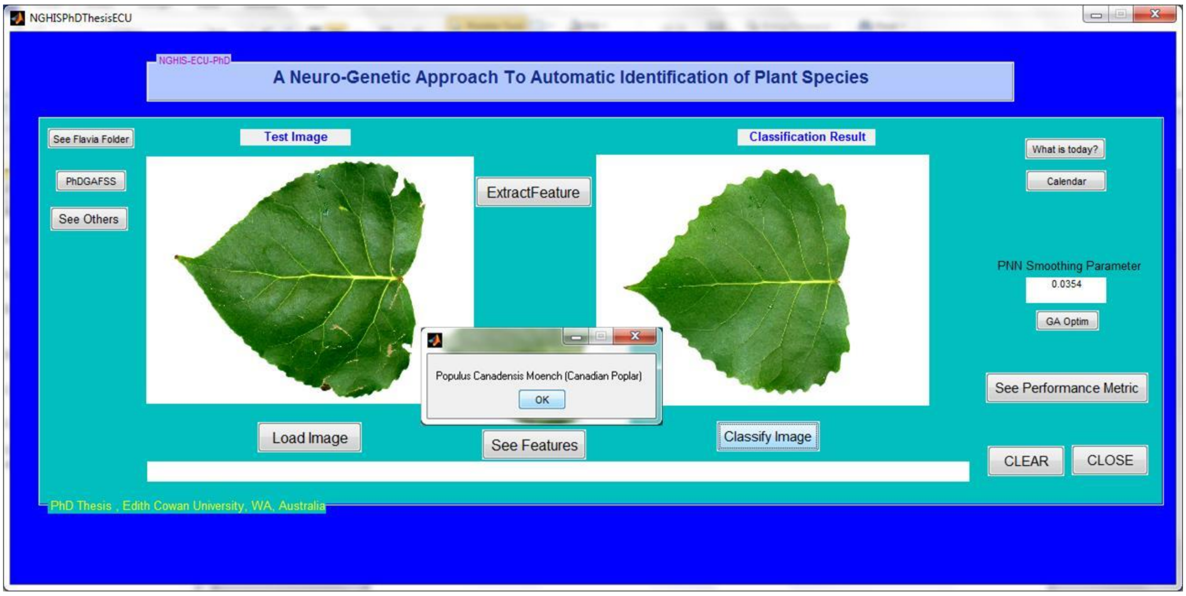

Figure 4. Plant Species classification system using Probabilistic Neural Networks and Genetic Algorithm (Babatunde, 2014)

Figure 5. An iPhone version of the Leafsnap project (Kumar,et al., 2011)

Table 3. Some existing and recent works on plant recognition systems

Author(s)	Techniques	Features
Jyotismita and Ranjan (2011)	Moment Invariants, Centroid-Radii, Neural Network,Image Pre-Processing	Leaf image moments
Zalikha, Puteh, Itaza, and Mohtar (2011)	Image Pre-Processing, Moment Invariants, General Regression Neural Network.	Leaf image moments
David, James, and Mathew (2012).	Aspect Ratio, Rectangularity, Convex Area Ratio, Convex Parameter Ratio, Sphericity, Circularity, Eccentricity, FormFactor, Regional Moments Inertia, Angle Code Histogram.	Geometric features
Wu(2007)	Probabilistic Neural Network (PNN), Image Pre-Processing, Principal Component Analysis (PCA).	Geometric features
Chomtip,Supolgaj, Piyawan, and Chutpong (2011)	K-nearest neighbor (k-NN),Image pre-Processing, Aspect ratio, Roundness, Ripples features, Half-leaf Area Ratio, Upper Leaf AreaRatio, Lower Leaf Area Ratio, Colour Features, Vein Features,Threshold.	Geometric features
Panagiotis (2005)	Fuzzy Logic Selection, Neural Networks, Image pre-processing, Principal Component Analysis	Geometric features
Valliammal and Geetha-Lakshmi (2011)	Fuzzy Segmentation, Image Pre-Processing, Wavelet Transformation	Leaf image moments
Jyotismita and Ranjan (2011)	Thresholding method, H-Maxima transfor-mation, Moment-Invariants, Centroid-Radii and Neural Networks classifiers.	Leaf image moments
Xiaoetal.(2005)	Image Segmentation, Wavelet Trans-form, Gaussian Interpolation, K-Nearest Neighbor (K-NN), Radial Basis Proba- bilistic Neural Networks.	Geometric Features, Leaf image moments.
Ji-Xiangetal(2005)	Douglas-PeukerAlgorithm (Shape Polygonal Approximation, Invariant Attributes), Genetic Algorithm, kNN.	Leaf image moments
Wang, Chi, and Feng (2003)	Centroid-Contour Distance (CCD) curve, Ec centricity and Angle Code histogram (ACH).	Geometric Features
Sandeep and Parveen (2012)	Color metrics, edge histogram computation, ImagePre-Processing	Colour moments
Yi-Tou.etal(2009)	Rotational Invariant Methods, Grey Level Co-occurrence Matrices (GLCM).	Image Features, Leaf image moments
Marzuki, Yusof, Anis, andMohd (2011)	Basic Grey Level Aura Matrix (BGLAM) tech-Nique and Statisitical Properties of pores dis-tribution (SPPD) for wood features.	Colour moments
Arora, Gupta, Bagmar, Mishra,and Bhattacharya (2012)	Image pre-processing(shadow,background correction,binarization),petioleremoval,El-lipsebasedBlobRanking,GrabCutleafseg-mentation,RandomForestClassifier	Tooth Features and Morpholog ical features as found in (Wu et al.,2007)
Belhumeur & David (2008)	Inner Distance Shape Context (IDSC),KNN, Color image segmentation.	Shape features

4. Discussion and conclusion

Various techniques used by researchers developing computer-based vision systems have been examined. In all the works examined, most authors considered the images of plant leaves for building their systems. The rational for this is due to the availability of leaves in most part of the year and images of leaves are also easy to handle being mostly 2D images. However, in all the works mentioned in this paper and in Table 3, some limitations such as low discriminating power between some crop plants and weeds, rejection of variability within the same species and acceptance of variability between different species of plants, extraction of complex features such as a leaf having different colour at the back and at the front, coupled with the need for improved classification speed and accuracy, are still the major challenges facing them. There is no hard and fast rule on how to choose the best of these existing works but nevertheless, the works identified by Figures 3 and 4 are very good choice as the classifier involved in one of these work was genetically optimized. Future works lies in the application of hybrid techniques and amalgamation of various parts of plants to narrow down error in classification as some plants from different species are similar and some from the same species are different. With the inclusion of several parts of the plants in one system and the use of more discriminating classifiers, the knowledge in this domain may move forward.

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Information Flow along Catfish Marketing Channels in Nigeria: Whither the Role of Mobile Telephony?

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A B S T R A C T

The objectives of this study were two-folds. First, examined the use of mobile phone technology to facilitate catfish marketing and second, identified the determinants of variations in the frequency of mobile phone use for catfish marketing among agents involved in the marketing chain. The study was carried out in Kwara-state, Nigeria. One hundred and forty respondents were stratified and randomly sampled and data was collected through the use of well-designed questionnaires. Descriptive and Poisson regression model were used to analyze the data. The study identified the use of mobile phone along five communication channels used for catfish marketing. Annual income generated from catfish business was significant in explaining variations observed in the frequency of mobile phone use ($p<0.05$). Findings imply that use of mobile phones can assist in the commercialization process of the catfish marketing and may help to forestall possible market failure. The study recommends the need for policymakers and the private sector to facilitate means of enabling access to mobile use. Furthermore, similar study can be conducted in the rural areas to ascertain specific determinants of mobile phone uses for agricultural marketing in the less urban areas.

1. Introduction

Despite the ups and downs, aquaculture continues to grow at an increasing rate and it is one of the fastest growing food sectors in the world. In Africa, aquaculture production is less impressive. In 2008, total aquaculture production in Africa was 1.71% of world production out of which Egypt alone accounted for 73% (FAO Fishstat, 2008). Nigeria is the second largest aquaculture producer in Africa with farmed catfish accounted for approximately 90 percent of Nigeria's domestic annual fish production (Cat Fish Supply Chain, 2008). Over the years, Nigeria has witnessed a steady rise in the demand for domestic catfish. This may be due to rise in average incomes and increasing taste and preferences for white meat. To satisfy this demand, Nigeria has become one of the largest importers of fish in the developing world, bringing in some 600,000 metric tonnes (MT) annually (Hempel, 2010). Furthermore, aquaculture and farm-raised catfish have been identified as a growing source of income for farmers in Nigeria. As shown by Hempel, Nigerian catfish industry provides approximately US$75 million in revenues at the farm gate and accounts for nearly US$180 million in consumer spending. The sector equally contributes to the employment of nearly 25,000 people, with the majority (over two-thirds) employed as restaurant workers (Hempel, 2010).

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Despite these encouragements, Nigerian catfish farmers indicate that the marketing of fresh catfish is among other things fraught with information asymmetry among the major actors in the enterprise (Catfish Supply Chain Program, 2008). In some cases, primary wholesalers in the enterprise have been noted to shield their sources of supply from secondary wholesalers and retailers. Furthermore, in some locations, retailers feel that they have to pay higher prices than necessary because they are unable to buy direct, or at least need better information about the selling prices at the farm.

However, with the increased subscription to mobile telephony use among Nigerian agricultural households, concerns about the telephony-divide have shifted from physical access to imbalances in its effective use for information and communication particularly within the multi-faceted context of agricultural value chain (Zhang et al., 2010). This is relevant because getting the right information, when and where needed, in a language understood and can be easily accessed are recognized as vital to the success of the agricultural sector as the right type of soil, adequate water, sunlight and any other input. Integration into the value chain therefore, poses an increasing challenge to resource-poor producers when asymmetries occur in access to information among stakeholders (Animashaun et al., 2014).

These salient but critical features underscore the rationale for considering the existing role of mobile telephony subscription to catfish marketing analysis. To empirically account for these, this study examined how the use and access to mobile phone for catfish farming activities enhances small-scale catfish actors' marketing activities in Kwara state, Nigeria.

Specifically this study

- mapped out the communication linkages available *via* mobile telephony for catfish marketing; and
- examined the determinants of frequency of mobile phone use for catfish marketing activities.

This study is important in informing better investment decisions on infrastructure provision to agricultural actors at both ends of the supply chain—the small scale producers and consumers.

2. Conceptual Framework and Literature review

Conceptually, the social network theory could contribute to a better understanding of the role of social networks in the value chain approach: the concept of embeddedness and the development of innovation through networking. The idea of embeddedness argues that the performance of either an individual or an organization depends on how that actor is tied into a larger web of social connections. Hence, it stresses that economic relationships cannot be easily separated from social ties Granovetter (1973). The concept of embeddedness is closely associated with Granovetter's concept of 'weak ties': weak ties are more likely to link members of different small groups than are strong ones, as: *those to whom we are weakly tied are more likely to move in circles different from our own and will thus have access to information different from that which we receive*. (Granovetter 1985).Weak ties are more likely to diffuse information and traverse social distances than strong ones. They can act as a bridge, connecting two points of a network by providing the only path between them (Granovetter 1973).

A lot of studies conducted at different times have corroborated this concept. Better communication via mobile networks leads to a reduction in the frequency of journeys and the time and expense afforded to travel, with an additional key benefit of enhancing the ability of poor communities to respond more quickly to emergencies (Mutu and Yamano, 2009; Aker, 2008; Jensen, 2007; Overa, 2006; Animashaun et al., 2012). Sife *et al* (2010) reports that four fifths of a sample of households in Morogoro, Tanzania experienced improved or greatly improved efficiencies in the conduct of social and productive activities, due to mobile phones, particularly when the costs associated with communication over large geographical distances were reduced. Peer-reviewed studies have pointed towards greater efficiencies in information search (De Silva, 2008) and in the coordination of multi-level local activities in agricultural value chains that are geographically extensive and organizationally complex (Overa, 2006). This study adopts the approaches of previous studies but differs in the choice of its area of study.

3. Methodology

The study was conducted in Kwara State, Nigeria. The study area has established small-scale culture catfish and several outlets exist for catfish marketing. Ilorin town was selected for the survey because it is the capital city of the study area and as such is a cosmopolitan with higher records of mobile phone subscription.

A 2-stage sampling technique was adopted for this study. The first stage involved the stratification of the active agents involved catfish marketing. A stratified sample of small-scale farmers, wholesalers, retailers and small-scale processors were sampled. The second stage involved a probability to proportional sampling technique relative to the population in each stratum. A breakdown indicates that approximately; 70 small-scale catfish farmers, 10 catfish wholesalers, 30 retailers and 20 processors in catfish enterprise were sampled for the study. On the aggregate, a total of 130 respondents were sampled. The data were collected through personal interviews around the months of March-May, 2012 using a pre-tested questionnaire. Data collected included respondents' socio-economic characteristics, farm-specific characteristics and marketing activities.

3.1 Analytical and Empirical Strategy

This study employed descriptive statistics, flow chart analysis, matrix analysis and the Poisson regression model for analyzing the study objectives.

The frequency of mobile phone use by respondents for catfish transactions in this study refers to the number of calls made and received by a respondent for catfish transaction purposes. They include calls made to and those received among producer, retailer, and wholesaler for marketing catfish purpose. The number of calls made assumes a non-negative integer values of discrete nature and are non-normal and hence are well estimated with the Poisson Regression Model (PRM) Winkelmann and Zimmermann, (1995) Greene (2008) Kirui, et al., 2010; Animashaun *et al.*, 2012 PRM density function is given by 2008; Wooldridge, 2002):

$$F(yi/xi) = \frac{e^{-\lambda(x)}\lambda i\ (x)^{(y)}}{\Gamma(1+yi)} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots(1)$$

Where $\lambda i = \exp(\alpha + X'\beta)$ and $yi = 0,1,\ldots$, i is the number calls made or received with respect to catfish marketing by the respondents; X = a vector of predictor variables.

Following Wooldridge (2002) and Greene (2003; 2008) the expected number of the events, yi per period is given as:

$$E(yi/xi) = \text{var}[yi/xi] = \lambda = \exp(\alpha + X'\beta) \quad \ldots\ldots\ldots\ldots\ldots(2)$$

for i = 1,2,….,m

The specific implicit functional form of the model estimated to examine the determinants of frequency of use of the mobile phone for catfish transaction is given as; Number of calls by the *ith* respondent = f (age, literacy, gender, occupation, fare to market, presence of electricity, presence of telephone operator service, log of income from catfish enterprise literacy, log of farming experience, own phone, group membership, dummy for role of respondent in the channel) + e

4. Results and Discussion

4.1 Respondents' socio-economic characteristics are defined in Table 1.

Table 1. Socio-economic Distribution of Respondents

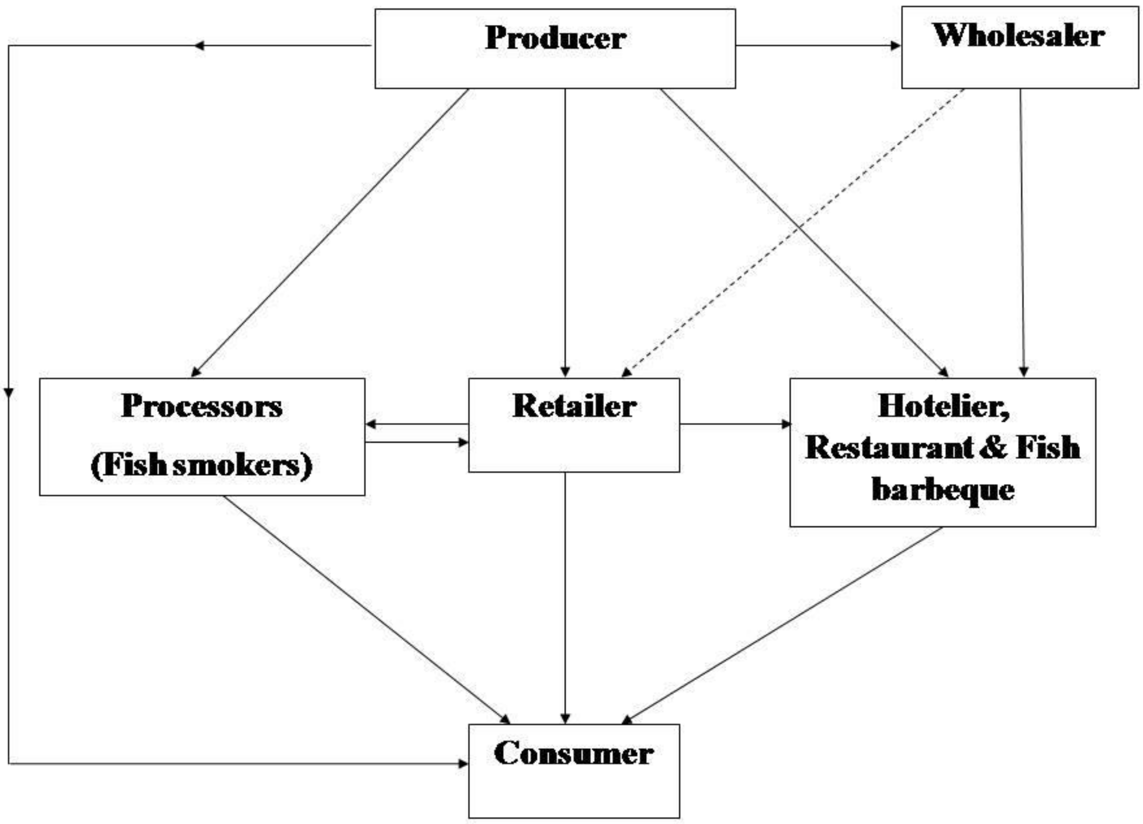
Respondent's strata	Sex		Membership of registered association		Literacy		Mean Experience (Std error)	Mean Income (Naira)	Mean calls made per week (std error)
	Male (%)	Female (%)	Yes (%)	No (%)	Literate (%)	Non (%)			
Producers (n=70)	94.2	5.8	50	50	100	0	7.8(1.05)	1,660,478	11.2 (0.91)
Wholesaler (n=10)	100	0	70	30	100	0	5.1(0.27)	1,840,000	13.8(1.95)
Fish Processors (n=10)	90	10	30	70	100	0	5(0.74)	1,294,500	13.9(1.86)
Retailer (n=30)	90	10	60	40	66.7	33.3	5.6(0.6)	1,444,330	11.4(1.06)
Hotelier/barbecues (n=10)	80	20	30	70	90	10	5.6(1)	750,873	9.5(1.7)

Source: Field survey

As revealed in Table 1, male appears to be the dominate gender of the actors involved in the catfish market chain in the study area. This may be specifically due to the nature of the venture or as a result of socio-cultural stereotype that predominate in the study area. The literate level was high for virtually all actors except for the retailers where 33% could not read and write. Average total income from catfish venture was highest for the wholesalers followed by the producers and the retailers respectively. This may be due to variation in the quantity of sale turnout and as expected, wholesalers may have a higher share of sales given their size of operation. Mean phone call with respect to catfish marketing was highest fish processors closely followed wholesalers.

4.2 Communication Patterns Established *via* Mobile Telephone among Agents for Catfish Marketing

The communication channels via mobile phone used for catfish marketing is presented in Figure 1.



Source: Field survey, 2012

Figure 1. Schematic chart of the communication channels employed for catfish marketing in the study area.

The study information identified the communication channels used for catfish marketing. From these results it was observed that market information flowed from producers to consumers through five different but interconnected linkages.
Specifically, the identified categories can be summarized as follows:

1. Producers ⟶ Consumers (Channel 1)

In this category, the study identified a direct communication linkage between the producers and consumers for the sales of catfish. Catfish is usually sold at farm gate while in some instances, consumer can make a phone call and request for house delivery of live catfish from the producers.

2. Producers ⟶ small-scale processors ⟶ local retailers

The study equally observed that a communication linkage exist through the use of mobile phone among the producers, small-scale processors (fish smokers and driers) and the final consumers. In some instances, small-scale processors would request about the availability of catfish and negotiate on the sizes and quantity requested as well as the location of the fish farm from the producers. The processors may equally be the market retailers or contact, through mobile phone, a market retailer who would eventually sell it to the final consumer.

3. Producers → Retailers → Consumers

The third identified channel exists between the retailers and the producers for the purchase of catfish. The study identified that retailers make negotiation with producers with respect to the availability, sizes and pricing of catfish before making the eventual contact for purchase.

4. Producers (Retailers) → Hoteliers, Fish Barbeques → Spot Consumers

The fourth communication channel used was identified between the agents engaged production and retailing and agents engaged in the food processing sector like hoteliers and fish barbecue spots. Fish barbecue spots are springing up rapidly in the study area. This may be due to the increasing population size, raising income and taste and preference of consumers. The hoteliers and fish barbecues operate on a relatively low but consistent demand for catfish which they source from producers and on other occasions from the retailers to meet up with consumers demand. The hoteliers in some instances buy large quantities of catfish stock from the producers and keep them in a make-shift pond to be killed as the need arises. The hotel and restaurant operators expressed that during dry season when catfish supply is relatively low; they usually buy at retail prices from the retail outlets across the study area.

5. Producers → Wholesalers → Retailers → consumers

Finally, the study observed a communication channel via mobile phone for marketing purpose between the wholesalers and the producers on one leg and between the retailers and wholesalers on the other hand. The wholesalers buy catfish in bulk from several small-scale catfish farmers and distribute within and outside the study area. In other to meet up with the demand, wholesalers make contact with the farmers ahead to fix a time for ascertaining the sizes and quantities of catfish available. The wholesale usually sell to retailers and processors within and outside the study area.

4.3 Determinants of Frequency of Mobile Phone use for Catfish Marketing

The result of the determinants of variation in the number of phone calls made and received per week with respect to catfish marketing is presented in Table 2

Table 2. Socio-economic Determinants of Frequency of Phone Calls

Independent variables	**Coef.**	**Std. Err.**	**Z**	**P>z**	**[95% Conf.**	**Interval]**
Sex	-0.0471593	0.2223803	-0.21	0.832	-0.4830166	0.388698
Experience	0.0088267	0.0073771	1.2	0.232	-0.0056322	0.0232856
Marital status	0.0785888	0.1032566	0.76	0.447	-0.1237904	0.2809681
Catfish as major Income source	0.0289579	0.1001942	0.29	0.773	-0.1674191	0.2253348
Catfish Annual Income	3.34E-08	1.64E-08	2.04	0.042**	1.23E-09	6.55E-08
Membership of association	0.0000275	0.0000381	0.72	0.47	-0.0000472	0.0001022
Constant	2.185537	0.2608302	8.38	0.00***	1.674319	2.696755
Goodness-of- fit (Chi^2)=161.8 Prob>chi2(40)=0.00 Log-likelihood=-189.28525						

Source: Field survey

The results of the Poisson regression model parameters indicate the goodness of fit of the model (Chi^2=161.8 df(40); p=0.00) in explaining the variations in the number of phone calls made by the respondents. Furthermore, the Poisson regression model estimated identified that of all the hypothesized factors, only the annual income gotten from catfish marketing was the only significant variable responsible for the variations ($p<0.05$), all other factors held constant. These findings indicate that agents with higher revenue from catfish enterprise make more phone calls.

The significance of these findings is that mobile phone use is required for facilitating commercialization of catfish industries enterprise in the study area.

5. Conclusion and Recommendation

This study examined the communication channels employed for catfish marketing and the determinants of variations in the frequency of mobile phone use for catfish marketing among the agents involved in the marketing chain. Descriptive and Poisson regression model were used to analyze the data.

The study identified five communication channels used for catfish marketing and underscored the importance of high income generated from catfish farming activity as a significant determinant responsible for the variations in the frequency of mobile phone use for catfish marketing in the study area. The implication of these findings is that use of mobile phones can assist in the commercialization process of the catfish marketing and will help to forestall possible market failure as a result of the perishability nature of the catfish product.

In view of these, this study recommends the need for policymakers and the private sector to facilitate means of enabling access to mobile use. Furthermore, similar study can be conducted in the rural areas to ascertain specific determinants of mobile phone uses for agricultural marketing in the less urban areas.

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e-Learning and the aspect of students in forestry and environmental studies

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A B S T R A C T

The new information technologies (ICTs) and the services they provide, are tools that can transport data with high speed and allow the diffusing of vast amount of knowledge and information, in order to lay the groundwork to redefine a new improved relationship between person and environment with benefits that are important for both recipients. The need for a sustainable natural environment, based on sustainable facts, has led to the resurgence and support of systems such as agroforestry, whose services are vital to the life of modern man. This work will therefore focus on a presentation of modern technology and tools of e-learning, describes the current situation in the European Union and Greece, but also examine the need for the participation of these tools in agriculture and forestry courses, particularly those of agroforestry systems and the aspects of students in forestry and environmental studies. For that reason, finally presents results from a survey that took place amongst students of Faculty of Forestry and Natural Environment.

1. Introduction

New technologies have significantly entered our lives and online services offer the opportunity for sustainable regional development. Electronic services offered by the new Information and Communication Technologies (ICT's), have proved an important tool in efforts to disseminate e-learning in modern education. The technological background is excellent, while broadband networks provide quality communication and have ever increasing inflitration rates in our country. E-Learning is a very broad term covering anything relating to the use of modern technologies in education, whether implemented online, offline or a combination of both (Black, 2002; Koutroumanidis & Andreopoulou, 2009) The concept of e-learning is quite general and includes any form of education using network resources or general capabilities of computers and education by distance. The e-learning courses can be categorized into synchronous and asynchronous depending on whether the students participate actively and in real-time or not. (Andreopoulou, Arabatzis, Koutroumanidis, & Manos, 2006). E-learning may therefore be a tool for direct transmission of knowledge, without spatial limitations, knowledge that is needed to formulate the philosophy towards all crises which follow one another in the early 21st century. No progress in the new Information and Communication Technologies (ICT's) would matter if there wasn't a specific application, with impact on society and on important aspects of human activities. Specifically, the comprehension and the total quality management of the environment is very important, with people learning about the natural environment and following practices which will lead to co-existence with it by pursuing sustainable development.

The agroforestry systems are a form of natural ecosystems multicultivation, which are fully exploiting the available natural resources, as of light, space, water and nutrients. The agroforestry, i.e. the intentional mixing of trees with crops and/or animal farming, is the key component of food and

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energy security in an unpredictable world affected by climate change and the shortage of fossil fuels (Schultz et al., 1987).

The agroforestry systems in our country consist of a large variety of trees and agricultural crops. The inventory of agroforestry systems at a national level is a high priority for their management and improvement. The importance of agroforestry ecosystems is reflected in the direction of the European Union, which in the recent EU Regulation 2013/1305, articles 21 and 23, defines that "agroforestry systems" are land use systems in which trees are grown in combination with agriculture on the same area (Papanastasis, 2014).

The first European Conference on agroforestry in Brussels, with participants from 17 European countries as well as representatives from America and Africa, organized by the European Federation of Agroforestry (EURAF), discussed the obvious and remarkable productivity and the efficient supply of ecosystem services of agroforestry systems. The agroforestry systems include all the spatial arrangement of trees at the boundary or within cultivated or grazed fields. The high productivity of agroforestry systems, namely an increase in land productivity up to 40% without additional inputs, is demonstrated in controlled experiments and testimonies from farmers. The agroforestry is also part of the solution to the challenge of bio-energy, which Europe is facing in the current period and can provide opportunities for employment, which cannot be ignored. The range of agroforestry ecosystems include mitigation and adaptation of climate change, control of soil erosion, protection of water, conservation of biodiversity and protection from fires in dry areas and generally all the benefits of agroforestry systems for mitigation and adaptation to climate changing (EURAF, 2012). It is obvious how important these systems are in Europe and in Greece, so we have to deal with them more and, while taking advantage of the use of new technologies in learning and in media, achieve the best but also the most massive diffusion of knowledge and information.

This paper is an attempt to capture the perspectives on e-learning for environmental issues in European Union, while in more details it is attempted to describe modern technology on the e-learning, with simultaneous presentation of modern tools, and description of the current situation about e-learning and especially in the EU and Greece. Furthermore, presents results from a survey that took place amongst students of Faculty of Forestry and Natural Environment, about their views on e-learning issues in relation to their integration into the curriculum.

2. Methodology

In order to achieve the objective of this paper, a research was carried out and depicted the kinds of e-learning and also presented the modern tools used to create e-learning courses. Research was expanded to include the recording and the description of the current situation, the relevant developments and the guidelines within the EU and Greece. Moreover a survey took place among students of forestry, to determine the dissemination of new technologies in their social and academic lives and to explore their views on the design and implementation of an e-learning program that will cover their curriculum as well as agroforestry issues.

The survey that took place for this paper was performed with the method of questionnaires. It took place in the period from May to September 2014. The sample size was calculated with the simplified formula of Yamane (Yamane, 1967),

$$n = \frac{N}{1+N * e^2} \qquad (1)$$

where n is the sample size, N is the number of the population of interest, and e the precision level (level of precision = 0.05) with 95% confidence level and volatility P = 0.5.

While applying the formula (1) and taking into account that the number of students in Forestry is 732, we find the sample size, which is 259.

3. Results

The concept of e-learning is quite general and includes any form of education that uses network resources or capabilities of computers in general and distance education (e-learning). The variations in the configuration of the offered e-learning platforms can be described by a number of characteristics. These features can be classified into synchronism, location, independence, and learning styles. (Wagner, Hassanein, & Head, 2008)

3.1 e-learning perspectives

In order to define the concept of e-learning better we distinguish four different types of e-learning: Self-paced training or independent e-learning, Asynchronous e-learning, Synchronous e-learning, (Ruttenbur, Spickler, & Lurie, 2000) and the Blended e-learning which is the most common today. The context of e-learning has the potential to provide guidance to : 1. planning and designing e-learning materials, 2. the organization of resources for e-learning environment, 3. the design of distributed learning systems, corporate universities, virtual universities and cyberschools, 4. the design of LMS, LCMS and integrated authoring systems (e.g., Omni), 5. the evaluation of courses and e-learning, 6. the assessing of authoring tools / e-learning systems, LMS and LCMS. 7. the design and evaluation of blended learning environments. Khan identifies e-learning as a multidimensional system in a framework, in order to capture the structure and requirements of e-learning to address issues comprising eight dimensions, (Khan, 2001).

The modern e-learning applications are a very important innovation for distance education, since they combine new ways of presenting information and offer opportunities for direct communication and interaction (Belanger & Jordan, 2000; Latchem, 2002). The effective use of modern e-learning systems and the formulation of reliable criteria for effectiveness of teaching / learning process is a matter of negotiation for the scientific community. According to many researchers videoconferencing systems are not just a technological tool in the field of distance education, but have profound educational and pedagogical implications (Harasim, 2000; Kerrey & Isakson, 2001).

As Baker says there are three major reasons why the Open Universities promote electronic sessions (Baker et al., 1996): overcomes the isolation of remote students, encourages the exchange of ideas and learning experiences, improves the distant delivery and presentation of learning materials through a structured and supportive environment. Certain software which can incorporate e-learning is required for the realization of e-learning, but one system cannot replace the other because they support dissimilar learning activities. This can be a LMS (Learning Management System) which is a course management system, supporting a number of short training events or a CMS (Content Management System) which supports long sessions of courses.

An LMS (Learning Management System) is a course management system covering the learning needs of registered members. It focuses more on learning information and less on learning itself. It is software for the management, documentation, monitoring and reporting of training programs, online events, e-learning and educational content (Ellis, 2009). Changes susceptible to the system are limited, likely to create problems regarding the adjustment needed to meet the various needs of individual institutions that use it. One of the most famous used in Greek higher education are the Open eClass, Moodle, BlackBoard, Sakai, Scientix etc.

The Content Management System (CMS) is a form of computer software that automates the creation, organization, control and publication of content in a variety of forms. Most CMS have the ability to manage content in the following formats: text, images, video, java animation, design patterns, databases etc. Many times a CMS allows the creation of a group of texts and other material and that is why it is so often used, for example, in the educational programs of many companies. A Web Content Management System and Web Publishing System is a form of computer software that provides additional features to facilitate the necessary work in publishing content online through a website. Some of the most popular content management systems are WordPress, Joomla, Drupal, etc.

Virtual Classroom. The possibility of video conferencing has created intense interest in the possibility of 'simulation' of the functions of the educational process, as it is carried out in normal rooms, in virtual classroom environment (virtual classrooms). Just as the term virtual implies a reality simulation, the virtual classroom is a simulated classroom via Internet, which provides a comfortable communication environment just like in a traditional classroom. A virtual classroom allows students to attend a course from anywhere in the world, and aims to provide a learning experience that is similar to a real class (Jadhav, 2006).

Past experience of utilizing the applications of new information and communication technologies has shown that the mere transmission of audiovisual information and face to face communication, do not necessarily contribute to the effective achievement of the cognitive objectives if not accompanied by appropriate teaching and learning activities, inviting the student to participate actively in all phases of the learning process. The effective use of applications of new information and communication technologies must follow the principles of modern constructive approaches to learning, which focus on proper coordination of learning activities, communication, ensuring greater opportunities for two-way interaction (two-way interactive communication) of the participants with each other and with conciliator tools, in the constructive nature of knowledge and creative engagement of students in the educational process (Willis, 1994). The best known and most widely distributed virtual classrooms are Blackboard, WizIQ, moodle Udemy, Peer 2 Peer University (P2PU) Learnopia etc. The main features of the virtual classroom are the ability to engage multimedia experience, the removal of geographical constraints, the ability of recording sessions, the faster organising of courses, the one-to-one communication, the fact that is easy-to-use and, finally, the support that it offers to what happens before and after a live session. The emerging virtual environment and the virtual classrooms come to meet the communication gap caused by distance learning (Arbaugh, 2000). Utilizing greatly the possibilities presented by the new technologies, virtual classrooms offer high-level interactions and opportunities for collaboration, crucial elements for the acquisition of knowledge.

The model "anyone - anywhere - anytime" is not the future of e-learning (Ruttenbur et al., 2000). Its true potential is the ability to offer the right information to the right people at the right time and place. Learning systems based on web services (Web Based Learning Systems) will revolutionize e-learning because they will provide personalized, interactive, relevant and user-centred learning tools.

Current situation in Greece, European Union and U.S.A.

Web 2.0 technology, led e-learning systems forward. Theorists and researchers continue to develop new tools and systems along with emerging web technologies.

United States of America: 65% of university colleges in the USA in 2004 offered online undergraduate and postgraduate courses at a rate of 44%.(E.I. Allen & Seaman, 2005). Over 5.6 million students (nearly 30% of the total) attended at least one online course in the fall semester of 2009, with annual growth rate of 21%, while the increase of students was only 2%. The 66% of rectors believe that the learning outcomes of online education are equal or superior to those of classroom teaching (E. Allen & Seaman, 2010).

European Union: The use of e-learning in Europe is generally very limited compared to the USA. In 2000 started an effort to incorporate technologies of informatics and communications (ICT) in education and training. The first attempt of teaching courses using synchronous e-learning was conducted by the Department of Information Systems University of Budapest (CUB) in students of Selye University, Komarno in Slovakia in 2000.

In May 2000, the European Committee proposed the e-learning initiative for achieving the objectives set by the Lisbon European Council, namely to make the European Union the most competitive economy in the world based on knowledge. (Council Resolution on eLearning EU, 2010) Similarly, in the field of vocational training, appears Ericsson Education, which created an integrated program of blended e-learning. In the European project INFO-2000 joined acts such as «Socrates», «Leonardo da Vinci» and «e-Learning», with most important goals for the last one being the familiarization with digital media (digital literacy), the virtual campuses and the twinning of schools (e-Twinning) (decision 2003/2318 / EC). Thus began to form a culture of e-learning since 65% of European universities in a survey in 2003 indicated that such services are an important priority for the future.

Significant differences between European countries (culture, language, technology, economic status, etc.) are reflected in the different penetration of e-learning in each of them. Increasing use of the Internet for education in Greece and other Mediterranean countries (Figure 1) may be due to the economic situation of the population in these countries, which now considers the transition to other Member States and / or other cities of the same Member State prohibitive. At the same time, while in France is documented a stagnancy with a slight decline in 2011 and a slight increase in the United Kingdom, there is a great increase in the southern Member States, such as Greece, Cyprus, Spain, Bulgaria, Romania, Spain and Portugal. In particular we observe that Greece, after staying stable in the years 2007-2010, report a surge in 2011, from 12% to 20%.

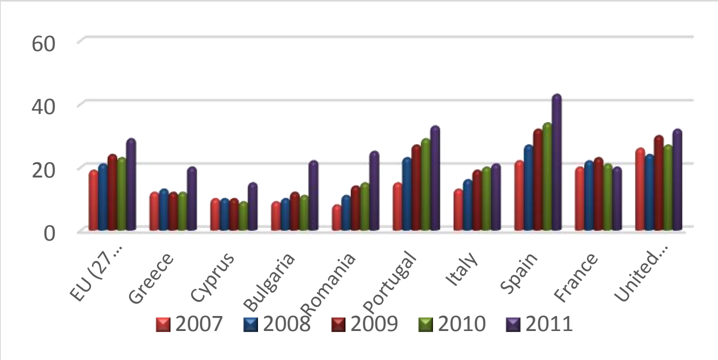

Figure 1. People using the Internet to search information on education (2007-2011) % of people aged 16-74 years, in South Europe, the Balkans and the East Mediterranean. Source: (Eurostat, 2013)

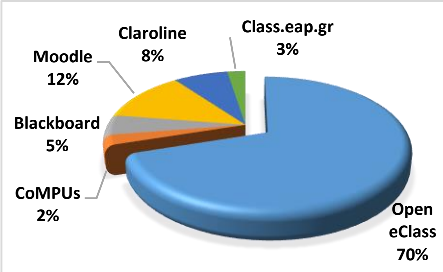

Figure 2. E-learning platforms in Greek higher education

Greece: The European policies are followed at a satisfactory pace. The Greek School Network, the Greek Open University, but also vocational training programs of tertiary institutions and programs of public bodies are some of the steps that Greek organizations are making on the path of e-learning. Advanced modern e-learning infrastructure created in specially designed rooms at the National Technical University of Athens (NTUA), National University of Athens (UOA) and the Athens University of Economics and Business (AUEB).

The Highest Educational Institutes, have already incorporated e-learning modules with over 1000 online courses. More specifically, for the modules of the online courses in Universities, 42.4% were presentations of lectures, with only textual notes was 36.69%. The use of multimedia in the form of audio-visual material (video and audio files) found in a very small percentage of 5.42%. An interesting feature was that while the presentations were split into smaller sections, the texts, with few exceptions, were a single entity covering the whole curriculum.

It was striking, however, that only 12.1% of the programs provided the opportunity of group discussions, but again the participation of students was negligible, while the provision of activities to enable students included exercises (20.6%) which involved solutions and / or examples in an even smaller percentage (17.5%).

Regarding used e-learning platforms, from a total of 38 higher education institutions, 70% use the Open eClass, while the second is Moodle with 12%, the third Claroline 8%, the Blackboard 5%, followed by other platforms with smaller rates (Figure 2).

3.2 Results of the survey

In schools and departments with fields related to Agriculture, Forestry and Environment, there are educational e-learning programs, but most of them only contain course notes and lecture presentations. But the addition of the lectures in the form of video is in progress in the Aristotle University of Thessaloniki in several of these modules. The research that took place amongst students of the Faculty of Forestry and Natural Environment, aimed to investigate the penetration of new technologies in everyday life and the structure of e-learning that they would prefer.

For this reason a pilot research conducted to 272 students of Forestry and Natural Environment according to methodology, in which it was found that 100% of the students questioned use the Internet, 85% use the internet from tablet or mobile phone, and 74% would like the potential usage of e-learning platform through mobile application and only 5% have attended a course through an e-learning platform, although none of them related to environmental, forestry or agricultural topic.

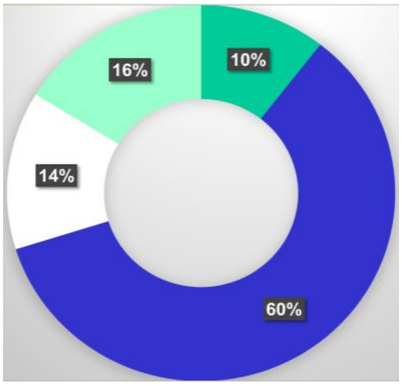

Figure 3. Attending e-learning classes

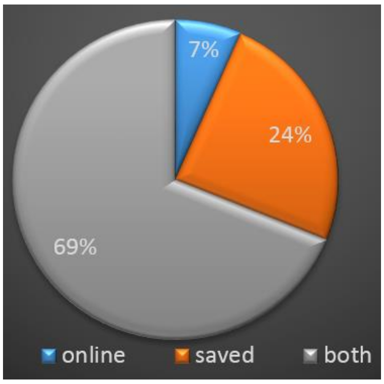

Figure 4. How do you like to have the courses

A minimum of 10% think that lessons of geotechnical content can be taught with e-learning (Figure 3), as opposed to 74% who believe that there are factors that affect this possibility (teacher, students and platform).

About the online or not carrying on of the e-learning course, (Figure 4) 7% prefer the online presentations with a specific timetable, 24% prefer stored video files while 69% prefer the online presentations and then stored in the form of video available to them.

Table 1. Most significant rated characteristics in an e-learning session

Characteristic	%	Characteristic	%	Characteristic	%
Notes	86.4	Suggestions	53.1	Bibliography	42.5
Papers	75.1	Multimedia	52.2	Examinations	41.7
Contact by email	72.8	on-line papers	49.1	Tests	34.2
FAQs	63.6	Class discussions using chat room	48.6	Feedback	22.8
on-line help	60.5	Communication via on line bulletin board	45.6	Contact by SMS	19.3

Regarding the most significant information, between 15 options, that should be included in an e-learning platform, 86% chose course notes, papers (75%), followed by e-mail contact (72.8%), frequently asked questions (63.6%) and online help (60.5 %). All options with their percentages are presented in Table 1.

For examinations - evaluations of e-learning courses (Figure 5), 50% prefer a physical presence in the room (traditional method) with 29% preferring on-line tests (both limited and unlimited duration, with or without automatic feedback), and forwarded via internet papers (21%).

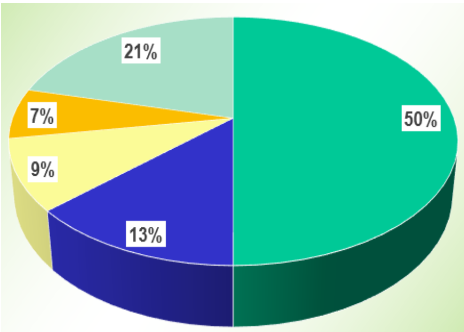

Figure 5. Preferable evaluation pattern

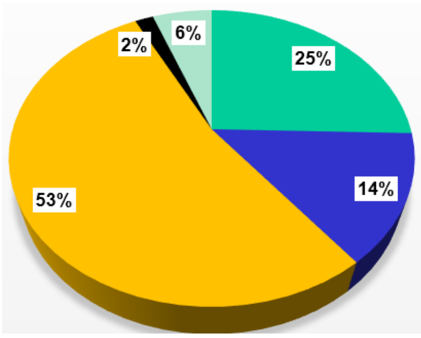

Figure 6. Need of instructor's physical presence

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In the matter of the physical presence of the instructor (Figure 6), 53% believe that it is essential, 14% that it is necessary only for the learning of skills while 25% claim that there is no need for physical presence but it is necessary for answering questions, of which 49% felt the need for the physical presence of the instructor more than twice per semester, 29% for twice per semester and 18% for once per semester. As for the preferable amount of live audiovisual communication with the instructor, 69% responded once a week, 23% once a month, while 8% think it is not needed, as long as they have answers to their questions via Forum, chat room or email (Figure 6).

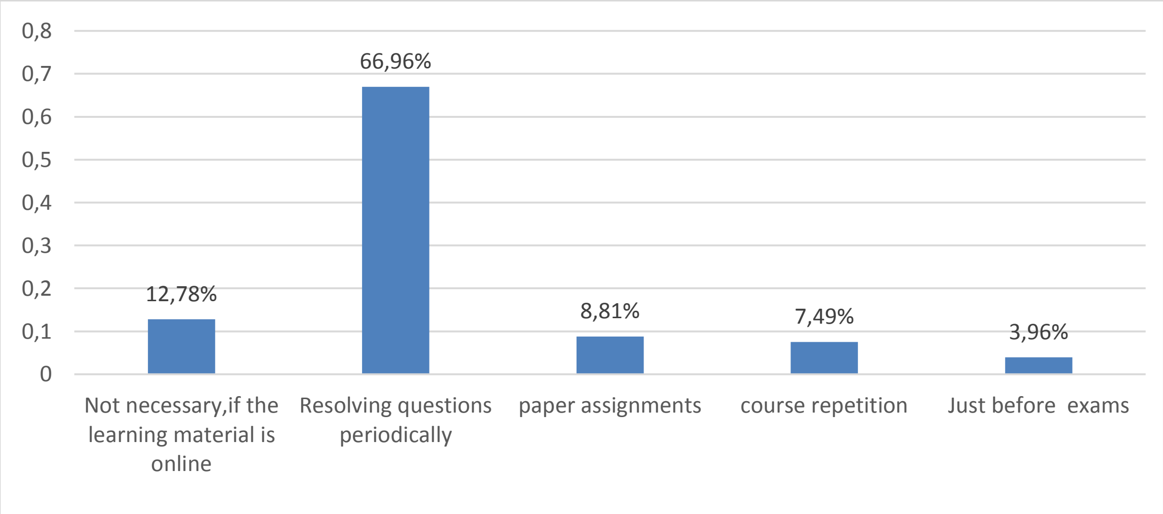

Figure 7. When virtual class is considered the most useful

For the running of virtual classroom 66.7% believe that it is useful for resolving queries at regular intervals and there is a 12,8% who believe it is not necessary as long as they can find the proper study material online (Figure 7).

Finally, in a question about the agroforestry systems that they would be interested to be informed further, 57% chose the silvoarable systems and followed by the agrosilvopastoral (33%) and the silvopastoral (10%).

4. Discussion - future challenges

The use of e-learning in Europe is generally very limited compared to the USA, but there is a lot of effort in that direction, in EU Council, so that such services are an important priority for the future. There is a great increase in use of the Internet for education in Greece. The results of the research show us that the responding students of Forestry, are users of the Internet, but also of programs and applications of new information and communication technologies. On the issue of e-leaning though, they have no experience and this urges them into conservative responses particularly in relation to the presence of the teacher, the pace of meetings with physical presence or via teleconference and the examination pattern. The rest of the answers, however, can be considered a first step, a basis for how a module of an e-learning course should be structured and what it should contain.

Based on the above and on the basis that agroforestry and its reintegration in common daily practice is an important development that should have the similar communication dissemination. That is the reason, it is necessary to extend the research, under the correct and thorough creation and operation of an e-learning platform for teaching and diffusion of knowledge about agroforestry issues and their positive effects (environmental, economic, social, psychological). Firstly, the research should include the views and opinions of students in agricultural schools who will attend the online courses. On the other hand, research will be conducted about the opinions of experts on the structure of the e-learning course, with the simultaneous provision for its needs in the near future. From the results of these researches and thorough international practice, should be possible to structure and draft a comprehensive e-learning module covering comprehensively the subject of agroforestry topics, in order to teach students in agricultural, forestry and environmental faculties, but also to enable ordinary people to be informed about developments in this matter.

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A Collaborative Virtual Learning Environment for Agro-Forestry Trainings

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ABSTRACT

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 training and qualification in the vocational, higher education and adult education. The main objectives of the project are to make a synthesis of needs and expectations, based on present the existing training actions and to set up a common framework, to build an innovative training system to create a technical collaborative support for the implementation of the project with communication tools and for providing access to the resources and training services during and after the project. The user profiles are Teachers, Professionals, Students, People (with disabilities in professional situations), Knowledge feeders, Knowledge builders and aggregators. There are needs for handling many formats in the knowledge databank. More open source and exist tools and services have been evaluated, tested, used and implemented in creating the service architectures and finalize the system components in the project. The architecture concept of the Knowledge Data Base and Services has been developed. The paper describes the results of the developments. The Moodle LMS system and videoconference servers are used for collaborative working and learning environment. This learning and collaborative platform is used as project management, project assessments tools and e-learning / on-line learning. The videoconference systems integrated with the Moodle system can demonstrate and show the path towards the near future service similar to the MOOC concept. This paper decribes the concept of the knowledge data base and service architecture and some aspects of using mobile tools.

1. Introduction

The agricultural system has experienced a strong abandonment of agro forestry in the 20th century, to count today only a few million ha in Europe. Following the work of scientific research, development structures and the experiments of the few professionals, in recent years, agroforestry has met a true national and European recognition. Based on the results of scientific research, development structures and those of the "farmer-researchers", experimental courses were conducted in different countries, including BE, FR, in the UK on a small scale as resources, trainers and available skills are

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scarce (Lundgren and Raintree, 1982). The partners have identified training needs in the short term: these needs are operators and future operators, adults and pupils / students, teachers and counselors, tutors. These requirements therefore relate to levels of European qualification L4 and L5 / L6 and two types of learners: Students and adults, farmers and future farmers on the one hand. In the short term, the project will address these two public through a system established by the partners: based on innovative teaching practices training, occupational situations providing access to recognized qualifications (Herdon et al., 2011; Várallyai and Herdon, 2013). Fortunately the ICT tools have been developed increasingly nowadays, so there are tools and methods for e-learning and e-collaboration (Bustos et al., 2007; Herdon and Lengyel, 2013; Herdon and Rózsa, 2012). 13 European partners from 6 countries participated in the project. One of the important parts of the project is to apply innovative solutions for building and using the web site (http://www.agrofe.eu/) and knowledge repositories for teaching and learning agroforestry. The ICT based concept and results are discussed in the next chapters.

2. The objectives and development methods

The main objectives are to make a synthesis of needs and expectations, based on the present existing training actions and to set up a common framework; to build an innovative training system (contextualized, modularized trainings, use of ICT, professionals participation); to create a technical collaborative support for the implementation of the project with communication tools (information of partners and promotion) and for providing access to the resources and training services during and after the project (knowledge databank, interactive services) (Ibanez et al., 2013). To achieve these objectives the following main activities have to be carried out:

- Exploitation of the tools and services.
- Building a collaborative working environment.
- Planning the architecture for development, teaching and training.
- Implementing the e-learning environment.
- Designing the multimedia tools to make the system accessible for learners, trainers.

That is why we will be able to build a collaborative working environment for the project partners and players who will join to this knowledge database and information service. We have to use the following methods (do the following activities):

- Using the experiences from former project and practice.
- Studying new technologies and methods.
- Developing Agroforestry in agri-environment BSc course
- Evaluating them.
- Selection.

3. Results in research and development on ICT tools

For the collaborative working in the project we plan to use existing open source and free services. One of the essential solutions was the latest version of the Moodle system. One selection criterion was based on that we have more than 7 years' experience in using this popular system which can give every function that we need for collaborative working during the project. The ICT system of the project will be based on a knowledge databank service and for mobility (field) work we will use tablets with Android, IoS, Windows platforms, using the central services and applications.

A variety of ways that two or more organisations can work together are covered the collaborative working. The range is wide from informal networks and alliances, through joint delivery of projects to full merger. Collaborative working can last for a fixed length of time or can form a permanent arrangement. What these options have in common is that they involve some sort of exchange, for mutual advantage, that ultimately benefits end users. In recent years, interest in collaborative working has been growing, driven by the sector's drive for effectiveness and efficiency, government policy and public opinion.

The types of collaborative working can be the following:

- Separate organisations maintain their independence, but work jointly on some activities or functions.
- Organisations with resources or expertise offer assistance to other organisations, a large national organisation working with a small local group.
- A new organisation to do joint work on some activities or functions.
- A group structure where a 'parent' organisation governs a group of 'subsidiary' organisations.
- Merger to form a new organisation working as one body on all activities.

CWE (Collaborative Working Environment) can be perceived as the tools, technologies, services and environments supporting individual persons in their working tasks to become more creative, innovative and productive involving the direct or indirect interaction (collaboration) with other individuals, groups or organizations (Collaboration@Work, 2005; Ibanez et al., 2013). Collaborative platforms providing sophisticated upper middleware services required for environment and person-aware distributed collaboration. It is based on system integration of Web Services, Semantic Web, CSCW, utility-like computing and connectivity (grid or alike), sensor and wireless technologies (beyond 3G, 4G), advanced networks services (e.g. IPv6), knowledge and content management, and WFMS based on peer-to-peer design principles to enable radically new collaborative environments. They can provide the support and operations required for complex virtualised working environments. Works include development of tools for sharing resources, knowledge/resources discovery, service composition, CSCW tools (including multi-conferencing) to ensure stable, dependable collaborative applications.

Collaborative working is not right for every organisation in every case. Carefully identifying and addressing issues of concern helps establish if collaboration is the right way forward.

Potential benefits of collaborative work

- New or improved services.
- Wider geographical reach or access to new beneficiary groups.
- More integrated or coordinated approach to beneficiary needs.
- Financial savings and better use of existing resources.
- Knowledge, good practice and information sharing.
- Better coordination of organisations' activities.
- Competitive advantage.
- Mutual support between organisations.

In Hungary there is a high speed research and education networks which enable an uncompromised quality audio and video collaboration. This system offers the following collaboration services (http://www.niif.hu/en/):

- Video and desktop conference (IP based videoconference). From anywhere to anywhere, with any number of participants for project and administrative meetings, consultation, distant teaching and learning (Vidyo Inc., 2014).
- Videotorium: Video sharing portal for higher education, research and public collections. Share research and education recordings through Videotorium, in up to high definition (HD) quality.

The video network now features around 140 meeting room terminals spread all over the country, and a compatible desktop videoconference system is available to be used with a computer and web camera (Vidyo, Inc., 2012). Within the AgroFE project we use the Multipoint Control Unit which gives HD services, it is able to record and / or broadcast the meeting on the Internet. The Desktop system is also used because every partner can join in a virtual meeting room very simply and we connect this virtual room with every participant to the MCU server. This desktop system works with the Vidyo software. The virtual collaborative system architecture and main functions what are used in the project can be seen on Figure 1.

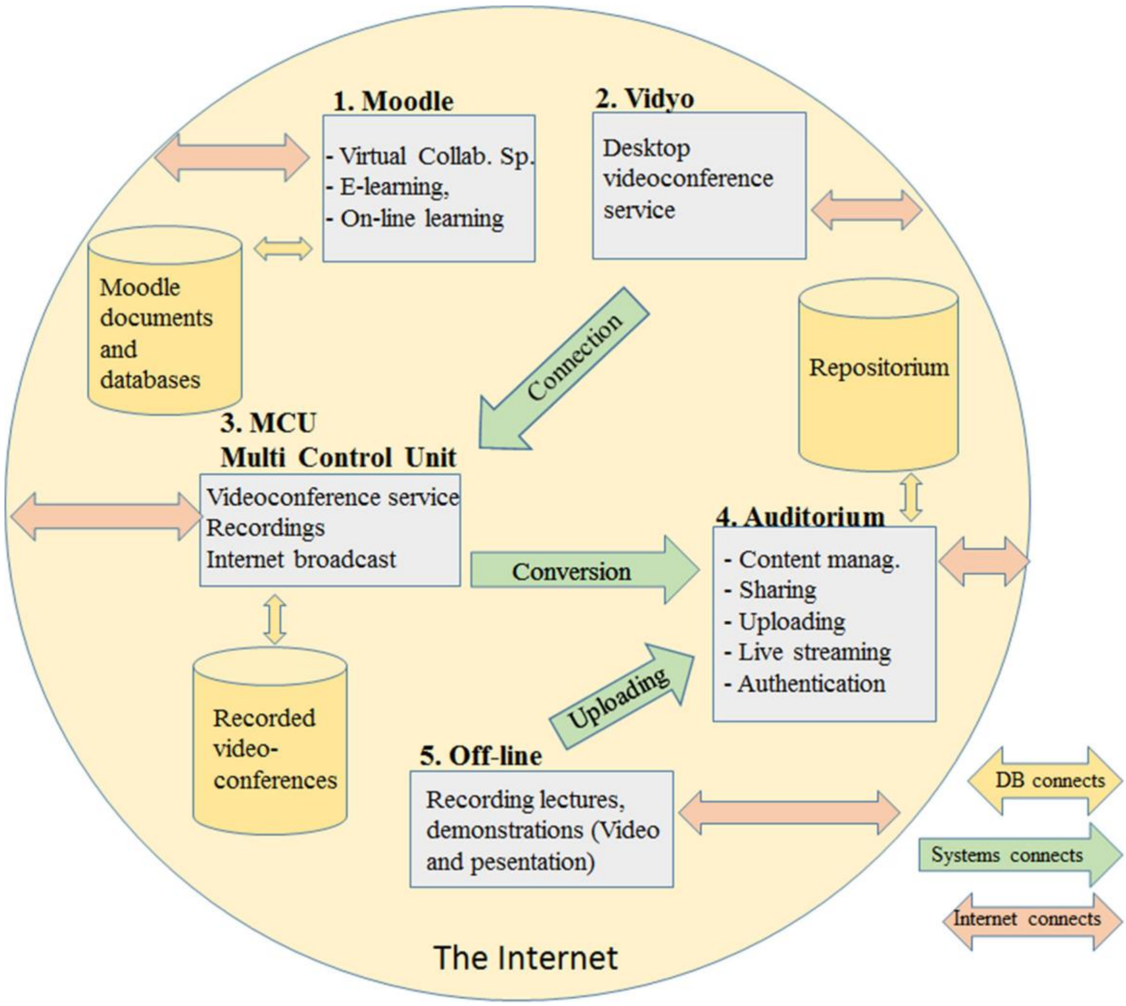

Figure 1. The architecture of the virtual collaborative environment

3.1. The Moodle as virtual collaborative space and e-learning platform

Online courses are moving into the mainstream and the software commonly used to deliver online courses can be prohibitively expensive. Classes take place online through the use of software packages that have special classroom features such as discussion forums calendars, chat rooms, where participants can communicate in real time with each other, and quiz and polling capabilities. Files such as word processing documents, sound files, pictures, and videos can be uploaded to the virtual classroom for viewing by students. Thus, the "platform" is essentially a place that looks like a private website and is intended to work like an electronic classroom. The classes taught on these platforms are accessible via the Internet, and are usually private, meaning that only individuals who are registered for the class can see the password-protected website. A platform for online courses may also be called an LMS (Learning Management System) or LCMS (Learning Content Management System).

Like many other higher education institutions, we introduced the Moodle system at University of Debrecen Centre for Agricultural and Applied Economic Sciences (UD CAAES) in 2007. The faculty leaders recognize the fact that modern technologies in education should be entered, which was realized in the Moodle system (Burriel, 2007, Lengyel and Herdon, 2009).

Departmental use and testing began in January 2008 with the introduction of the Faculty of Business and Rural Development. Since the introduction the Moodle System has been continuously updated. The system is used by a large number of users (teachers and students). The number of courses has grown rapidly. The Agri-Business Administration Education Program began in 2009 and number of courses and users has continued to grow. Implementation of the phases during the system upgrade has happened several times in order to make the newer features available. In the past we used the Moodle in more European project for collaborative work and adult trainings too. The preliminary experience entitled us to use this system for creating a collaborative space and e-learning in the AgroFE project (https://moodle.agr.unideb.hu/agrofe/).

The Moodle server is used as virtual collaboration space and e-learning system. The system implemented in September of 2014. We created the initial structure for collaborative work and starting the e-learning courses. Up to this time 136 users and 70 students are registered (enrolled) in the system (Figure 2).

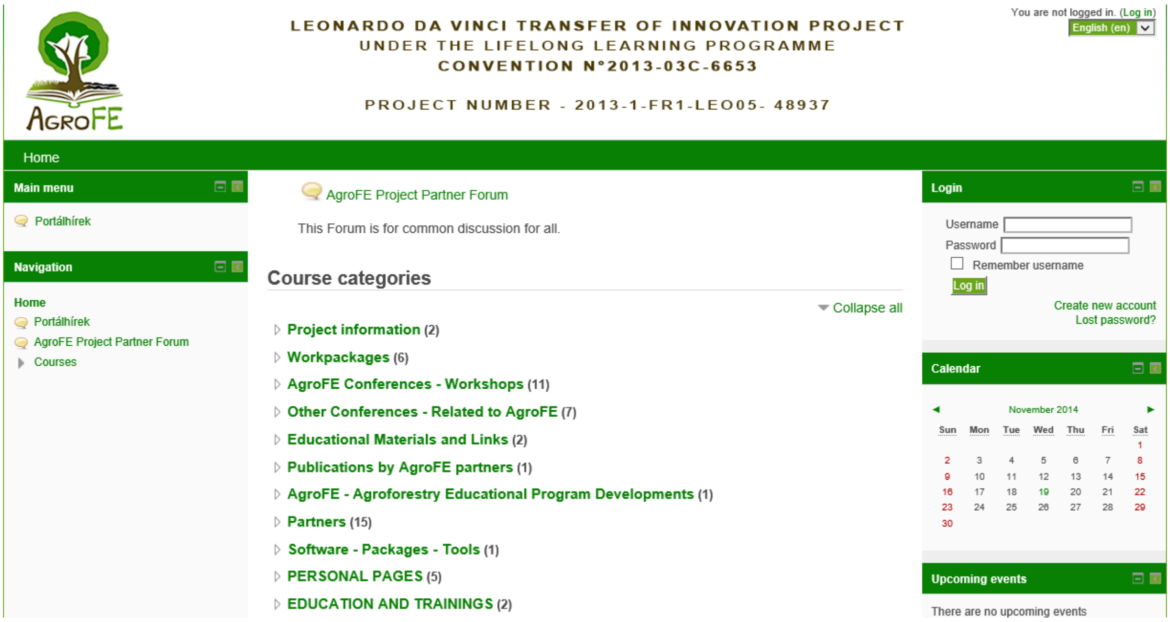

Figure 2. The main topic (called Course categories).

3.2. The Vidyo as collaborative and on-line teaching tool

The Vidyo portfolio (http://www.vidyo.com/) includes everything we need to deploy: the HD video collaboration to everyone in an organization, from core infrastructure to solutions that video-enable any device or application. Vidyo works the way we do. It runs on the devices we're using from smart phones to tablets, desktops to video room systems, bringing HD-quality video and content to every participant (Vidyo, Inc., 2012). The VidyoDesktop™ app extends high-quality video conferencing to Windows, Mac and Linux computers, allowing users on these systems to participate at office, from home, or on the road. The vidyo is by support encoding at resolutions up to full HD and dual-screen multipoint video. The key features are

- 2X Extreme Definition (XD) display people and content on one or two monitors, each up to 1440p.
- Multiple user-selectable layouts for continuous presence, active speaker, and shared content.
- In-conference public and private text chat.
- Share any app or desktop into the conference, and switch between multiple streams of shared content.
- Far-end camera control of Vidyo and third-party group solutions.

The VidyoMobile™ app brings high-quality video conferencing to popular Apple and Android tablets and smartphones. Host a person-to-person or multi-party video conference from your office, home, or in transit on both wireless broadband and WiFi connections. As a full-featured endpoint in your VidyoConferencing™ solution, VidyoMobile delivers transcode-free video conferencing for natural communication at the pace of conversation, without the broken pictures associated with traditional solutions. Using the Vidyo in the AgroFE project is shown on Figure 3.

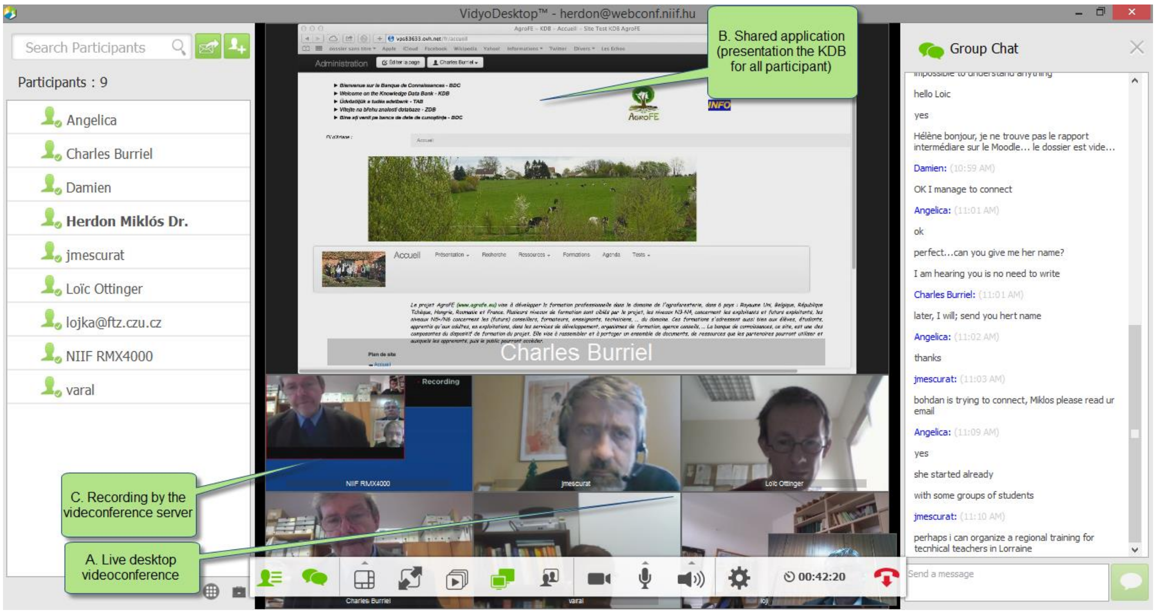

Figure 3. Using the Vidyo videoconference system for virtual meetings in the AgroFE project (The main functions of the system: A. the participants; B. Application share; C. The MCU server records the videconference and broadcast on the Internet; Personal chat; Group chat, Toolbar on the client computers).

3.3. Using the MCU server for videoconference service, recording and internet broadcasting

A multipoint control unit (MCU) is a video-conferencing device that links two or more audiovisual workstations into one audiovisual conference call. There are two kinds of multipoint video meetings; switched (or voice activated switching / VAS meetings) and transcoded meetings. In a switched meeting, the MCU switches the image of the currently speaking site to all sites. Most importantly, the MCU does not process the video signals at all. In a transcoded meeting, the MCU receives the incoming signal from each participant, mixes the signals together, then creates and sends a signal back to each participant. In this type of meeting, the MCU processes the video signals, and as a result can provide a signal optimized for each participating endpoint.

MCU makes it possible for a multipoint audio/video conference to be controlled and moderated from a single location. Multi-stream audio/video conferencing is bandwidth-intensive, easily requiring up to 6 Gbps, depending on the number of members. The units gather bandwidth data for all connected points and then adjust quality so that all points are capable of good performance. MCU are connected near the WAN, often contained in a rack server configuration.

MCU allow a user control different modes of displaying conferenced terminals. Modes include:

- All individuals displayed on a split screen.
- Voice-activated selection of displayed speakers.
- Individual conference points displayed full screen and switched between manually by a human moderator.

3.4. The Videotorium service and repository

Videotorium is a video/audio sharing portal created for the players of research and education. Videotorium provides professional presentation of video content recorded at higher-education organisations, research institutions and public collections. Videotorium has been launched in June 2010 by the maintainer of the Hungarian research and education computer network infrastructure, the National Information Infrastructure Development (NIIF) Institute (Kovács, 2009). The portal is the successor of former “Video on Demand” repository aiming professional accommodation for the growing collection of recordings and content upload and sharing by institutions.

Videotorium is freely available for users of any NIIF member institutions, but any non-profit research and education activity can be supported (Kovács, 2011). The content created by affected organisations can be infinitely various: scientific conferences, seminars, university lectures, trainings, scientific events, scientific experiments, research PR, documentary, interviews, etc.

Primarily, the portal offers its services to higher-education (students, lecturers), research and public collection community users, but the high number of public recordings offers a good opportunity for learning or self-entertainment. One recorded lecture (held by Prof Jerzy Weres on the Agricultural Informatics 2014 International Conference) can play as video on demand from the Vedeotorium (Figure 4).

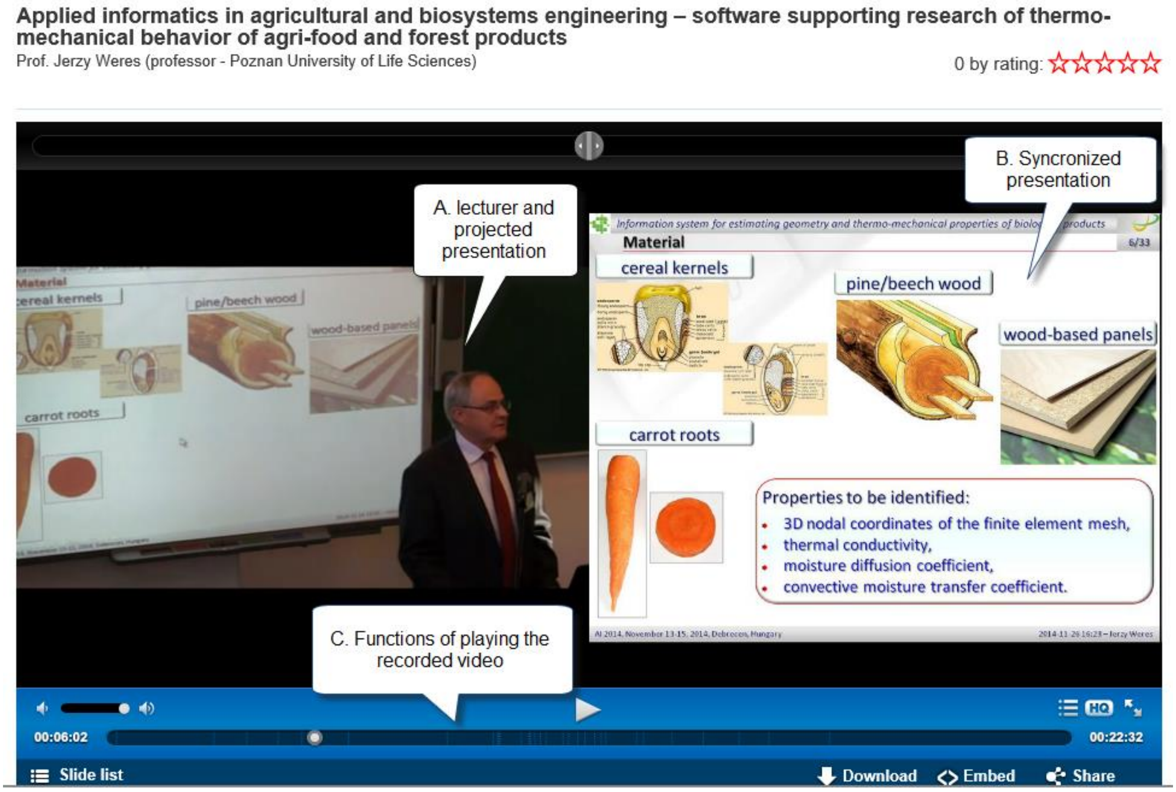

Figure 4. Playing the video from the auditorium (A. The lecture can be recorded on video; B. Upload the video and ppt presentation, synchronize the video with the ppt; C. Video on demand can be used for on-line learning with wide functionalities – share, embed, position to any slide, etc.) (http://videotorium.hu/en/)

The Videotorium would like to meet special requirements of higher-education, research and public collections community, which would be rather difficult to satisfy by a general video sharing portal. Major features briefly:

- Sharing of audio- and video recordings without barriers on length and quality (up to High Definition), free and unlimited storage capacity.
- Uploading presentation slides to recordings. Upload your PowerPoint or OpenOffice presentation and synchronize slides to the recording of your speech.
- Organisational micro sites: present all recordings of your institution through an own Videotorium site with individual URL, design and news.
- Flexible metadata scheme meeting requirements of scientific publication and providing effective retrievability.
- Flash based playback, compatibility with all popular browsers.
- Sharing through community sites (e.g. Facebook) and embedding recordings in external web pages.
- eduID federative authentication and authorization (Shibboleth AAI).
- Content aggregation with standards based metaadata exchange mechanisms (OAI-PMH).
- Live streaming: broadcast your event live through Videotorium to deliver your event to thousands of users through our high capacity servers.

We are testing this system for storing and streaming videoconferences and on-line lectures (on-line learning).

3.5. Building the Knowledge Base Systems

A knowledge base or knowledge bank is a special kind of database for knowledge management (Glick, 2013). 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 Data Bank (KDB), there is, at least, a back-end which is a DBMS. Within the AgroFE project the final target is to build and open source based system. The concept of the system architecture can be seen on the Figure 5.

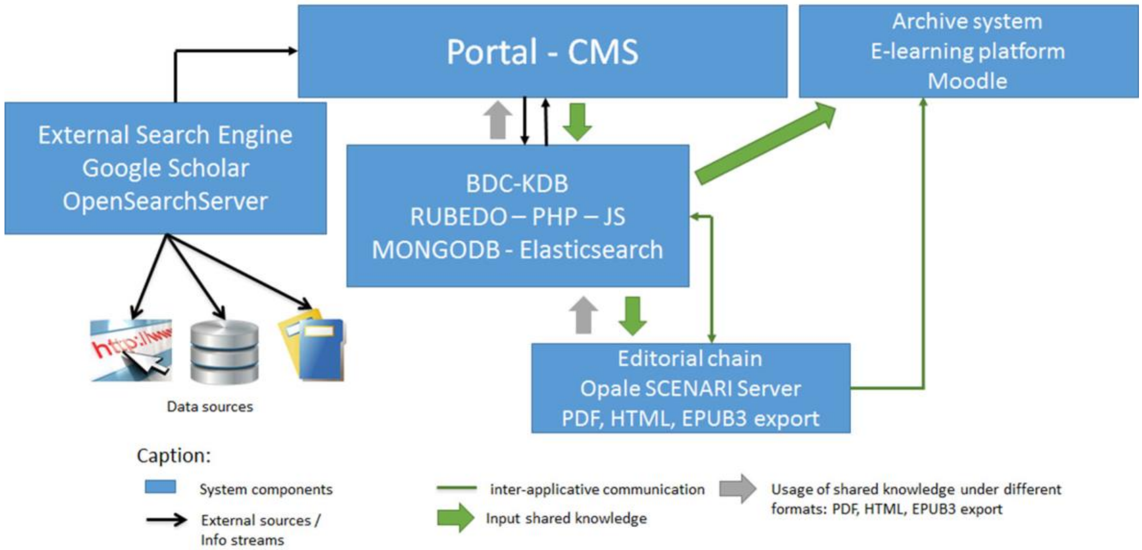

Figure 5. AgroFE Knowledge Data Base System architecture (Archiceture of the prototype)

In the context of the AgroFE project, the Technologies of Information and Communication, ICT, include four components, the collaborative tools (OTC-CWS), the Knowledge Data Bank (KDB-BDC), the tools for training and archiving and a portal that integrates the tools (Zheng et al., 2012).

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, a “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 (So et al., 2009).

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.

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 data bank in the prototype of the AgroFE project is based on RUBEDO software, developed in PHP and RUBEDO is built on different components:

- A data base management software (DBMS), type 'NoSQL', MongoDB
- The user interface uses the ElasticSearch search engine.

The prototype of the knowledge data bank will be evaluated during the project and is open to the public. The system can be accessed by the different project partner's languages.

3.6. Using mobile tools for field work

Within the AgroFE project University of Debrecen (UD) purchased the following tablets under a tendering process in June 2014:

- 2 pieces SAMSUNG Galaxy Note 10.1 P600 32GB WiFi TABLET PC - Android
- 2 pieces ASUS VivoTab TF600T 64GB TF600T-1B031R 10" - Windows
- 2 pieces TOSHIBA TAB Encore WT8-A-102, 8" - Windows
- 4 pieces LG G Pad 8.3 V500 16GB 8.3" – Android.

Mobil informatics solutions are begin to widespread from the education to the field work in the world, in which one of the most outstanding tools are tablet computers. It could be separated these tools based on a different point of views, e.g. goal of using and operation system (Rogers et al., 2010). As we highlighted before the mobile solution, tools became more and more important, that is why we are focusing these trends in the project. The e-learning, the Vidyo (videoconference service), Videotorium can be accessed and used by tablets and smart phones for collaboration, communication, e-learning. But besides these functions are very important to use these tools at any-where. This means we need these equipments in the field work. In the next paragraphs describe some examples where we tested mobile apps.

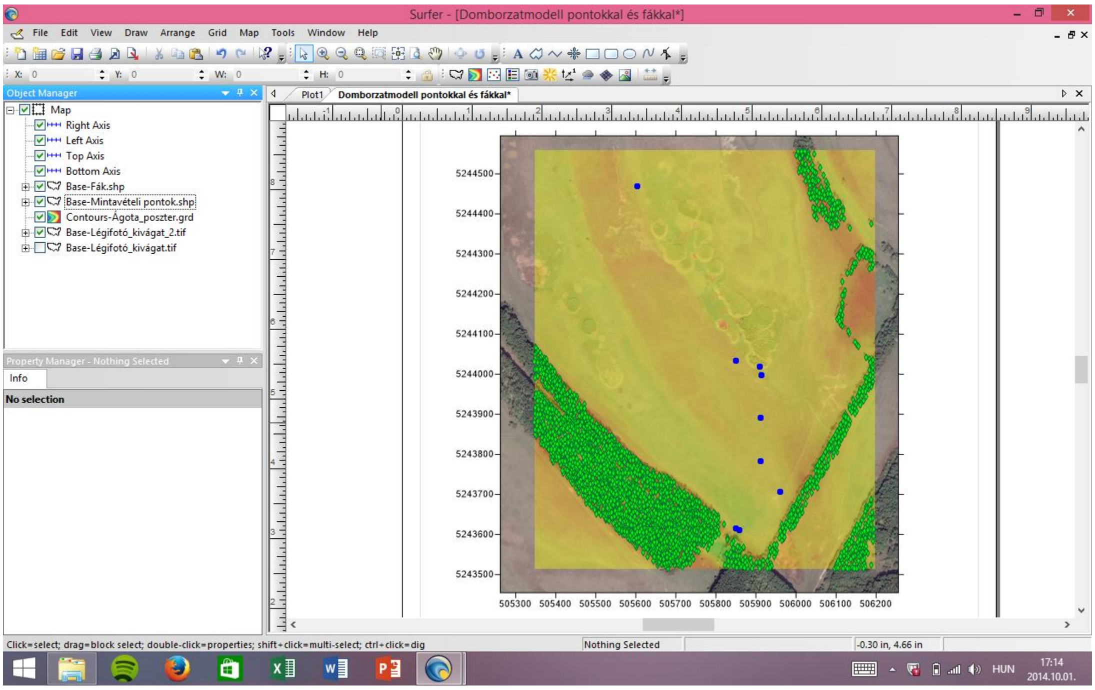

Figure 6. A Screenshot of the tablet, when Surfer 11 GIS software was running. Blue spots represent the field survey data which is collected by the GPS Satellite app

Field survey (Figure 6), data collection and data processing are sometimes carried out at different time, but we need prompt decision in many cases. Technical and informatics backgrounds are needed to solve these problem. These two main elements are the mobile data storage and handheld GPS devices (Wagtendonk and de Jeu, 2007). Tablets could be ideal tools for using on the field and supporting decisions. Tablets can be classified according to the operation systems. The Microsoft Tablets are operated by the Windows operation system, which is provided flexible platforms for work. Microsoft tablets worked on Windows 8 and Windows RT operating systems (Donatis and Bruciatel, 2006).

Now the Window 8 OS is basically a personal computer operating system, so some kind of GIS software can be installed on these tablets. Since the memory and the internal storage capacity of the tablets are now limited, so only preprocessing is possible or previously processed data can be used. Besides the installed software, on the Windows Store more than 500 000 application can be downloaded and installed. Tablets – independently from the operation system – have built-in GPS receiver which can communicate with certain applications, thus it provide real time data collecting (Figure 6).

The Windows RT is an edition of Windows 8 designed for mobile devices that use 32-bit ARM architecture. Windows RT has some limitation for software and applications what are available in Windows Store.

The Android OS is based on Linux kernel and developed by the Google. Typical desktop software cannot be installed, but the high amount of applications (more than 1,200,000) provide the easy data collecting, which are downloadable from the Google Play. Some typical field survey applications are available and most of those communicate with GPS satellite (Figure 7).

Figure 7. A Screenshot of GPS Field Area Measure application with surveyed areas

One of the most important parts of the field survey is the photo documentation (Figure 8). In-built opportunities are achievable on tablets, which record the GPS coordinates during taking of the photo. Desktop software and/or different applications are ideal for taking geotagged photos on a map, due to it is easier to identify the surveyed object on it.

Tablets could be very useful tools in education too. The basic office service is both Windows and Android operation systems. Documents, worksheets and presentations are automatically synchronized with different operation systems. Tablets can be connected with projectors by network or video cable too, thus presentations can be displayed for the students during the lessons.

Data storage is on the internal memory and henceforth web-based storage is available. OneDrive system is supported by Windows OS, which provides up to 30 GB data storage in cloud. Opposite of this, Android OS was developed by Google, so the cloud storage is on the Google Drive, to this is needed internet connection (3G, 4G, Wi-Fi).

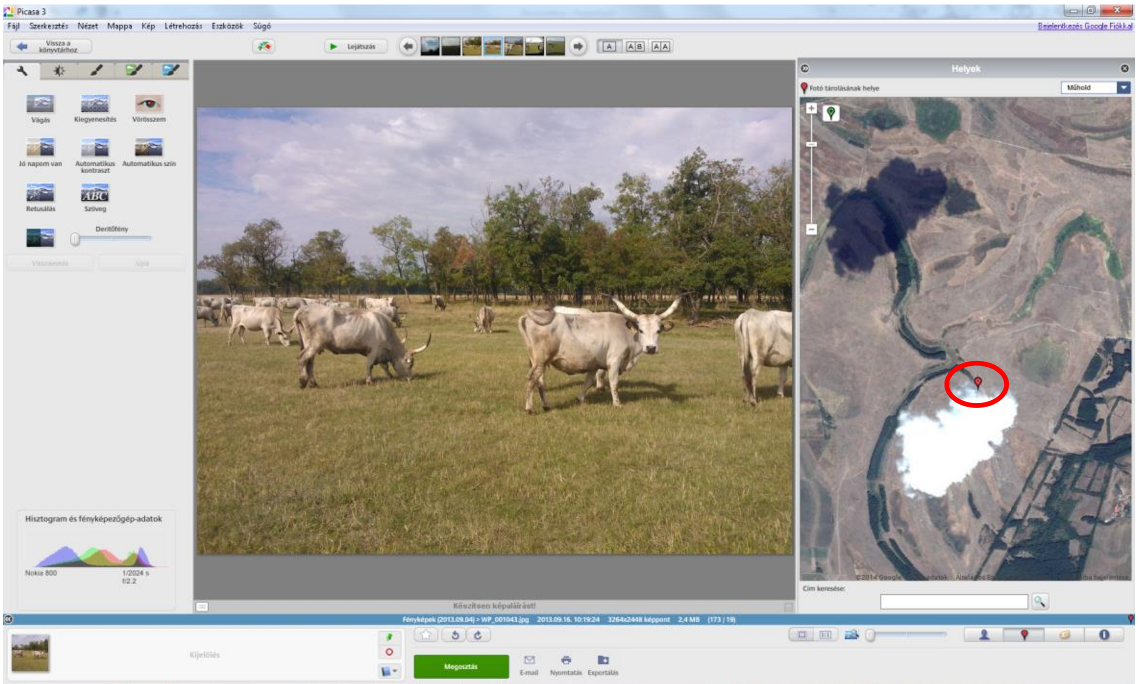

Figure 8. Geotagged photo with place of field survey in Google Picasa

4. Conclusion

The agroforestry will be important for rural areas and farms according to more aspects. Environmental, economic, agricultural production and rural living are very important issues. The project participants are involved in developing curricula for more training levels. Up to now we have developed subjects for BSc and MSc level in "Agroforestry" which are accepted by two faculty boards. The latest version of the Moodle system has been implemented for collaborative space and carried out more virtual meetings by the new videoconference systems, which have been tested and used times. All the virtual meetings have been recorded in the Videotorium system.

Within the AgroFE project the final target is to build and open source based system. In the context of the AgroFE project service system includes the collaborative tools (OTC-CWS), the Knowledge Data Bank (KDB-BDC), the tools for training, archiving and a portal that integrates the tools components. Under the project, the 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. At the end of the evaluation phase the KDB can be extended to other contributors, for other uses, such as exchanging of materials and supporting different actors of Agroforestry.

We are convinced that using the innovative technologies and solutions the system will serve and support to achieve the project goals.

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Training Needs Assessment on the Use of Social Media among Extension Agents in Oyo State, Nigeria

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ABSTRACT

Agricultural information exchange has been dominated by industrial media such as newspapers, television, and magazines for decades. However, social media as a form of Information and Communication Technology (ICT) method for harmonizing sustainable agriculture and natural resources provides broader agricultural community that eliminates physical distance. The study therefore examined training needs assessment on the use of social media among agricultural extension agents in Oyo State, Nigeria. All the 90 agricultural extension agents in Oyo State Agricultural Development Programme (OYSADEP) were interviewed. This includes 35 from Ibadan|Ibarapa zone, 22 from Saki, 19 from Oyo and 14 from Ogbomosho zone. Result shows that the mean age of extension agents in Oyo State was 38±2 years, (98.8%) had one form of tertiary education or the other. Majority (72.0%) exhibited high need for training on the use of social media even when the result revealed that Facebook (47.6%) was mostly used social media among the agents. The result of inferential statistics shows that there was a significant relationship between education $\chi2$=10.142, $p<0.05$), marital status ($\chi2$ =19.632, $p<0.05$), social media used (r= -0.337, $p<0.05$) and training needs. However, inverse but significant relationship existed between extension agents' knowledge of social media (r= -0.875, $p<0.05$) and training needs. Concerted efforts by relevant stakeholders to train extension agents will in no measure foster sustainable food security drive in Nigeria.

1. Introduction

Increasing smallholder productivity is one the greatest challenge in this century. The dimensions of the challenge include growing populations, growing demand for food, rising poverty, economic stagnation, worsening environmental degradation, and climate change. ICTs based applications like Variable rate technology, Geographical Information System (GIS), Geographical Position System (GPS), satellite imagery, and other data collection technologies have increased the information available about soil health, weather conditions, and disease outbreaks. These ICTs based applications provide information that makes very site-specific farming possible and thereby raising hope for agricultural productivity. However, the key to using these technologies to boost productivity requires complementary technologies. Data analysis technologies (such as data mining or mediation software) and information dissemination technologies (such as mobile phones and radio) are essential to reaching smallholders effectively. Dissemination also includes the crucial human component: Extension agents and farmers themselves must transmit and share knowledge (International Institute for Communication and Development (IICD), 2006).

Agricultural enterprise requires knowledge management to enhance agricultural productivity and combat the problem of food insecurity. This enables appropriate agricultural information to reach agricultural extension agents (knowledge intermediaries) and smallholder farmers in a timely manner. Rural education is increasingly becoming important means of disseminate these information, however

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many rural schools still operate tenuously, some relying on untrained or volunteer teachers necessarily disconnected from pedagogical training or dominance of the subject matter.

Currently in Nigeria, agricultural information comes mainly from research institutions, which generates new technologies to farmers. It thus follows that the agricultural research information service center is the custodian of several information resources including CD-Rom databases (which could be bibliographic, research, factual), multimedia knowledge bases and in house publication. Other sources may include agricultural information providers such international organizations and local non-governmental organizations and community based organization. The main modes of delivery are farmers' magazines, newspaper, posters, handbooks, radio, television, films and videos. However, there are ample rooms for testing other forms of information dissemination, such as the mobile telecommunication system (Omotayo, 2005).

Social media use for disseminating agricultural information has the potential to bridge the gap created by the short fall in the farmers' extension ratio. The ratio of extension agents to farm families as recommended by Food and Agricultural Oraganisation is put at 1:250; this is against 1: 4,882 with 415,030 farm families in Oyo state (FAO, 2012). The use of social media is becoming increasingly necessary among all professionals of the world. The information that is transfer on the social media cannot be compared to any other means of information dissemination in the world because it gives direct access to information source and how to go about the use of the information gathered. This is believed to have the potential to change the face of agriculture in Nigeria and improve or increase the channel of gathering information among farmers because the ratio of agricultural extension officers is very low compare to the number of farmers that exist in the country (FMARD, 2011).

The field of agricultural extension specializes in the dissemination of information to the farmers and rural dwellers to improve their standard of living in all aspect of life. Social media could provide a platform for an interaction mediated by electronic communication between the farmers or extension officers. According to Ogungbameru (2004), when there is difference or gap between actual performance and what is needed or expected, productivity suffers. Training can reduce it if it does not completely eliminate this gap. The training is to improve the means of disseminating information through the use of social media. The rate at which technology is increasing is overwhelming and social media as a part of technology improvement is growing day by day. Integrating social media into extension work for disseminating agricultural information to farmers will elicit easy access to innovations and invariably improve agricultural production. However, the use of social media is not yet maximized by professionals in Nigeria and as such makes it difficult for farmers to get necessary information to solve their problems.

In the recent time, extension service, service providers and extension clients are experimenting with new digital opportunities that can be effectively used to exchange process, manage and communicate information to help rural farmers to effectively utilize any agricultural information received (Sanusi, Petu-Ibikunle and Mohelia, 2010). Therefore, It suggests that competent and well-trained extension agents are needed if adoption of new technologies required to achieve Millennium Development Goals (MGDs) hope to be achieved in 2015. Social media will provide quick and easy way to build relationships and interact with people in agriculture. Social media creates a much broader agriculture community, so obstacles like physical distance and isolation are issues of the past (MSU, 2012).

One of the major roles of social media in extension is its ability to facilitate effective linkage between extension workers and farmers and also between farmers and research result. IDU (2006), a study conducted on cyber Extension (University Based Extension Based Project for Agricultural Research) found that the web could be effectively used to facilitate extension work, appropriate forum for educational outreach and cost-effective means to reach extension agents, educators and opinion leaders who will transfer the knowledge gained to their clientele. It is against this backdrop that the study was carried out to assess the training needs of extension agents on the use of social media for agricultural information dissemination in Oyo State, Nigeria. The specific objectives are to:

determine the perception of extension agents on the use of social media for agricultural information dissemination.

1. determine the awareness of the extension agents on the use of social media for agricultural information dissemination.
2. investigate the knowledge of extension agents on the use of social media for agricultural information dissemination.
3. ascertain the constraints in the use of social media by extension agent.

2. Hypotheses

a) There is no significant relationship between types of social media used and training needs on social media.
b) There is no significant relationship between perception of social media and training needs on social media.
c) There is no significant relationship between knowledge of social media and training needs on social media.

3. Methodology

3.1. Study Area

The study was carried out in Oyo state, Nigeria. Ọyọ State is an inland state in south-western Nigeria, with its capital at Ibadan. It is bounded in the north by Kwara State, in the east by Osun State, in the south by Ogun State and in the west partly by Ogun State and partly by the Republic of Benin. Oyo state is situated in Latitude $7^0$241N and Longitude $3^0$54E as well as altitude 234m above sea level. Oyo state was created in February, 1976 and covers a total of 28,454SqKm of land mass. Oyo state has a population of about 5, 591, 589 people with 33 local government areas. The Climate is equatorial, notably with dry and wet seasons with relatively high humidity. The dry season lasts from November to March while the wet season starts from April and ends in October. Average daily temperature ranges between 25 °C (77.0 °F) and 35 °C (95.0 °F), almost throughout the year (wikipedia, 2013).

The population of the study constituted all the agricultural extension agents that work under Agricultural Development Programme (ADP) in Oyo state.

Sampling Procedure and Sample size: Oyo state has four Agricultural Development Programme (ADP) zones which include Ibadan/Ibarapa, Saki, Oyo and Ogbomosho zones. Ibadan|Ibarapa has 35, Saki 22, Oyo 19 and Ogbomosho 14 extension agents to give a total of 90 respondents. All the 90 extension agents in the state were sampled for the study.

3.2. Measurement of variables

Independent Variables

The use of Social Media

Respondents were provided with list of the following social media: Facebook, Twitter, MySpace, BBM, YouTube, Yahoo Messenger, MSN, goggle talk, logbook, LinkedIn. They were asked to respond to questions related to access, frequency of use and the purpose for which they are used. The mean score was determined to ascertain respondents' access, frequency of use and the purpose for which social media were used for various purposes. This was measured at interval level of measurement

Perception on the use of social media

Respondents were asked to react to 21 perception 5 likert scale statements to ascertain their perception on the training needs on the use of social media for agricultural information dissemination. All positive statements were scored 5, 4,3,2,1, while negative statements were score in reverse other. The perception value above the mean was considered favorable and below mean unfavorable. This was measured at nominal level of measurement.

Knowledge on the use of Social media

Respondents were presented with 16 social knowledge questions. Correct response was score 1 and incorrect response 0. The maximum score was 16, while the minimum score was 0. The scores were standardised using the mean to categorise respondents' knowledge on the use of social media into high and low. This was measured at nominal level of measurement.

Dependent Variables

The dependent variable for this study is the training need on the use of social media. A two point rating scale was used to measure the training needs. The scale was coded needed (1) and not needed (0). A mean value was used to represent the responses into needed and not needed. A training need that was needed has a score equal or above mean and while lower than mean was not needed. This was measured at interval level of measurement.

4. Results and Discussion

Structured questionnaire was administered to all the 90 extension agents sampled by trained enumerators. However, 91.1% return rate was obtained that represented 82 respondents analysed and discussed in this section. Data were analysed with Statistical Package for Social Sciences (SPSS) software to obtain the Pearson Product Moment Correlation (r) and Chi Square ($\chi^{2)}$ values.

Distribution of Respondents according to their personal Characteristics

Table 1 shows that the mean age of extension agents in Oyo State was 38 years, as the majority (84.1%) of them were between 28 and 49 years old. Only 4.9% and 11.0% of them were younger than 28 years and older than 49 years, respectively. This result is consistent with Akinbile (2007) who found that population between 21 and 40 years of age constitute the active work force. It implies that even distribution of age among the extension agents will assure continuity in the extension processes and knowledge exchange among the extension agents required for increase productivities. Majority (89.0%) of the extension agents were male while only 11.0% of them were females. This indicates a serious gender imbalance in the Agricultural Development Projects of the State. In Akinsorotan and Oladele (2009) Agricultural Development Project extension officer are mainly male officers and this is not good for gender equality in extension services. The result further revealed that most of the respondents were married (91.5%) while only 8.5% were single. Nearly all (98.8%) had one form of tertiary education or the other. This result indicates that extension service delivery among the literate minds. This will provide a solid platform to inculcate social media training for dissemination agricultural information required to drive the development of agricultural transformation agenda. (FMRAD, 2011) asserted that education is required as a basic prerequisite to sharpen extension agents' knowledge, skills and practices for effective delivery if food security will be achieved in Nigeria.

Table 1 further show that the mean income per annum of the extension agents was $2,016. The majority (78.0%) of them earn between $884 and $3,149 per annum. The income distribution of the agents reveals that the agents were not well paid in the study area. Consequently, their financial status will affect their purchasing power of ICTs needed for social media. FAO (2012) opined all agricultural extension agents should be well remunerated as an incentive to ensure proper and adequate agricultural information delivery. The mean year of experience of the extension agents was 7 years. The majority (84.1%) of them had between 2 and 13 years of experience. It implies that majority of the extension agents are still learning on the job and adapting to new technologies might not be difficult, this consistent with Jibowo (2005). On the type of extension services used by the respondents, majority (62.2%) operates the T&V service delivery system, while 24.4% of them operate the general extension service system. Only 3.6% specialised in crop and fishery extension, while 6.0% were specialised in women extension service delivery system. It implies that there is a dearth of specialised extension service delivery system in the state and as such makes dissemination of viable information through social media somewhat difficult. This is against Sokoya, Onifade and

Alabi (2012) who found that extension services delivery is developing fast due to the introduction of information communication technology.

Table 1. Distribution of the extension agents according to their personal characteristic N=82

Variables	Frequency	Percentage
Age category (in years)		
<28	4	4.9
28-49	69	84.1
>49	9	11.0
Mean=38		
Sex		
Male	73	89.0
Female	9	11.0
Marital status		
Single	7	8.5
Married	75	91.5
Educational level		
Secondary	1	1.2
Tertiary	81	98.8
Income per annum ($)		
< 884	17	20.7
884 – 3,149	64	78.0
>3,149	1	1.2
Mean= 2,016		
Religion		
Christianity	65	79.3
Islam	17	20.7
Years of experience		
<2	3	3.7
2-13	69	84.1
>13	10	12.2
Mean=7		
Type of extension service		
General	20	24.4
Crop	3	3.6
Fishery	3	3.6
Women	5	6.0
T and V	51	62.2

Distribution of Respondents according to the Type of ICTs use for Social Media

Table 2 shows that all (100.0%) of the extension agents were using mobile phones for extension services particularly through text messages which a major component of the growth enhancement scheme of the agricultural transformation agenda of the Federal Government of Nigeria. Very few were using laptops (26.8%) and desktop computers (20.7%) for extension work. However, none of the extension agents were using the latest multifunctional ICTs that is iPads and tablets which is an indication that the use of ICTs was still low among the agents. Tesfaye (2010) opined that multifunctional ICTs like iPads and tablets offer quicker access to social media as it can be moved around in the farms and rural environment.

Table 2. Distribution of ICTs Use by Extension Agents N=82

ICTs	Frequency	Percentage
Mobile phone	82	100.0
Laptops	22	26.8
Desktop computer	17	20.7
Ipads	0	0.0
Tablets	0	0.0

Distribution of Respondents according to Social media use for Information

Table 3 shows that Facebook was the mostly (47.6%) used social media among the agents, followed by Yahoo Messenger (22.0%). This medium if well harnessed the gap between researchers and farmers can be bridged. This is premised on the fact that social media enables blogging, tagging, discussion and networking. Social networking sites are becoming the mainstream cultural phenomenon and Agricultural Researchers (ARS) have found tremendous role social media can play in establishing connections, facilitating dissemination of agricultural research findings and exchange of information as an important ingredient for increasing agricultural production (Boyd and Ellison, 2007).

Table 3. Distribution of Social Media Use by Agricultural Extension Agents N=82

Variables	Frequency	Percentage
Twitter	7	8.5
MySpace	8	9.8
Facebook	39	47.6
YouTube	9	11.0
BBM	7	8.5
Google talk	10	12.2
Flickr	2	2.4
LinkedIn	3	3.7
Yahoo messenger	18	22.0
MSN	10	12.2
Logbook	2	2.4
Pheed	0	0.0

Respondents' Perception of social media for information Dissemination

Table 4a and 4b show the distribution of respondents according to their perception of social media for agricultural information Dissemination. Extension agents perceived the use of social media to be effectively save time and energy (mean=3.6), they also felt that misuse of social media can negatively affect the extension agent in charge of account (mean=2.9). Extension agents expressed the fact that Social media can be used in other aspect side from extension service delivery (mean=2.4). The Tables further show that more (54.9%) of the extension agents had a favourable perception of social media while 45.1% were unfavourably disposed to social media use. The implication of this is that the extension agents' perception of social media was favourable and if the advantages can be maximised for disseminating agricultural information, farmers will have access to results of researchers needed to boost production. This finding is consistent with Sokoya et al (2012) who affirmed that disposition to the use of social media can affect the use for whatever purpose it is intended.

Table 4a. Distribution of Extension Agents' Perception 0f Social Media N=82

S/n	Statement	Strongly agree	Agree	Undecided	Disagree	Strongly disagree	Mean
1	Social media aids or encourage information dissemination	45 (54.9)	29 (35.4)	-	8 (9.8)	-	1.7
2	Age is not a barrier in the use of social media	19 (23.2)	43 (52.4)	10 (12.2)	10 (12.2)	-	2.1
3	Social media can be use in extension delivery services	37 (45.1)	32 (39.0)	4 (4.9)	4 (4.9)	-	1.6
4	The use of social media may not effectively save time and energy	8 (9.8)	12 (14.6)	4 (4.9)	24 (29.3)	31 (37.8)	3.6
5	Social media can be used in other aspect of life than in extension delivery service	25 (30.5)	22 (26.8)	12 (14.6)	20 (24.4)	3 (3.7)	2.4
6	For new users, social media might require the technical know-how to operate it	19 (23.2)	58 (70.7)	5 (6.1)	-	-	1.8
7	Social media encourage a continuity in inter personal relationship which can help to maintain a cordial extension agent to farmer relationship	48 (58.5)	31 (37.8)	3 (3.7)	-	-	1.5
8	Social media has more advantages to disadvantages	26 (31.7)	47 (57.3)	6 (7.3)	3 (3.7)	-	1.8
9	Social media is not a good platform for confidentiality	17 (20.7)	38 (46.3)	9 (11.0)	17 (20.7)	1 (1.2)	2.4
10	Social media training will encourage the highest level of extension professionalism	45 (54.9)	29 (35.4)	6 (7.3)	2 (2.4)	-	1.6
11	Social media encourage important dialogue	41 (50.0)	33 (40.2)	8 (9.8)	-	-	1.6
12	Social media promotes better and fast agriculture solution	46 (56.1)	30 (36.6)	5 (6.1)	1 (1.2)	-	1.5
13	Extension agents can pay more attention to details through social media	33 (40.2)	26 (31.7)	2 (2.4)	8 (9.8)	13 (15.9)	2.3
14	Social media encourage easy access to information for extension agents	38 (46.3)	33 (40.2)	5 (6.10	3 (3.7)	-	1.6
15	Social media is a good way to enlighten the farmers on issues relating to whatever problem they are facing	38 (46.3)	30 (36.6)	9 (11.0)	5 (6.1)	-	1.8
16	Social media is the best way to improve extension delivery service in Nigeria	41 (50.0)	37 (45.1)	3 (3.7)	1 (1.2)	-	1.6
17	Social media aids the coming together of people in their groups	36 (43.9)	34 (41.5)	6 (7.3)	6 (7.3)	-	1.8
18	Social can be used to easily track farmers inputs and outputs	25 (30.5)	40 (48.8)	6 (7.3)	7 (8.5)	4 (4.9)	2.1
19	Social media help in achieving transparency in extension services	36 (43.9)	30 (36.6)	4 (4.9)	12 (14.6)	-	1.9
20	Social media bring about collaboration between extension agents across the globe	41 (50.0)	32 (39.0)	7 (8.5)	2 (2.4)	-	1.6
21	Social media misuse can affect the extension agent in charge of the account	10 (12.2)	27 (32.9)	19 (23.2)	13 (15.9)	13 (15.9)	2.9
22	There is need for training on the use of social media for extension agents	41 (50.0)	31 (37.8)	7 (8.5)	-	-	1.5

Table 4b. Extension Agents' Level of Perception of Social Media N=82

Variable	Frequency	Percentage
Unfavourable	37	45.1
Favourable	45	54.9

Distribution of Respondents according to their Knowledge of social media

Knowledge test results on Table 5 revealed that many respondents already had basic knowledge of social media. About 95.1% of the extension agents knew about social media and 92.7% knew that it can be used to share innovation. Also, 91.5% knew that it can be used to send information to many people in different places within a short period of time and can be used to store contact details. Okwu and Daudu (2011) observed that Nigeria has an elaborate agricultural research and extension system but the result of these researches are not fully made available to the end users; hence, the researchers, extension workers, farmers, which means that end users are not sufficiently exposed to new knowledge. It is imperative there that effort should be made by relevant government and non-government agencies to establish connections among stakeholders for proper dissemination of current and relevant information/knowledge for sustainable agricultural production.

Table 5. Distribution of Extension Agents' Knowledge of Social Media N=82

S/n	Statement	Yes	
		Frequency	Percentage
1	Have you heard about social media e.g Facebook, twitter, YouTube, 2go, MSN, Pheed etc	78	95.1
2	Do you use social media for personal communication	69	84.1
3	You can upload video, picture, message via social media	62	75.6
4	You can communicate with your farmers through social media	65	79.3
5	You can send information to many in different places within a short period via social media	75	91.5
6	You cannot create personal accounts on social media	49	59.8
7	It is possible to see your farmers while attending to them via social media	42	51.2
8	You can attach documents to be sent through social media	69	84.1
9	You can have personal information or notes on social media	68	82.9
10	You can have conference talk through social media	55	67.1
11	You can share new innovation through social media	76	92.7
12	You can have most of your contact details on social media e.g phone number, email etc	75	91.5
13	Most of your social media account can be linked to each other	65	79.3

Distribution of Extension Agents' Awareness of Social Media

Table 6 reveals that Facebook is the social media that was the most popular (97.6%) and followed by Yahoo Messenger (69.5%). Other social media that they were familiar with include Blackberry Messenger (58.5%), Google Plus (53.6%), Google Talk (52.4%), Youtube (46.3%) and Twitter (42.7). All the respondents maintain at least one account with the social networking sites, but Facebook was the most popular social media used by agricultural extension officers in Nigeria. This support the opinion of Boyd and Ellision (2010) that Facebook is the most used social media in Nigeria.

Table 7. Distribution of Extension Agents' Awareness of Social Media N=82

s/n	Social media	Yes	
		Frequency	Percentage
1	Facebook	80	97.6
2	Twitter	35	42.7
3	YouTube	38	46.3
4	Blogs	16	19.5
5	MSN	25	30.5
6	Google talk	43	52.4
7	Yahoo messenger	57	69.5
8	Google plus	44	53.6
9	2go	51	62.2
10	BBM	48	58.5
11	Pheed	16	19.5
12	Logbook	17	20.7
13	MySpace	23	28.0
14	LinkedIn	17	20.7
15	Flickr	15	18.3
16	Hi5	15	18.3
17	Friend feed	15	18.3

Training need

Table 8 reveals that the top needed areas of training in the use of Facebook among the agents were 'tagging contact to a picture or video (70.7%), 'placing an advertisement (70.7%)', 'creating a group (68.3%)' and 'uploading pictures and videos (64.6%)'. The top needed areas of training in the use of Twitter were 'opening an account (78.0%)', 'posting a link (76.8%)' and 'making a tweet one's favourite (76.8%)'. In addition, the top needed areas of training in the use of YouTube were 'placing an advertisement (78.0%)', 'posting a video message (76.8%)' and 'viewing a video (76.8%)'. The top needed areas of training in the use of Blog were 'creating an account (76.8%)', 'posting messages and information (76.8%)' and 'maintaining an account (76.8%)'. This result shows that the extension agents require basic skills in the use of all the social media.

Table 8. Distribution of Extension Agents' Training Need on the Use of Social Media N=82

S/n	Variable	Needed	
		Frequency	**Percentage**
A	**Area of training Facebook**		
1	Opening Facebook account	48	58.5
2	Uploading pictures and videos	53	64.6
3	Posting message	40	48.8
4	Share Information	41	50.0
5	Create your group	56	68.3
6	Send and receive messages	39	47.6
7	Place an advertisements	58	70.7
8	Search for new friends	45	54.9
9	Add new friends	46	56.1
10	Tag contact to a picture or video	58	70.7
B	**Area of training on Twitter**		
1	Open an account	64	78.0
2	Post tweet	55	67.1
3	Post link	63	76.8
4	Follow a friend	57	69.5
5	Unfollow a friend	55	67.1
6	Search for new friends	54	65.9
7	Make a tweet your favorite	63	76.8

S/n	Variable	Needed	
8	Send and read direct messages (DM)	54	65.9
C	**Area of training on YouTube**		
1	Open an account	60	73.2
2	Receive video message	60	73.2
3	Post video message	63	76.8
4	Placing advertisement	64	78.0
5	Searching for videos	61	74.4
6	downloading video	61	74.4
7	How to view video	63	76.8
D	**Area of Training on Blog**		
1	Create an account	63	76.8
2	Post messages or information	63	76.8
3	Receive message or information	62	75.6
4	Create a link to other media	62	75.6
5	Maintain an account	63	76.8
E	**Area of training on 2go**		
1	Registration of an account	59	72.0
2	Receive and send message	58	70.7
3	linking it to other social media	58	70.7
4	Receive messages from other social media	58	70.7

Hypotheses testing

Result of analysis on Table 9 shows that there were no significant relationship between sex (χ^2=1.347, p>0.05), religion (χ^2 = 1.652, p>0.05), type of extension practice (χ^2 =8.729, p=0.05) and their training need on the use of social media. However, there was a significant relationship between their educational level (χ^2 =10.142, p<0.05), marital status (χ^2 19.632, p<0.05) and training need on the use of social media. This result implies that the extension agents' training need on the use of social media is irrespective of their sex, religion and type of extension practice, but on their marital status and educational level. The significance of marital status is due to age category. The expected relationship between educational level and training need was upheld; meaning that the more educated an extension agents had less need for training on social media. In a related study, Sokoya et al (2012) affirmed education is imperative to acquiring social media skills.

Table 9. Chi Square relationship between socioeconomic characteristics and training need

Variable	Chi-square value	df	p-value
Sex	1.347	1	0.246
Marital status	19.632	2	0.000*
Educational level	10.142	1	0.041*
Religion	1.652	2	0.438
Type of extension practice	8.724	5	0.121

***significant : p<0.05**

Result of analysis on Table 10 shows that there was significant relationship between social media used (r= -0.337, p<0.05) by the extension agents and their training need on the use of social media. This could be due to the similarities in commands of all the social media; an agent that is vast in the use of one is likely to be able to use another well enough, Steinfeld and Lampe (2007) also establish the fact that social media provides a unique environment because of its heavy usage patterns, ability to bridge gaps and similarity among the social media helps in the usage. The Table further revealed that there was a significant relationship between extension agents' perception of social media (r=0.935, p<0.05), knowledge of social media (r= -0.875, p<0.05) and their training need on the use of social media. It implies that the extension agents put a lot of value on the potentials of social media and therefore would like to be trained on its use for their professional effectiveness. In a related study, Paul

(2011) asserted that, afterschool professionals increasingly embrace social media platforms as perception and knowledge increases, but there seems to be a limited understanding of its applicability to the workplace. Thus, the call for training becomes imperative for the extension agents.

Table 10. Pearson Product Moment Correlation (PPMC) Showing Relationship between Social Media Used, Perception, Knowledge and Training Need

Variables	r-value	p-value
Perception of social media	0.935	0.028*
Knowledge of social media	-0.875	0.033*
Social media used	-0.337	0.002*

***significant : p< 0.05**

5. Conclusion and Recommendations

The weak linkage between researchers, extension agents and farmers explains the failure in application of research findings to improve rural poor farmers. A critical and effective training platform for agricultural extension agents will foster meaningful participation to harness social media skills. Deliberate capacity building programme as an integral part of all ICT projects will also guarantee food security and human resource development through knowledge building and information sharing. Based on the foregoing, the following recommendations were made:

- Agricultural extension training should encourage e-learning programmes using various social media platforms.
- Relevant stakeholders in agricultural extension delivery should facilitate an extension system that is ICTs driven.
- Nigerian agricultural technology transfer policy should emphasize the use of social media for transfer of technical information to farmers.

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