Bio@gro – An online multilingual organic agriculture e-services platform

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Abstract. Although worldwide organic agriculture is constantly gaining ground compared to traditional agriculture, still a number of countries encounter problems mostly related to lack of validated information and knowledge, technical support by specialized agronomists, coordination and organization of the trading network and promoting mechanisms. The appropriate use of Web technologies and mobile computing and communications can help to the solution of the aforementioned problems. In this context, this paper presents the bio@gro e-services platform, which provides accurate, certified and multilingual content (i.e. information and services) related to organic agriculture through Internet connected devices or mobile phones using the short message service. The proposed platform takes into consideration the organic agriculture stakeholders’ needs from Greece, Germany, Romania and Cyprus. More specifically, it aims at providing to organic agriculture stakeholders electronic business, electronic learning and electronic government content in four languages, namely in Greek, German, Romanian and English in order to offer information on several aspects of the organic agriculture domain, to provide the ability to exchange views and experiences as well as to compare the means, methods, practices and cultivation techniques used in each country.
Keywords: Organic agriculture, electronic services, mobile services, multilingual content

1. Introduction

Organic agriculture (OA) is one of the fastest growing agricultural sectors during the last decades with a continuous increase in production and consumption of organic products. It is constantly developing, practiced in approximately 100 countries all over the world. According to [1], in 2006 more than 26 million hectares globally were managed organically, with Oceania, Latin America and Europe holding respectively 42, 24.2 and 23% of total organic land. The agricultural community is turning to certified organic farming systems as an alternative way to decrease reliance on non-renewable resources, preserve the environment, assure food quality and promote sustainable development in rural areas [2]. Moreover, many consider that OA can meet the demands for lower input costs and capture of high-value markets and premium prices, and therefore increase the farmer’s income. Nowadays, OA is considered as a promising sector in an increasing number of countries. As a result, many of their governments are providing support to it.

Globally, many agricultural organizations and institutions have developed Web sites and portals, attempting to facilitate access to OA content (i.e. information and services). Searching the Web using

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popular search engines (e.g. Google, Live, Yahoo) for the term ‘organic agriculture’, useful conclusions were extracted. In specific, the Web sites or portals of large international organizations, such as the Food and Agriculture Organization of the United Nations (FAO, URL: http://www.fao.org/organicag) and the International Federation of OA Movements (IFOAM, URL: http://www.ifoam.org), as well as non-profit organizations, such as the Organic Europe portal (URL: http://www.organic-europe.net) and the OA Centre of Canada (URL: http://www.organicagcentre.ca) provide content concerning, mainly OA principles, information for consumers, transition strategies, certification, research results, news, country reports, statistics, events, bookstores etc. Most of them refer to researchers presenting scientific results, statistics and objectives of projects. Furthermore, none of them provides access to OA content via mobile and wireless communication technology, even though the use of mobile devices (e.g. mobile phones, smart phones, personal digital assistants) has been rising rapidly during the last decade [3].

In many European countries, OA stakeholders encounter a number of problems (e.g. high production cost, lack of specialized OA technical knowledge and information, technical support by specialized agronomists, coordination and organization of the OA trading network, promotion mechanisms), which contribute notably to the blocking of the further development of OA [4]. This fact reinforces the view that the current European OA supportive mechanisms are inefficient and there is a need not only for evolving them but also deploying alternative ones.

To this direction, the objective of this paper is to present the development of an electronic services (e-services) platform for OA, termed as bio@gro e-services platform providing access to accurate and multilingual OA electronic business (e-business), electronic learning (e-learning) and electronic government (e-government) content, as well as mobile services for all European stakeholders of the OA value chain (e.g. organic farmers, traders, processing companies). This platform has been developed in the context of the European e-Content Programme project 11293: ‘Bio@gro’ for information dissemination and public awareness increase regarding OA [5]. The design of the platform is based on a thorough analysis of the requirements of OA stakeholders in four European countries (Greece, Germany, Romania and Cyprus). The platform is based on portal technology and mainly supports: (a) access to multilingual content, and particularly in four languages Greek, German, Romanian and English, (b) access to specialized, updated and certified OA content, and (c) access via different communication channels (i.e. Internet, short message service – SMS). The remaining of this paper is structured as follows: the next section identifies the OA stakeholders and determines their requirements. The third section describes the way bio@gro e-services platform is designed and deployed following the stakeholders’ requirements, portal and multi-access technology principles. The fourth section refers to the OA content of the platform. The fifth section presents the platform’s evaluation results. Finally, the sixth section lays down the conclusions of this work.

2. Bio@gro requirements

This section presents the requirements of all key stakeholders of the OA value chain in Greece, Germany, Romania and Cyprus, as regards access to OA content via different communication channels. According to [6], the identified OA stakeholders are:

- **Organic farmers (individuals or farmers’ groups)**, who are interested in finding information and selling their organic products as quickly as possible.
Traders, who want to find information, buy organic products and distribute them. Wholesale enterprises, retail stores, certified shops, supermarkets, street markets, health food shops and even conventional greengrocery stores are considered as traders.

Processing companies, which purchase organic products and use them as raw material for the production of secondary products, such as jam, pasta and dairy products.

Buyers, who want to be informed about organic products or buy them. They can be distinguished into individuals or collective buyers (e.g. restaurants, hotels, hospitals).

Administration bodies, which are responsible for the provision of all the necessary legislation, support, and the coordination of developing initiatives. They are also responsible for the issuing of the OA legislation, as well as the monitoring and supervision of the certification system.

Certification and inspection organizations, which are the exclusive certification bodies for organic farmers. Apart from certification, these organizations promote OA with a series of activities, such as the publication of relevant books and magazines and organization of educational conferences and special informational events.

Research institutions and universities, such as the OA laboratories, which are in charge of research, innovation and technological advancements in OA.

Agronomists and farm advisors, who can act as consulting agents to organic farmers.

European agricultural agencies, which are responsible for OA activities in European countries.

The determination and analysis of OA stakeholders’ requirements is of particular importance, since it contributes to the better delineation of the stakeholders’ profile and more profound comprehension of their needs, as well as to the creation of a package of certain requirements for the platform design. The gathering of stakeholders’ requirements has been realized through questionnaires [7]. The survey was carried out in April and May of 2005. In particular, two types of questionnaires have been produced targeting to specific groups. The first group was OA experts who have also experience in the use of information and communication technologies. This group included mainly members of administration bodies, certification and inspection organizations, research institutions and universities, and European agricultural agencies as well as agronomists and farm advisors. A total of 133 questionnaires has been produced. More specifically, 21 questionnaires were from agronomists, 15 from academics, 7 from veterinarians, 10 from researchers, 5 from food scientists, and 76 from other OA experts (e.g. consultants, economists). All of them hold a university degree, while 38% hold also a PhD degree. Most of the experts (almost 80%) have daily access to the Internet. The majority of the experts (97%) believes that the Internet can support OA activities as well as that the existing level of OA information obtained from various sources, such as organizations, newspapers, radio and TV, is not satisfactory. They suggest that all the OA stakeholders should have access to information and services through the Internet (considered to be very important). About 79% of the experts prefer services delivered through Internet, while 11% believe that mobile services are extremely or very important.

The second group included buyers, farmers, traders and processors. A total of 752 questionnaires has been produced. In particular, 502 questionnaires were from buyers, 188 from farmers, 31 from traders, and 31 from processors. About 30% of the buyers have basic education, while 30% of them are graduates of higher education. Farmers appear to have basic education with school leaving certificate, while traders and processors have mostly college or higher education. A total of 72% of the buyers, 90% of the processors and 82% of the traders have Internet access. Most of the farmers (56%) are interested in a Web portal concerning OA, with the highest percentages appearing in traders (87%) and processors (96%). Farmers (52%), processors (79%) and traders (68%) are interested in being advertised through an OA Web portal.
The analysis of the results has proven that the OA stakeholders consider as very important the ability to access via Internet the following content categories: news and events, directories to OA related links, legislation and certification issues, e-learning services, OA market reports and trends, directories of suppliers, traders, farmers, electronic shops (e-shops) and electronic markets (e-markets) with OA products, as well as online resources and services offered by public agencies.

Especially for farmers, the use of SMS in mobile phones appears to be a promising solution, since they are not computer literate, they usually are far off the markets and policy-making centres and it is neither always feasible, due to lack of transportation, time, money or bad weather, nor convenient to travel for obtaining the necessary information for participating in markets or for making use of public services [8]. Thus, farmers’ considerations for content via SMS are: (a) product information concerning new cultivation techniques and product prices, (b) epidemic alerts, referring to the outbreak of diseases, (c) weather alerts, concerning weather forecasts and extreme weather conditions, (d) legislation news, referring to new laws and regulations, (e) administrative information, which has to do with notifications for procedures of public agencies, and (f) business news, concerning any information about business activities.

3. Bio@gro e-services platform design and deployment

Taking into account the analysis of the questionnaires’ results, the bio@gro e-services platform architecture is subsequently presented, based on a three tier model comprising: (a) the data tier, where the data are stored in a database and all the supported services store and retrieve the necessary data to/from this tier, (b) the application tier, where the processing of the data takes place through specific modules, and (c) the presentation tier, that is responsible for transforming the data to the appropriate display format for the device that requested connection. In particular, due to different display capabilities (e.g. screen resolution and colour depth) of desktop computers and mobile devices, the presentation tier has to adjust the requested data according to the display capabilities of the device.

Analyzing the application tier, its constituent modules are described as follows:

*Information catalogue module*: This module is responsible for providing users with searching capabilities through the deployment of multiple and hierarchical levels of information supported by an advanced criteria-searching mechanism.

*Search mechanism module*: This module acts complementary to the information catalogue module, and provides searching capabilities through multiple criteria (category, date of publication, publisher, type of content etc.). To support this searching functionality, the module provides free text searching and the ability to group results by criteria.

*Web presence module*: This module is responsible for providing users with the ability to develop and operate their own Web site. It provides rapid and accurate content management, dynamic development of Web pages and creation and modification of content using user friendly tools.

*Business opportunity module*: This module allows searching for potential business partners (e.g. traders, farmers, processors) and exploitation of new business opportunities. This module is composed of the following sub-modules:

- *Business opportunity catalogue sub-module*: This sub-module permits users to upload their product catalogue including information such as prices and delivery methods.
- *Business opportunity publishing/submission sub-module*: This sub-module permits users to submit their business collaboration requests/offers.
• **Business opportunity searching sub-module**: Through the use of this sub-module, users are able to search for business opportunities either by a step-by-step guide (wizard) or by a search mechanism.

• **Business opportunity matching & notification sub-module**: This sub-module provides automatic user notification, whenever new business opportunities submitted at the system.

**Mobile services module**: This module provides direct and up-to-date information mainly to organic farmers via SMS. The information refers to a range of issues, such as organic products information, weather and epidemic alerts, subsidies, legislation news, product prices and market status, deadlines for submitting important documents, announcements and events.

**Advertising service module**: This module is used to support advertising services. It provides the ability to manage and post advertising banners on specific Web pages of the bio@gro e-services platform.

**Online certification form module**: This module provides the ability to organic farmers to download and submit documents online regarding certification issues provided by certification bodies.

**User registration module**: This module provides the ability to users to register in order to gain access to the full capabilities that are available to the bio@gro e-services platform.

**Administration module**: This module deals with the content management and the administration of all services provided by the above modules. It also supports the administration of users and management of their access rights and permissions.

The bio@gro e-services platform is divided into the ‘client system’ and the ‘administration system’. The ‘client system’ is split into the ‘public e-services subsystem’ and the ‘private e-services subsystem’ that can be accessed by users according to their type, rights and permissions. In particular, two types of users are supported, namely ‘non registered’ and ‘registered’. ‘Non registered’ users can access the ‘public e-services subsystem’ via Internet and use the following modules: (a) information catalogue module, namely searching and viewing the part of content that is available for free, (b) search mechanism module, (c) business opportunity searching sub-module, (d) online certification form module, namely to view, download and print forms, and (e) user registration module. ‘Registered’ users can access the ‘private e-services subsystem’ via Internet or SMS, and use the following modules: (a) information catalogue module, (b) search mechanism module, (c) Web presence module, (d) business opportunity module, (e) mobile services module, and (f) online certification form module. The ‘administration system’ is accessed by the ‘administrator’ and the ‘content group’. It is supported by the administration module. The ‘administrator’ controls and manages the operation of the platform and users’ access rights and permissions. The ‘content group’ is responsible to collect and publish proper and up-to-date content.

Figure 1 depicts an overview of the bio@gro e-services platform architecture. The implementation of the platform is based on the concept of using a user friendly, open and cost effective solution. Therefore, the current version of the bio@gro e-services platform is based on PHP scripting language that is especially suited for Web development and can be embedded into hypertext markup language (HTML). Furthermore, the open source PHP layers menu system and the PlaySMS mobile portal system are used. The PHP layers menu system is a hierarchical menu system for the creation of ‘on the fly’ dynamic HTML (DHTML) menus, while PlaySMS is an SMS gateway, which communicates directly with an SMS centre responsible to store and forward messages to and from a mobile phone. PlaySMS is also in PHP and can be modified so as to fit to various services such as personal messaging, group communications, marketing, mobile emergency services, mobile information services and mobile commerce. The platform is backed up from the MySQL database server which is a multithreaded, multi-user SQL database management system (DBMS).

Figure 2 presents the home page of the bio@gro e-services platform, while Fig. 3 presents the screen of a mobile phone that received an SMS form the platform. In order to secure the platform at
the application tier the transport layer security (TLS) protocol is used. TLS is concerned as cryptographic protocol which provides secure communications for Web browsing, e-mail, instant messaging and other data transfers. It allows applications to communicate across a network in a way designed to prevent eavesdropping, tampering, and message forgery [9]. Furthermore, in order to ensure the quality of the content, the members of the ‘content group’ are identified using digital signatures. The access to the bio@gro e-services platform is available through several URLs: http://www.bioagro.gr, http://www.bioagro.ro, http://www.bioagro.com.cy, http://www.bioagro.info, http://www.bioagro.biz, http://www.bioagro-deutschland.de, http://www.bioagroportal.net, http://www.bioagroportal.info. The reason for this selection is the multilingual and multinational orientation of the platform, so that the users get a feeling of a local (in terms of nationality) system.

4. Bio@gro content

The main focus of the bio@gro e-services platform is the provision of accurate and certified content that is collected by the ‘content group’. Therefore, the ‘content group’ uses a content collection methodology that takes into account the priorities, peculiarities, crop-production needs, marketing and trading needs, specific conditions that OA presents in European countries, and OA stakeholders’ requirements for content. The content collection methodology includes the following stages: (a) tracking down and collecting bibliography, Web sites, portals, databases, projects results etc., (b) evaluating, organizing and classifying content, (c) approving and registering content, and (d) Web publishing. The home page of the bio@gro e-services platform presents the following content categories (Fig. 2).
What is OA: This category includes the core definitions for OA, the principles of OA, and glossary of terms as presented by various validated OA sources such as non-profit organizations, research institutes, universities and scientific journals. The functionality of this category is supported by the information catalogue module and the search mechanism module.

Legislation and certification: This category contains a detailed description of the current legislation related to OA at European, national and international level. Due to the fact that legislative documents
are commonly written in a very complicated way, parts of them have been transformed (interpreted, explained and simplified) to a more understandable form. The functionality of this category is supported by the information catalogue module, the search mechanism module and the mobile services module.

**Information resources:** This category includes news, announcements, events, links to European and national OA initiatives, links to certification bodies and monitoring organizations, information about labelling of organic products, links to other related Web sites. The functionality of this category is supported by the information catalogue module, the search mechanism module and the mobile services module.

**Educational resources:** This category provides a catalogue of online educational resources, a digital library with OA reports, studies, papers, e-learning courses, best practice guides and frequently asked questions for OA. The functionality of this category is supported by the information catalogue module, the search mechanism module and the mobile services module.

**E-business resources:** This category is divided in the three sub-categories, as follows:

- **Business outlook:** This sub-category contains subsidiary programs, organic advisory and related services such as taxation related to OA (European and national), market reports, market information and trends, OA product price reports and status, etc. The functionality of this sub-category is supported by the information catalogue module, the search mechanism module and the mobile services module.

- **Promotion and collaboration:** This sub-category includes contact details for suppliers, traders and farmers, presentation of products and advertising services, where interested parties can promote their enterprises and/or products and search for business partners. This functionality of this sub-category is supported by the Web presence module, the business opportunity module and the mobile services module.

- **E-shops and e-markets:** This sub-category provides links to existing e-shops and e-markets. The functionality of this sub-category is supported by the information catalogue module and the search mechanism module.

**E-government resources:** This category provides a directory of OA related governmental organizations and agencies as well as a directory of e-services offered by governmental organizations and agencies. Moreover, the platform offers to ‘non registered’ users the ability to download and print online forms of certification issues while to those who are ‘registered’ the ability to submit these forms online. This is offered in collaboration with certification bodies. The functionality of this sub-category is supported by the information catalogue module, the online certification form module, the search mechanism module and the mobile services module.

The content objects included in the aforementioned categories of the bio@gro e-services platform are termed as ‘bio@gro content objects’ or simply BCOs. A BCO is defined as a single information unit that can be identified, collected, and described in a meaningful and useful (for the OA stakeholders) way. BCOs are categorized in the platform, either collected from the Web or developed by the ‘content group’. They have related copyrights or permissions of use (restricted access) and some may not (free access). The documentation and identification of BCOs follow the international metadata standards [10]. A number of 1665 BCOs is available in the platform, translated in German, Greek and Romanian as well as in English. In specific, there are 103 BCOs in the category ‘what is OA’, 116 in ‘legislation and certification’, 712 in ‘information resources’, 270 in ‘educational resources’, 411 in ‘e-business resources’ and 53 in ‘e-government resources’.
5. Evaluation results

In this section the platform’s evaluation results are presented. The evaluation was carried out in middle of 2006 with users from the countries under study (Greece, Germany, Romania and Cyprus). The goal of the evaluation is threefold: firstly, to evaluate the functionality and the user friendliness of the platform; secondly, to evaluate the content publishing mechanism of the platform; and thirdly, to evaluate the users’ behaviour while navigating the platform. Thus, different methods were used in order to collect multi-criteria evaluations [11]. More specifically, the following methods were selected:

- **Structured questionnaire**: A questionnaire consisting of 20 questions with grades ranging from 1 to 4 was used, as researches have proved that people often tend to decide for the medial number. This type of evaluation has been carried out by using offline and online questionnaires.
- **Semi-structured interview**: The semi-structured interviews were divided in two phases. In the first phase the interviewees have been asked to fill a questionnaire about the validity, the completeness, the up to date, the value added and ease of use of the platform’s content using ranging from 1 to 4. In the second phase, OA experts have been asked to answer by full text input to questions about (a) strengths and weaknesses of the platform, (b) accuracy of information, (c) usefulness of the services, (d) competitiveness to relevant sites/portals, and (e) proposals for improvement.
- **One-on-one testing**: This test was used for observing the activity of users in the bio@gro e-services platform. Specific tasks were selected to be completed and the results were recorded in categories such as the number of successful tries, the number of failures and the time spend (minutes) to come to success.
- **Cognitive walkthrough**: This method was applied on the platform’s administration system where the ‘content group’ tested the creation of a BCO following the necessary steps. In order to identify critical points within the administration back office and the improvements needed, the evaluators were asked about: (a) the problems appeared while creating a BCO, (b) expectations in the use of the back office mechanism, (c) suggestions for improving the back office mechanism, and (d) the security of the back office mechanism.
- **Log files analysis**: It has been performed using a log file analyser in order to extract statistics and understand the traffic patterns. This method measures the usability of the platform in terms of different metrics, such as frequency of use of a specific page or the navigation patterns that the users follow.

The first three evaluation methods have been carried out by groups of students, farmers and agronomists. The evaluation survey has resulted in 282 structured questionnaires, 134 semi-structured interviews, and 131 one-on-one testing. From the analysis of the results, it has been identified that the platform seems to have met the basic stakeholders’ requirements in terms of functionality, content quantity and quality, as well as usability. In details, 70% of evaluators have responded that navigation is easy (the average rating was over 3 out of 4), while only 10% had difficulties in navigation that lead them to consider it as poor. Moreover, most of the evaluators proposed that the content needs to be extended in order to cover more aspects of OA such as agro-tourism and eco-tourism. In the cognitive walkthrough method, 14 out of 18 members of the ‘content group’ participated. They performed successful submissions of BCOs over 700 times, but they suggested that improvements concerning the content publishing mechanism are needed, in order to be easier and less complicated. The log files analysis revealed an always increasing average of visits. It showed an average of 34 visitors per day with an average duration of visiting time near to 23 minutes. The majority (about 55%) of the visitors, during their visit, viewed
more than 10 pages. Most of the users used the platform only once, but 20% of them have visited the platform more than once. These numbers are very encouraging as they show a constant increase of the times that each unique visitor uses the platform, leading to an increased popularity and acceptance.

6. Conclusions

This paper presents the bio@gro e-services platform that aims at facilitating the access to OA content through the Internet and/or mobile phones. In specific, the bio@gro e-services platform takes into account the peculiarities, different needs and priorities that the European OA presents. It provides accurate, certified and multilingual e-business, e-learning and e-government content related to OA through Internet connected devices or mobile phones using SMS. The content is available in four languages: English, Greek, German and Romanian, through several URLs. It is estimated that the multilingual content will support and increase the internationality of the platform, enabling OA stakeholders to exchange views and experiences as well as to compare means, methods and cultivation techniques used in other countries. Furthermore, the conclusions of the evaluation will be used as guidelines for the improvement of the platform’s structure and content in order to cover more aspects of OA. The implementation of the platform is based on the concept of using a user friendly, open and cost effective solution. Therefore, the platform can be easily modified and adapt in order to support the needs of other agricultural sectors as well as other business sectors.

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