Designing an e-Business Agricultural Decision Support Company: The Case of Olivenia

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Abstract. The primary sector has been receiving increasing attention both at national and global level aiming at the quality of nutrition. 93% of worldwide olive production comes from Spain, Italy and Greece that treat olive farming not only from a solely economic point of view but as a way of living, too. Pests and diseases of the olive tree can cause damage, if not addressed, reaching levels of up to 80% of the production. Existing methods (biotech, growth regulators, symbiotic bacteria destruction, pests' technical sterilization, etc.) in order to be efficient & effective require information/prediction on the biological cycle of pests that is not currently available. Olivenia is a Smart Agri application in order to help olive farmers manage their crops and to effectively and efficiently tackle the diseases and pests of olive trees by providing detailed instructions on the least harmful possible required preventive and therapeutic actions in order to maintain quality and quantity of crop. ICT methods allow not only for easy pertinent data collection and fast prediction activities on the threats of the crop but also for knowledge mining and extraction from collected data.

Keywords: Decision Support System; SaaS; Olive-fruit fly; Electronic smart-traps.

1 Introduction

Nowadays, the need for support and development of primary sector receives increasing attention both at national and global level as modern studies attribute the quality of nutrition. The development of increased quantity and healthier foods by use of biological methods or the use of cultivation practices with less chemicals and fertilizers are a requirement in societies and markets. Still, this very requirement of active reduction of chemicals and fertilizers creates problems in farming.

For Spain, Italy and Greece, one of the key crops of the primary sector is based on olive trees and their products but it also represents the continuation of a tradition and a way of living. Accordingly, olive related holdings should be not assessed only from

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a purely economic point of view as in numerous cases are also associated with many other non-economic factors that make olive tree production sector a way of living.

Olive oil is one of the basic ingredients of the famous Mediterranean diet and has enormous benefits for health. According to numerous studies the consumption of olive oil can control cholesterol (Mensink and Katan, 1989; Planell et al, 2014; Visioli et al, 1995) and protect from heart disease (De la Torre et al., 2017; Estruch et al., 2013; Keys et al., 1986). It is associated with reduced risk of diabetes (Martínez-González et al., 2008; Lasa et al., 2014), reducing blood pressure (Galvão Cândido et al., 2017) and inhibiting the development of some forms of cancers (Escrich et al., 2011; Storniolo and Moreno, 2016; Smith-Warner et al., 2001; Trichopoulou et al., 1995; Ayoub et al., 2017). Finally, olive oil can be a great ally for weight loss (Esposito et al., 2011; McManus et al., 2001).

However, the management of olive-related diseases is still being currently addressed with terms and practices of the past century, despite the plethora of modern technologies for monitoring and early warning of possible outbreaks. In particular, the pest olive-fruit fly (*Bactrocera oleae*) is the most serious entomological enemy of olive and is nowadays prevalent in all the olive cultivation/producing countries. The damage it can cause in the absence of control measures, can reach up to 80% of production (Neuenschwander and Michelakis, 2009; Neuenschwander et al., 2009).

Depending on the region, olive-fruit fly displays two to five generations per year (Donia et al., 1971; Economopoulos et al., 1982; Kapatos and Fletcher, 1984). It can even be found during the winter in the olive groves as a fully developed pest in case the climatic conditions are not prohibitive for its survival. Accordingly, in areas with mild winters and when the olives-fruits are suitable for feeding the larvae of the pest, it may be possible to have it present in all its biological stages.

1.1 Motivation and contribution

It is therefore clear that tackling the olive-fruit fly is a very complex problem. The common method producers use, chemical applications, with total or partial coverage may be completely ineffective if the application (in most cases spraying) is not in the correct and optimal time and place. To tackle the pest, chemical control may be applied preventively and/or therapeutically. Unlike the therapeutic approach, the preventive, in order to be effective, is applied over large areas to address re-infection scenarios so it is organized by organizations such as ministries of agriculture and local farming directors. A prerequisite for the success of the bait method (ground or air) is timely and meticulous implementation of the first spray that is decisive for the further course of the pest control since it coincides with foundation generation of the pest. It is therefore obvious that the urgent need for reliable monitoring & prediction of the biological cycle of pests and diseases affecting the olive trees are of great impact on their control. Advanced Information Communication Technologies (ICTs) provide for management of crop-land, IoT sensory hardware, cooperating with manually collected data from the field, as well as organisation and prediction of pests' and diseases' activities.

In order to address these requirements, this work proposes the design of an e-Business Agricultural Decision Support (DS) company based on the experiences of the “Olivenia” venture. Accordingly, the key contributions of this work can be summarised as follows:

- Overview of current applications of ICT in agriculture and specifically on the olive-tree sector,
- Proposal of a novel way to address the existing shortcomings,
- Identification of market opportunity, and
- Definition of revenue model.

2 The case of “Olivenia”

Olivenia, a name coined for a venture presented in the 2017 KATANA contest[1], an EU Horizon2020 project that aimed at promoting ICT in the agrifood sector and at funding new ideas. The proposal[2] of Olivenia got the fourth position at the initial sorting of ideas from a pool of approx. 600 ideas from all over Europe.

Olivenia is a Smart Agri application in order to help olive farmers to effectively and efficiently tackle the diseases and pests of olive trees by providing detailed instructions on the least harmful possible required preventive and therapeutic actions in order to maintain quality and quantity of crop. The ICT methods proposed did not only allow for easy pertinent data collection by the farmers and fast prediction activities on the threats of the crop but also for knowledge mining and extraction from collected data that would otherwise be very hard to do manually and are necessary for better crop management.

2.1 Cropland management

Initially, users/farmers determine the geo-characteristics of their farmland to allow the system to use the geo-informational graphical features for pests’ and diseases’ predictions. This is necessary in order to define the main entity of land describing the geographic area of a farmer’s/user’s olive grove as well as the mounting points of pests’ traps (Fig. 1).

1 http://katanaproject.eu/

2 https://www.youtube.com/watch?v=wWY-RVm91q8

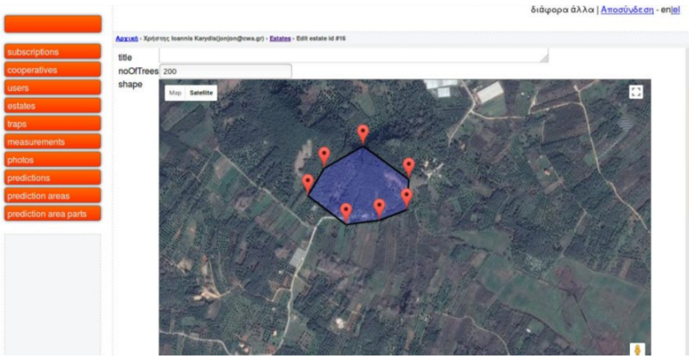

Fig. 1. Cropland management interface during design and development.

2.2 Information collection from traps

Olivenia includes a mobile application (app) for both android & iOS operating systems that is designed to allow users / farmers perform a semi-automated information collection from traps. The app uses the GPS position sensor of the smartphone to determine the trap being tested and subsequently raises predefined questions, to the user/farmer, regarding the status of the trap. The questions are related to the collected olive-fruit flies. Moreover, the app supports taking pictures of collected pests for further training of automatic inference of pests' characteristics (Kalamatianos et al., 2018). The collected data are automatically submitted to Olivenia's servers using internet access, when available.

Olivenia uses fully automated smart-traps as a way of collecting, digitising and transmitting the necessary data at a processing center based on the Electronic Olive Fruit (E.O.F.) fly trap, i.e. an electronic version of the classical McPhail trap (Kalamatianos et al., 2018). This trap is self-sustainable as far as electric power is concerned by use of batteries and charging solar panels and features a multitude of meteorological sensors, a camera and networking capabilities. An array of such traps / sensors, placed in an olive grove, forms an ad-hoc network that makes propagation of information easier, almost not requiring physical presence, given internet access at any point of the ad-hoc network and minimal required maintenance for the cleaning and liquids' refresh of the McPhail part of the E.O.F. fly trap.

2.3 Exacerbation & treatment recommendations predictions

The user/farmer has the opportunity to receive outbreak predictions and treatment recommendations for the olive-fruit fly. The predictions are customized to the characteristics of the specific farmland. Outbreak predictions and treatment proposals, aside from being available at request, are also sent to the mobile device of the user/farmer for timely information dissemination. Moreover, if a prediction for actions to farmers, whose results are likely to affect other farmers (e.g. due to physical proximity of croplands) is made, the service also notifies all interested parties.

It is thus evident that Olivenia tackles the knowledge creation & information dissemination as a continuous process not relying or necessary requiring the interested parties' action to provide timely results. All in all, Olivenia provides olive farmers with: (a) virtual cropland management using graphical interface, (b) smartphone applications allowing hassle-free collection of information from traps set on olive trees, (c) smart-traps minimizing the required manual activity performed at the traps using arrays of sensors and wireless connectivity, (d) information on the actions required in order to tackle the pests, and (e) pest outbreak predictions and necessary treatment recommendations.

2.4 Monetization scheme

The business model followed by Olivenia is based on the subscription for the olive-grove cataloging and prediction services. Initial plans are to include only the temporal dimension of the subscription (yearly & perpetual) while future plans include the olive-grove's size dimension as well. Given a subscription's expiration, the user's account will retain all information, but no changes will be possible nor any prediction services will be rendered.

The minimum duration of a package (5 years) was selected based on the requirement of the algorithms for training to be able to provide customized results in outbreak prediction and on the cultivation cycle's special characteristics. The "perpetual" package's duration was based on the requirement for increased sales-driven services especially when for these the key expenditure on ICT infrastructure resources is almost constant. Accordingly, Olivenia's perpetual levels of "temporal" subscription is valid for as long as Olivenia exists as a company, and Olivenia is run by the same company, and Olivenia offers to its customers the same SaaS product the "forever"/"perpetual" subscription refers to.

The "perpetual" package is also divided into two differentiated categories based on the inclusion of smart-traps. Accordingly, the "perpetual" package does not include leased smart-traps, while the "perpetual+" does indeed. The extraneous cost of including the appropriate volume of smart-traps in the "perpetual+" package is to be leveraged by increased cost of the package and minimization of the manual labour required by the user in providing for the prediction algorithms. The simple "perpetual" package is expected to lead to minimized use of the prediction services in some cases by the users given the lack of their input and thus minimization of the increase of the yield of the grove.

2.5 Effects of using Olivenia

Given the damage the olive-fruit fly can cause, in the complete absence of control measures, reaching of up to 80% of production (Neuenschwander and Michelakis, 2009; Neuenschwander et al., 2009), it's safe to assume that use of Olivenia is expected to increase the effective production in the range 10% to 20% (Fig. 2), by solely performing the usual suppression of the olive-fruit fly but in a more effective and efficient way. Using the "perpetual" subscription, farmers with olive groves as small as 250 olive trees break-even the cost of the subscription in 5 years and subsequently have only net profit from using Olivenia (Fig. 3).

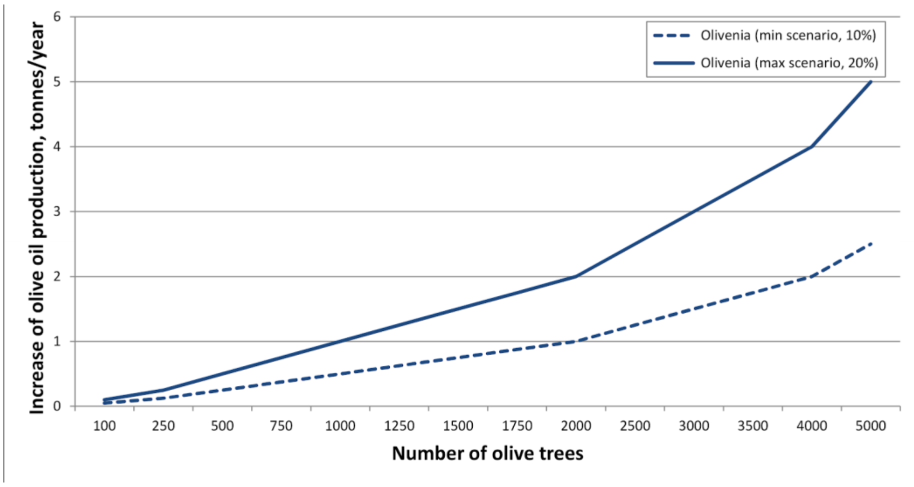

Fig. 2. Farmers' olive production increase with the measures proposed by Olivenia for varying sizes of olive groves.

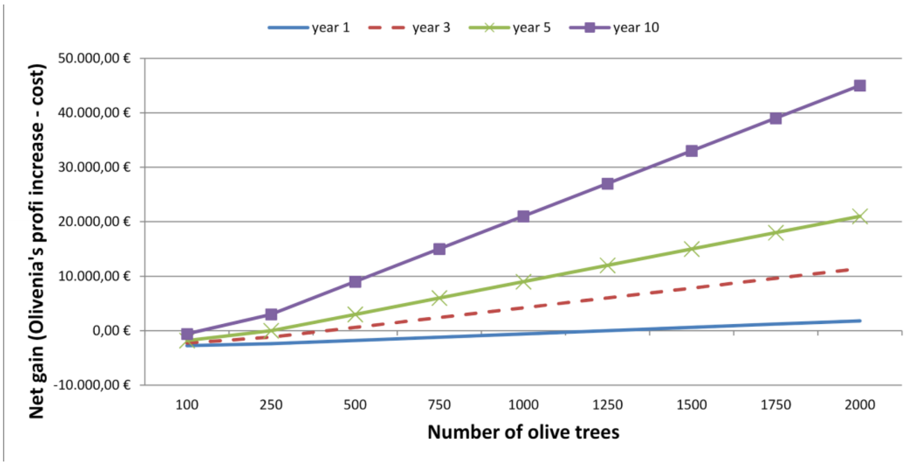

Fig. 3. Farmers' net gain with the "perpetual" package for varying size of olive groves and years of subscription.

2.6 Market opportunity

Over 750 million olive trees are cultivated worldwide, 95% of which are in the Mediterranean region. Most of global production comes from Southern Europe, North Africa & the Near East. Of the European production, 93% comes from Spain, Italy & Greece. Spain has the highest number of olive trees and is nowadays the world's leading olive-fruit & olive-oil producer and exporter with 2.1 million hectares of olive groves.

Italy is the second EU producer with two-thirds of its production leading to extra-virgin oil with 37 Protected Origin Appellations widespread on its territory. In Italy there are about 6180 olive oil mills & the overall amount of processed olives in 2006/2007 was about 3.500.000 tons with a production of about 600.000 tons of oil.

Greece devotes 60% of its cultivated land to olive growing. It is the world's top producer of black olives and has more varieties of olives than any other country. Greece holds third place in world's olive production with more than 132 million trees, which produce approximately 350,000 tons of olive oil annually, of which 82% is extra-virgin.

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