

## Business model canvas analysis on Greek farms implementing Precision Agriculture\*

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### Abstract

*The main aim of this paper is narrowing the innovation divide on entrepreneurship and the effective application of sustainable Precision Agriculture (PA). For this purpose, the Business Model Canvas (BMC) analysis was carried out for farms belonging to different crop sectors in Greece. The goal is to present how the use of BMC methodology analyses the entrepreneurial formula of farms that have successfully implemented PA technologies. Furthermore, it can be a new tool towards “Agriculture 4.0” to support companies that could invest in PA in order to grow economically and, at the same time, decrease the environmental impact. To succeed this, 5 BMC analyses were performed and SWOT analysis to investigate barriers, drivers, benefits, and impact, according to the entrepreneur’s perception, towards the implementation of PA technologies. Finally, there was evaluation research of the BMC experience from both the interviewed farmers’ and interviewers’ point of view. The results of this analysis showed that the samples of the five cases have a common attitude regarding PA. On the one hand, the barriers highlighted where the lack of knowledge, lack of support systems and high investment costs. On the other hand, the benefits where higher quality productivity and profitability and lower environmental and control costs. As for the drivers and the expected impact, all farmers agreed on the development of a more environmentally friendly sustainable agriculture with reduced costs. Finally, this paper clarifies how the “human factor” is the element key to motivate farmers to adopt PA practices.*

**Keywords:** *Business Model Canvas, SWOT Analysis, Precision Agriculture, Farm, Environment*

**JEL classification:** D83, L26, O13

### Introduction

Rural areas and agriculture are facing many challenges; globalization, climate change, other environmental threats to name a few, are making imperative the need to build more resilient futures and more sustainable farms in economically, socially and environmentally (Scaramuzzi et al., 2020). Sustainable agriculture and investing in innovations, like Agriculture 4.0 (Dung and Hiep, 2017) may result to increased yields and reduction of inputs, better environmental footprint and overall better economic

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figures driven by data and analytics (Yahya, 2018). To this end Agriculture 4.0 (in the early 2010s) has brought the development of various technologies and a new promotion of Precision Agriculture (PA) (Kovács and Husti, 2018). The latter is a sustainable agricultural system that incorporates spatial data analytics in decision making and management of the farm (Anastasiou et al., 2019) by taking into account the variability of the fields (Paustian and Theuvsen, 2017).

The diffusion of these sustainable agricultural practices, as PA, is supported across Europe by educational programs and extension services, to farmers (Michailidis et al., 2010) including a wide range of enabling technologies such as technologies used for object identification, geo-referencing, measurement of specific parameters, Global Navigation Satellite Systems (GNSS), connectivity, data storage and analysis, advisory systems, robotics and autonomous navigation. In fact, farmers should get tailored training to fully understand the principles and technologies of PA and incorporate them in their farms (Kountios et al., 2018a; Kountios et al., 2018b; Michailidis et al., 2013; Charatsari et al., 2014; Michailidis et al., 2011).

Apart from educational courses one other strategy that can improve the diffusion of technological innovations and ameliorate the transition to Agriculture 4.0 is the support of an effective business models (Long et al., 2017). Benijts (2014) mentions that the business model concept evolved in the late 1990s and it can describe how a business creates value, selects customers, assigns processes and enters markets and can be useful for analysis, comparison, management and innovation. Towards this direction Osterwalder (2005) developed a simple tool, the Business Model Canvas (BMC), that can help users to understand the business model of their organization (Joyce and Paquin, 2016) by visualizing revenues, value proposition, channels, key resources and other key components (Scaramuzzi et al., 2020). In fact the BMC concept was used to test the diffusion of technological innovations for climate-smart agriculture (Long et al., 2017).

Stemming from the works of Osterwalder and Pigneur (2010) this paper is focused on the implementation of a BMC, to a handful of farms in Greece that have successfully adopted PA. This approach presents a novel attempt to adapt the BMC in the context of small and medium Greek farms that have successfully implemented PA in their farms. We critically analyze the process of implementing the BMC and the results of this co-creation process. We will start by outlining the theoretical framework in regard to BMC and its applications in agriculture and then the five case studies (agricultural businesses – farms) are presented with main results, a SWOT Analysis for the total 5 BMCs for the application of PA and an overall assessment of the BMC experience are also elaborated. Finally, conclusions are put forth with methodological issues, limitations of the research and policy implications.

### **Literature review**

A business model is commonly understood as the strategy (process and design) and operations (implementation) of companies to carry out their business ideas in the market. When it comes to agriculture in a large number of agricultural companies the business model is often not clearly defined from the beginning of their activities. Key elements of the model, such as the flow of information, risk assessment, channels and accounting, are often neglected in the digitization processes and PA adoption in which companies are involved. Towards this direction a Business Model Canvas (BMC) can be used as an effective tool that enhances the performance of a business by identifying, at the spot,

critical issues that might speed up the problem-solving processes (Osterwalder et al., 2015), in a wide range of problems or challenges that a business is facing.

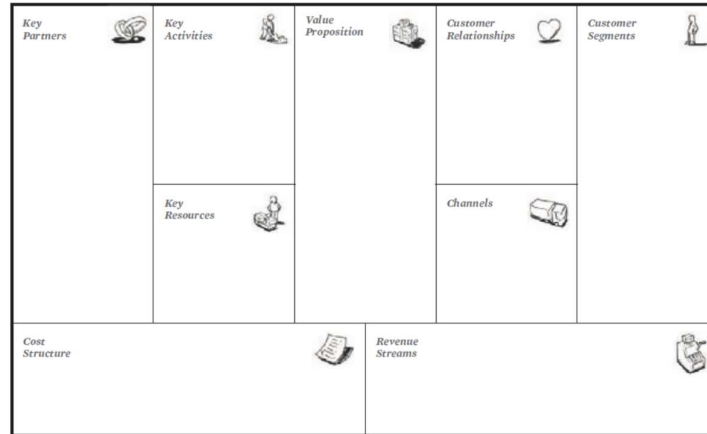
The BMC has been used in a number of cases and fields. For example, scholars have been using the tool in order to identify critical factors for rural development and development of rural tourism, social farming, strategies, for forest cooperatives, for the expansion of renewable energy and overall for describing business models in several industries (Scaramuzzi et al., 2020; Zanjirchi et al., 2020; Trigkas et al., 2020; Benjaminsson et al., 2019; Guirado et al., 2017). According to Osterwalder and Pigneur (2010), a BMC aims at the satisfaction of existing but unanswered market needs, bringing new products, services, and technologies to the market, improvement, or transformation of an existing market or creation of an entirely new market. It has gained popularity due to its use for different types of users, the visual presentation, the ability to communicate with facilitation of discussion and debate (Joyce and Paquin, 2016) along with flexibility and simplicity (Lewandowski, 2016; Drejerska et al., 2019).

A BMC is a tool by which a company can figure out how it makes money by specifying where it is positioned in the value chain (Chesbrough and Rosenbloom, 2002). Triyanto et al. (2019) refer that BMC is a visualization tool of a business model that explores the relations between the business owners and their partners along with their customers and their interconnections. Another definition proposes the BMC as a strategic management tool that reconfigures several elements relevant to the three dimensions of the business model (who, what, how) in order to improve the value potential of the business and sustain it for a long time (Mahadevan, 2004). A BMC helps entrepreneurs align their activities and the developed relations in order to design their firm strategy (Trigkas et al., 2019). At this point it is also worth noting that designing a BMC is not only interviewing the entrepreneur and the business management, but making an analysis of the business model of the company and co-designing the entrepreneur formula by using questions, examples, and interaction. Atuahene-Gima and Amuzu (2019) highlight the importance of familiarizing with the BMC concept when it comes to agricultural businesses and innovation.

Osterwalder and Pigneur (2010), mention that a BMC can be better described through nine basic building blocks, which cover four main areas of a business, customers, offer, infrastructure and financial viability. These nine basic components of a BMC are, customer segments, value propositions, channels, customer relationships, revenue streams, key resources, key activities, key partnerships, and cost structure (Osterwalder and Pigneur, 2010). The nine basic components of a BMC are presented in Figure 1 and further elaborated accordingly (Ching and Fauvel, 2013) as follows:

- Customer Segments, all the people or organizations for which you are creating value
- Value Propositions, all the products and services that create value for the customers
- Channels, through which there is interaction/communication with the customers
- Customer Relationships, the type of relationship which is established with the customers
- Revenue Streams, the pricing mechanisms through which the business is creating value

- Key Resources, the assets required to offer and deliver the above described elements
- Key Activities, all the things that need to perform well
- Key Partnerships, resources outside of the business required for some outsourced activities
- Cost Structure, all the business elements result in this block



**Figure 1.** The Business Model Canvas (Osterwalder and Pigneur, 2010)

The left side of the canvas represents the product-related components whereas elements on the right side focus on the customer. “Value proposition” is located in-between linking products and services, aiming at satisfaction of users’ needs and creating value (Larosa and Mysiak, 2019). Torquati et al. (2015), suggest two more areas. The first is the supplier who is responsible for the organization of the resources and the coordination of all the partners. The second is the relationships, networks of the farm, like contacts with customers and partners. Despite the fact that BMC is simple it leads to a constellation of interconnected factors that actually provide an effective process towards the creation, deliver and capture of value within an organization (Scaramuzzi et al., 2020, Osterwalder and Pigneur, 2010).

**Methodology**

The study adopted the principles of action research and actually the research happened with the practitioners (farmers) and not on them, bringing together theory and practice (Lavoie and Daim, 2020). It was carried out in three steps: (i) implementation-adaptation of the BMC, (ii) SWOT Analysis for the 5 BMCs, (iii) evaluation research of the BMC experience. More specifically, the BMC analysis was performed on 5 case studies farms chosen as suitable examples of farming’s characteristic business models in Greece. The implementation of the BMC methodology was aiming to analyze the entrepreneurial formula of farms that have successfully adopted PA solution during the past year. A second selection layer was the crop of each farm. Focus was given to productive trees, olive trees and fruits, as well as aromatic plants and rice crops. The profile of the participant farmers is thoroughly described in Table 1. The research team invited all five farmers-entrepreneurs, on different dates, at an amicable environment in which apart from

the farmer and project members a number of MSc students were also involved as external participants-observants.

**Table 1. Farms'/Farmers' Profiles**

<b>Case Study #1</b>	
Type of Business	Small cultivation and marketing company
Name of entrepreneur	Nikos
Crops	Oranges, citrus, mandarins, lemons, kiwi, kumquat
Number of employees	2 owners & seasonal works (harvesting)
Used PA technologies	Remote sensors
<b>Case Study #2</b>	
Type of Business	Small scale organic family farm-Private company
Name of entrepreneur	Michalis
Crops	Origanum vulgare ssp. Hirtum
Number of employees	2 owners & 5 employees depending seasonal works (harvesting)
Used PA technologies	Sensors, Drones and Special cameras (multispectral and infrared)
<b>Case Study #3</b>	
Type of Business	Farm
Name of entrepreneur	Giorgos
Crops	Olive trees
Number of employees	2 owners & 20 seasonal works
Used PA technologies	Remote sensors
<b>Case Study #4</b>	
Type of Business	Farm
Name of entrepreneur	Konstantinos
Crops	Fruits/ Sea buckthorn
Number of employees	2 permanent & 15 seasonal works
Used PA technologies	Remote sensors
<b>Case Study #5</b>	
Type of Business	Farm
Name of entrepreneur	Giorgos
Crops	Rice (Bonnet and Ronaldo)
Number of employees	6 permanent & 2 temporarily
Used PA technologies	Unmanned Aerial Vehicles, remote sensors, Variable Rate Technologies

Onwards, the entrepreneurs involved in the research identified the key factors that motivated and facilitated or, on the opposite side, hindered the adoption of PA practices within their farm-business. To collect their contributions, a SWOT analysis specifically modified, was used to investigate barriers, drivers, benefits and impact related - from the entrepreneur's point of view - to the introduction of PA within the production system of the farm.

At the end, an assessment of the effectiveness of the BMC in the PA sector was carried out in order to measure the level of diffusion/knowledge and satisfaction about this tool within the group of all members of the research team (interviewed entrepreneurs, interviewers, and observants). To make this assessment session, on the one hand, the interviewed farmers were asked to complete a short questionnaire to evaluate the experience. On the other hand, in order to assess the BMC experience from the

interviewers' point of view, the focus group methodology was applied with all observants of the process. At all stages of the process farmers were given a feedback and a sum up of major outcomes of the research.

## Results

### *Analysis of the BMCs*

The adaptation of the BMC in the five case studies (see figure 2) revealed that not all components were relevant to the implementation of PA.

The first case study (a farm with orange trees mainly) started the implementation of PA a year ago in order to be able to detect infected trees at early stages (with non-visible symptoms). The two partners have for a long time trying to find ways to minimize inputs and use in an environmental friendly way all assets of the farm (especially water). The sensors that they have applied give them the opportunity to make a transition towards a new business model. They want to create also yield maps and gather soil data in order to create management zones and forecast yield variability. The problem is to have an effective – timely- management of the orchards and the prevention of food loss. In particular some of the problems they wanted to solve were:

- √ Assessment of infected trees and detection of non-visible symptoms at an early stage of the infection using multi-spectral images and special algorithms.
- √ Construction of hazard maps and their connection with a database in which the evolution of the disease will be recorded as well as the cultivation management for the trees' recovery.
- √ Prediction of the financial damage and estimation for the management cost.
- √ Recommendation services for taking the appropriate management measures for the treatment.

From their BMC it was evident that one of the main aspects in their “value propositions” was the quality of the product and their affordability, both achieved by the implementation of PA. The fact also that they are using direct sales and Alternative Food Networks (such as open solidarity markets) has been identified as a key component of the business model. The farm costs have been slightly minimized since the PA adoption.

In the second case study, a small scale organic family farm growing oregano, PA was adopted since 2016 in collaboration with researchers from the Institute of Genetics for Improvement & Plant Genetic Resources, the Institute of Soil Resources of ELGO DIMITRA, the Department of Pharmacology and Pharmacology of the Faculty of Pharmacy of the Aristotle University of Thessaloniki and the Agricultural Laboratory of the Agricultural School of the Aristotle University of Thessaloniki. The collaboration with a private company also started during that time or even earlier. In this case therefore in the BMC the key partners were the crucial factor for the success of the business. The farmer proceeds uses drones, equipped with high-definition multi-spectral cameras, high-resolution RGB cameras and infrared cameras are used. The data are analyzed by a group of experts (agronomists and field biologists) that cooperate with the company. The latter inform the farmer in regard to the evolution of the plants and he determines the appropriate harvest date, depending on the desired quality characteristics. Having all these data it is possible to take decisions and alter cultivation practices and to ensure the best possible quality of oregano oil. Remote sensing also helps him spot any imbalances in the field and target them specifically, reducing interventions. All the aforementioned

techniques provide a high value product, which was also embedded in BMC matrix in the value proposition.

The third case study, a farm with olive trees, has also developed a network of partners and especially from which an IT company has contributed to the successful implementation of PA on the farm. Authentic taste, local identity and high nutritional; value were identified at the value proposition due to the PA adoption.



Figure 2. Example of the adoption of the BMC

The fourth case study a big farm with fruits and sea buckthorn was using remote sensors for irrigation. Data from sensors are transmitted via Wi-Fi in real-time to a mobile phone based on IOS/Android. In the light of obtained data, the seasonal precision irrigation system was created depending on the amount of water required by the plants at each stage of their growth stage. The required energy of the system was provided by solar energy. Their motivation was to introduce new cultivation methods and innovative processes that can upgrade the quality and nutritional characteristics of our beneficial crops, through intensive R&D. Another major driver was the promotion of cultural food heritage, promotion of healthy living and healthy entrepreneurship. Two problems that PA is trying to solve are the need to take care of assets and especially water and of course have a quality higher crop yield. They were assisted by the project KATANA in terms of facilitating in the production of their first functional food via PA. They also worked with other partners such as the Aristotle University of Thessaloniki, the Hellenic Agricultural Organization – DEMETER, Agroapps and the Institute of BioSense. In this case study the researchers, agri-experts, field –farm labour and machinery were identified as a key resource in order to manage the PA.

The fifth case study, of a big farm with rice was motivated to exercise PA by the need to improve quality and increase quantity of our produce, and overall reduces costs. The farmer wanted to reduce the amount of fertilizers escaping to the environment and

minimize plant protection products during sprays. Another major aim and problem was the phosphorus and potassium deficiency (due to the fertilization). They closely work with a PA company and again one of the most important comments on the value proposition was the premium quality of the product. In this case study the skilled labour was identified as a key resource in order to manage the PA.

In Tables I-V (see Annex) the full-detailed BMCs of the five case studies are presented.

*SWOT Analysis*

Although economic factors are often an important element slowing the rate of PA adoption, there are other factors including drivers and benefits that can overcome them and promote PA technologies. As some of these aspects are difficult to measure, entrepreneurs have been asked to identify the key factors that can motivate and facilitate or, on the opposite side, hinder the adoption of PA solution. To collect their contributions a SWOT analysis was performed specifically modified to identify the barriers, drivers, benefits, and impact presented in Table 2.

**Table 2.** SWOT Analysis

<b>BARRIERS</b>	<b>DRIVERS</b>
<p><b>Lack of knowledge/support from experts</b></p> <ul style="list-style-type: none"> <li>• Lack of experience in IT technology plus hard to deepen in IT fields of knowledge</li> <li>• Inadequate technological background i.e remote sensing</li> <li>• Lack of expertise / training in PA</li> <li>• Time consuming to understand PA</li> </ul> <p><b>High costs</b></p> <ul style="list-style-type: none"> <li>• Cost of PA</li> <li>• Money Investments</li> <li>• High cost in case of wrong decisions</li> <li>• High costs of the PA equipment</li> </ul> <p><b>Lack of specific network</b></p> <ul style="list-style-type: none"> <li>• Reestablishing agreements with local providers</li> <li>• If you don't have the network to support you (and fill in the knowledge gaps) this might be a disaster</li> </ul> <p><b>Resistance to change</b></p> <ul style="list-style-type: none"> <li>• Difficulty in adapting new way of thinking</li> </ul>	<p><b>Improvement of the business performance</b></p> <ul style="list-style-type: none"> <li>• Creating standard decision making mechanisms</li> <li>• Find a way to take decisions (best time to harvest a quality product)</li> <li>• More accurate decision on harvesting, watering etc</li> <li>• Composing a method to control quantity and (mostly) quality of final product</li> <li>• Standard quality (premium quality)</li> <li>• Minimize food loss</li> <li>• Minimize costs</li> <li>• Low prices that we used to have (due to the previous-the low quality)</li> <li>• Predict oregano growth patterns</li> <li>• Range of products expansion</li> </ul> <p><b>Environmental protection</b></p> <ul style="list-style-type: none"> <li>• Conserve resources while reducing chemical runoff</li> <li>• Safeguard a living standard for the small farmer/small family farm</li> <li>• Promotion of healthy living</li> <li>• Healthy entrepreneurship</li> <li>• Innovation</li> <li>• Employment</li> <li>• Cultural food heritage</li> </ul>
<b>BENEFITS</b>	<b>IMPACT</b>
<p><b>Higher productivity</b></p> <ul style="list-style-type: none"> <li>• Higher field performance (productivity/economy)</li> <li>• Optimal harvest time</li> </ul>	<p><b>Environmental protection</b></p> <ul style="list-style-type: none"> <li>• Environmental protection (reduce of unnecessary spraying &amp; less irrigation and fertilizers)</li> </ul>



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<ul style="list-style-type: none"> <li>• Higher crop yield</li> <li>• Real-time monitoring of cultivation</li> <li>• Better quality product</li> <li><b>Higher profitability</b></li> <li>• Higher negotiation margins</li> <li>• Higher yields of quality product</li> <li>• Make decisions easier –effectively</li> <li>• Branding</li> <li><b>Decrease of costs</b></li> <li>• Lower costs</li> <li>• Cost controlling</li> <li>• Prevent food loss</li> <li>• Reduce staff costs</li> <li><b>Low environmental impact</b></li> <li>• Decrease of water usage</li> <li>• Reduce environmental impact</li> </ul>	<ul style="list-style-type: none"> <li>• Protect the environment with less inputs / Environmental friendly farming practices</li> <li>• Positive impact on the environment</li> <li>• Protect the environment with less inputs / Environmental friendly farming practices</li> <li>• Food safety</li> <li>• Minimize food loss (an economic and a social problem)</li> <li>• Nutrient and pest management</li> <li>• Soil quality</li> <li>• Water quality</li> <li>• Reducing cost of farming</li> <li>• High quality and competitive final products</li> </ul>
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**Evaluation of the BMC experience**

Regarding the questionnaire entrepreneurs had to fill after completing the BMC, it was noted that most of them did not know this methodology while only one farmer had already performed it in the past. The majority of the farmers felt comfortable while doing this exercise. Some suggestions that mentioned to improve the process are the thorough description of the methodology and its final purpose before its application, the simplification and the reduction of the questions. Generally, some of the positive comments of the BMC evaluation that have been noticed are:

- *“Composing the BMC helped me answering questions that I have never thought about before like: who are my clients, do I want these clients, what kind of clientele do I want, can I satisfy their expectations, am I selling as high as I can etc.”*
- *“For the first time I felt as a businessman in agriculture and not as a farmer who wants to do business”*
- *“The tool is overall evaluated as helpful and more interesting from other mainstream”*
- *“It’s best for startup companies, but reflection is always a good thing to do”*
- *“The questions were quite good and interesting. Overall, the tool was evaluated as very helpful and very interesting”*
- *“The canvas model is important because it can serve as an important internal management tool”*

On the contrary, there were some negative comments like:

- *“The tool is smart but not really helpful to my business”*
- *“Useful but rather in details, and not applicable for small farms. The questions were quite large in number, and not always with an answer”*
- *“I would rather evaluate it when I will have some output”*

However, all the entrepreneurs referred that they will use again the BMC methodology in their businesses.

The assessment of the BMC experience from the interviewers’ point of view was carried out with the focus group methodology. Table 3, below, presents the results from the focus group experience assessment. Interviewers’ identified parts of the BMC

methodology that both worked and those that need improvement. They also suggested some ideas that could facilitate the whole process. In general, the importance of creating a trustful and friendly environment, the simplification of the questions for both interviewers and farmers and the reduction of the duration of the interview are emphasized.

**Table 3.** Focus group of experience assessment

What worked?	What could be improved?
<ul style="list-style-type: none"> <li>• Methodology: physical framework</li> <li>• The tool to be used has been explained and it's very easy</li> <li>• Staff: at least 3 persons</li> <li>• Advanced farmers like talking to technicians who know PA</li> <li>• Interesting, a good analysis of the farm</li> <li>• Good opportunity to see the reality</li> <li>• Farmers like to see their BMC at the end</li> <li>• It's an opportunity for farmers to talk/share their true problems and needs</li> <li>• Network of trust farm entrepreneurs</li> <li>• Previous visit of the company business</li> <li>• A visit of the farm is very welcome</li> <li>• Importance of the environment for the interviews (where farmers feel comfortable)</li> <li>• Friendly environment (trust)</li> </ul>	<ul style="list-style-type: none"> <li>• Possibly involve different figures in the company (administration, ownership, production) not only person involved in PA</li> <li>• More figures as experts, someone entrepreneurship, research on PA and farmers</li> <li>• Need more people from the business</li> <li>• Possibly involve in the staff some students to focus learning points</li> <li>• Prepare correct standard communication (by email) to clearly explain the procedure and time needed</li> <li>• Record the BMC session</li> <li>• GDPR agree needed</li> <li>• It would be advisable to have more information before the interview in the farm</li> <li>• Probably the duration of the interview is too long</li> <li>• Farmers don't feel like business men</li> <li>• Farmers don't see the need of filling in a BMC (what for?). Results maybe incomplete</li> <li>• BMC looks intimidating or difficult</li> <li>• Understand how they feel themselves</li> <li>• Questionnaire more easy for small farmer</li> <li>• Too many details, good for us but...</li> <li>• Instead of questionnaire co-work with farmers and other actors of the chain</li> <li>• Maybe some "numbers" (economical) are necessary</li> <li>• Present some results to farmers</li> <li>• Synthesis of the interviews</li> </ul>
Questions	Ideas
<ul style="list-style-type: none"> <li>• What happen when there are more partners?</li> <li>• Can we let them do it themselves?</li> <li>• "Too much technology and advice"</li> <li>• Companies have tech but they need the knowledge for using it</li> <li>• Question to add "are you ready to introduce innovation in processes"</li> <li>• Difficult to convince farmers to do it, some questions don't make sense for farmers (commodities, rigid structure, exit prices...)</li> <li>• Farmers sometimes didn't know the financial numbers, it can be complicated and maybe need advice for accounting</li> </ul>	<ul style="list-style-type: none"> <li>• A women's point of view</li> <li>• We tried to record the interviews but it was "intimidating"</li> <li>• "Hide" the BMC: go with 2 people, one does the natural interview, while the other summarizes the responses in the form of a BMC "privately"</li> <li>• Some farmers were not talkative</li> <li>• Open questions or Yes/No?</li> <li>• Report are difficult to complete sometimes</li> <li>• Implementing the BMC to farm business in order to focus a little bit and to save time in the end form report</li> <li>• Social network Instagram!</li> </ul>

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- The focus should be only on “activities”
  - In general farmers don’t want to share all details about their companies
  - People don’t like to confess their failures
  - Finding farmers willing to sit down with us was difficult
  - More oriented to PA
  - Webinar on students seminar
  - Keychain! Some gift is needed
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## Conclusions

This paper investigates the effectiveness of the BMC methodology by performing it to 5 farms in Greece that implement PA technologies. The results showed that this methodology can be really useful for entrepreneurs as an important internal management tool to analyze their farm formula. There have also been noticed some negative aspects of the BMC like the number and the difficulty of the questions and the time that has to be spent on the procedure.

Our research fits to the findings of Pölling et al. (2017) that the strategic management template of the BMC allows both the analysis of the organisations and performances of the farms (economically and socially) and defines the success factors, barriers, competitors and innovations. The proposed BMC can be useful for identifying the connection between business performance and adoption of PA in farms Torquati et al. (2015) proposed the BMC as a very useful tool for all contexts of multifunctional agriculture. This is consistent with the findings of Long et al. (2017) that reveal the importance of a BMC in the adoption of technological innovations to agriculture. They, also, identified the barriers and the factors located in the BMC that can improve the diffusion of smart agriculture. Uvarova et al. (2019), highlighted in their research the lack of knowledge and understanding of the BM analysis.

The results from the SWOT analysis highlighted the trends and specific issues that characterize the factors facilitating or hindering PA adoption. Firstly, among the barriers, there were the lack of knowledge and training in PA between farmers and workers, lack of supporting systems/networks, high investment costs and resistance to change. Secondly, the drivers were the improvement of the farms performance and a more environmentally sustainable agriculture. Thirdly, the benefits arisen were higher profitability and productivity and lower cost and environmental impact. Finally, the expected impact referred to be the development of local agriculture, more sustainable agriculture, and increased environmental protection, economic development favoring social development. One last feature that seems to be shared by all farmers is the need to work in networks (public, private, sectorial or cross-sectoral) connecting different “stakeholders” - farmers, universities, administrators, and distributors - in order to be able to face the investment. Regarding the evaluation results from the questionnaires and the focus groups, they may have limited value from a scientific point of view. However, we believe that it is very important to try to understand if the BMC methodology can be effectively used with farmers and, even more important to collect suggestions to improve the methodology in the agriculture sector.

Most interesting though, apart from the technical and economic factors taken into consideration, the study highlights the “human factor”. The passion of the farmer for agriculture, the personal satisfaction they get out of constant improvement in their profession. The “human factor” is also inescapable when playing against. Farmers resist

to change because they do not trust the innovation because they are afraid they will not be able to manage it, simply because the mass of small farmers are “late adopters” of new technology and need to see other bigger players introduce it and “obtain measurable, consistent results” before they invest in it. To overcome the lack of trust it is necessary to increase the number of pilot projects, scale the number of quality comparable data, disseminate and diffuse information among farmers, select testimonials and model examples able to influence the mass of small and medium farmers. This last element is the key to motivate farmers to start introducing PA in their practice.

The limitations of this study focus mainly on the fact that this study is one of the few in the existing literature on PA and BMC. Therefore there are some weaknesses identified in the comparison of the presented results with similar studies and also in the number of case studies as it is limited. It, hence, appears that the results are not representative at a country or global level. The fact that farms had different crops and different perceptions of PA there might be some conceptualization gap.

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ANNEX

**Table I.** Business Model Canvas of Case Study 1 (Orange, citrus, mandarin, lemon, kiwi and kumquat crops)

KEY PARTNERS	KEY ACTIVITIES	VALUE PROPOSITIONS	CUSTOMER RELATIONSHIPS	CUSTOMER SEGMENTS
<ul style="list-style-type: none"> <li>• Co-founder of the company</li> <li>• Volunteers groups of AFNs</li> <li>• Solidarity networks</li> </ul>	<ul style="list-style-type: none"> <li>• Standard programme</li> </ul>	<ul style="list-style-type: none"> <li>• Fresh products (BC)</li> <li>• Local products (B2C)</li> <li>• Affordable products (B2C)</li> <li>• Quality –price (B2B)</li> </ul>	<ul style="list-style-type: none"> <li>• Personal contact (time costly)</li> </ul>	<ul style="list-style-type: none"> <li>• B2B: –grocery shops</li> <li>–Consumer’s cooperative shop</li> </ul>
	KEY RESOURCES		CHANNELS	
		<ul style="list-style-type: none"> <li>• Farm assets</li> <li>• Labour</li> <li>• Land</li> <li>• Capital</li> <li>• Tractors</li> <li>• Knowledge (agronomical+ marketing)</li> </ul>	<ul style="list-style-type: none"> <li>• Direct Sales</li> <li>• Pre-orders (telephone)</li> </ul>	
<b>COST STRUCTURE</b>			<b>REVENUE STREAMS</b>	
<ul style="list-style-type: none"> <li>• Fruit picking (5%)</li> <li>• Farm costs (30%)</li> <li>• Transportation costs (20%)</li> <li>• Distribution costs (45%)</li> </ul>			<ul style="list-style-type: none"> <li>• Cash only</li> <li>• Not fixed prices</li> <li>• Sharing economy</li> </ul>	

**Table II.** Business Model Canvas of Case Study 2 (Origanum vulgare ssp. Hirtum crops)

KEY PARTNERS	KEY ACTIVITIES	VALUE PROPOSITIONS	CUSTOMER RELATIONSHIPS	CUSTOMER SEGMENTS
<ul style="list-style-type: none"> <li>• National Agricultural Research Foundation</li> <li>• Nursery plantation</li> <li>• Suppliers for specialized packaging material (i.e violet glass bottles)</li> <li>• Agricultural consultant</li> <li>• Agricultural Cooperative</li> </ul>	<ul style="list-style-type: none"> <li>• Producing Greek organic oregano essential oil</li> <li>• Production-aromatic plants (seedlings)</li> </ul>	<ul style="list-style-type: none"> <li>• Consistent high quality</li> <li>• Certified organic farming</li> <li>• Additional quality standards (vegan)</li> <li>• Personal contact with clients</li> <li>• Healthy nutritional awards</li> </ul>	<ul style="list-style-type: none"> <li>• Events</li> <li>• Social media (Instagram, blog)</li> </ul>	<ul style="list-style-type: none"> <li>• Niche market</li> <li>• Diversified (more aware customers)</li> <li>• Special stores</li> </ul>
	KEY RESOURCES		CHANNELS	
		<ul style="list-style-type: none"> <li>• Human (land workers)</li> <li>• Intellectual (NAGREF)</li> </ul>	<ul style="list-style-type: none"> <li>• Specialized retail stores for distribution                             <ul style="list-style-type: none"> <li>- Restaurants</li> <li>- Direct sales</li> </ul> </li> </ul>	

Modousa in Lesvos island <ul style="list-style-type: none"> <li>• Certified organic distillery</li> <li>• Graphic Designer</li> <li>• Drones company</li> </ul>	<ul style="list-style-type: none"> <li>• Financial (private investment)</li> <li>• Copyright registered (trademark/logo)</li> <li>• Data gathering</li> </ul>			
<b>COST STRUCTURE</b> <ul style="list-style-type: none"> <li>• Planting</li> <li>• Certified organic inputs</li> <li>• Human resources (handpicking)</li> <li>• Packaging (materials imported)</li> <li>• Drones/flights</li> <li>• Laboratory analysis</li> </ul>		<b>REVENUE STREAMS</b> <ul style="list-style-type: none"> <li>• Customer's cash</li> <li>• Price list</li> <li>• Asset sale (transactions)</li> </ul>		

**Table III.** Business Model Canvas of Case Study 3 (Olive trees)

KEY PARTNERS	KEY ACTIVITIES	VALUE PROPOSITIONS	CUSTOMER RELATIONSHIPS	CUSTOMER SEGMENTS
<ul style="list-style-type: none"> <li>• The Agricultural School of the Aristotle University of Thessaloniki</li> <li>• The Association of Enterprises of Halkidiki SA/ CLUSTER</li> <li>• Private IT company</li> <li>• Marketing team</li> </ul>	<ul style="list-style-type: none"> <li>• Cultivating olive trees of a special variety</li> <li>• Producing olives and olive oil of a special variety</li> </ul>	<ul style="list-style-type: none"> <li>• High nutritional value</li> <li>• Authentic taste</li> <li>• Low environmental impact</li> <li>• High value for money</li> <li>• Identity uniqueness of</li> </ul>	<ul style="list-style-type: none"> <li>• B2B distinguished expo events</li> <li>• Exhibition &amp; trade olive oil shows</li> <li>• Gourmet shows</li> <li>• Presentation &amp; interviews in olive oil specialized magazines</li> </ul>	<ul style="list-style-type: none"> <li>• Companies with: attitude of innovation</li> <li>• Final consumers that respect values as: authenticity, uniqueness, low environmental impact, high nutritional expectations</li> </ul>
	<b>KEY RESOURCES</b> <ul style="list-style-type: none"> <li>• Grove farming knowhow</li> <li>• Human labour</li> <li>• IT specific knowledge</li> <li>• Methodology for decision making models</li> <li>• Financing</li> </ul>		<b>CHANNELS</b> <ul style="list-style-type: none"> <li>• HO.RE.CA in Greece (or international) emphasizing in clients who can appreciate high quality products</li> <li>• Delicatessen &amp; gourmet retail stores</li> <li>• Exclusive e-shop sales</li> </ul>	
<b>COST STRUCTURE</b> <ul style="list-style-type: none"> <li>• Tree protection</li> <li>• Irrigation</li> </ul>		<b>REVENUE STREAMS</b> <ul style="list-style-type: none"> <li>• Transaction based revenues</li> </ul>		



<ul style="list-style-type: none"> <li>• Fertilizing</li> <li>• Human labour</li> <li>• Packaging</li> <li>• Laboratory analysis</li> <li>• IT systems</li> <li>• Advertisement</li> <li>• Branding</li> </ul>	
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**Table IV.** Business Model Canvas of Case Study 4 (Fruits/ Sea buckthorn crops)

<b>KEY PARTNERS</b> <ul style="list-style-type: none"> <li>• Research Institutes</li> <li>• Agri- Tech companies</li> <li>• IT companies</li> </ul>	<b>KEY ACTIVITIES</b> <ul style="list-style-type: none"> <li>• Sales</li> <li>• Distribution</li> <li>• Processing</li> <li>• Marketing</li> <li>• R&amp;D in functional food</li> </ul>	<b>VALUE PROPOSITIONS</b> <ul style="list-style-type: none"> <li>• The production is a trusted source of high quality food</li> <li>• Less waste usage than traditional agriculture</li> <li>• Waste production</li> <li>• Positive environmental impact</li> <li>• Loyalty with customers</li> </ul>	<b>CUSTOMER RELATIONSHIPS</b> <ul style="list-style-type: none"> <li>• Customer analytics for customized products</li> <li>• Social media</li> </ul>	<b>CUSTOMER SEGMENTS</b> <ul style="list-style-type: none"> <li>• Customers with a healthier approach in life</li> <li>• Impulsive customers</li> <li>• Protection of the environment enthusiasts</li> <li>• Field sales agent (having an ID for your field, rises its value)</li> </ul>
	<b>KEY RESOURCES</b> <ul style="list-style-type: none"> <li>• Researchers</li> <li>• Agri- experts</li> <li>• Field- farm labour</li> <li>• Machinery</li> </ul>		<b>CHANNELS</b> <ul style="list-style-type: none"> <li>• Retail: hotels, e-shop, duty free shops, gift shops, shops with superfoods</li> </ul>	
<b>COST STRUCTURE</b> <ul style="list-style-type: none"> <li>• GIS</li> <li>• Equipment (pipes, drippers, water tanks, drones, sensors)</li> <li>• Marketing promotion</li> </ul>		<b>REVENUE STREAMS</b> <ul style="list-style-type: none"> <li>• Cash</li> <li>• Price list</li> <li>• Asset sale</li> </ul>		

**Table V.** Business Model Canvas of Case Study 5 (Rice crops)

<b>KEY PARTNERS</b> <ul style="list-style-type: none"> <li>• Certified body for the organic produce</li> <li>• Export company</li> </ul>	<b>KEY ACTIVITIES</b> <ul style="list-style-type: none"> <li>• Logistics</li> </ul>	<b>VALUE PROPOSITIONS</b> <ul style="list-style-type: none"> <li>• Premium quality</li> <li>• Consistency to delivery</li> <li>• Trust</li> </ul>	<b>CUSTOMER RELATIONSHIPS</b> <ul style="list-style-type: none"> <li>• Stable cooperation</li> </ul>	<b>CUSTOMER SEGMENTS</b> <ul style="list-style-type: none"> <li>• Middle- men (they take all the produce)</li> </ul>
	<b>KEY RESOURCES</b> <ul style="list-style-type: none"> <li>• Skilled labour</li> </ul>		<b>CHANNELS</b> <ul style="list-style-type: none"> <li>• Export company only</li> </ul>	

<ul style="list-style-type: none"> <li>• Agricultural input suppliers</li> <li>• Private company for PA</li> </ul>				
<p style="text-align: center;"><b>COST STRUCTURE</b></p> <ul style="list-style-type: none"> <li>• Certification costs</li> <li>• Transportation costs</li> <li>• Equipment</li> <li>• Rents for land</li> <li>• Operational costs</li> <li>• Wages (seasonal)</li> <li>• Value driven business</li> </ul>		<p style="text-align: center;"><b>REVENUE STREAMS</b></p> <ul style="list-style-type: none"> <li>• Direct payments (after negotiation)</li> </ul>		