Happy Goats – A Decision Support Web App for Sustainable Small Ruminant Farming

Sotiria Vouraki[1], Yannis Skourtis[2], Dinos Psichos[2], Gus Rose[1], Georgios Arsenos[1]

[1]Laboraratoty of Animal Husbandry, School of Veterinary Medicine, Faculty of Health Sciences, Aristotle University of Thessaloniki, Greece, e-mail: svouraki@vet.auth.gr
[2]Integrated Information Technology and Digital Communication

Abstract. The European sheep and goat sector is characterized by low incomes and increased production costs. There is no established farm management methodology; farmers rely on public subsidies to remain financially sustainable. Moreover, there is an extremely low level of innovation and adaptation of technology. This paper proposes Happy Goats, a model-driven decision support software which helps farmers make annual management planning decisions by running different what-if scenarios for the future. Happy Goats takes into account all important farm aspects (flock size, production, feeding, grazing, prices and cost factors) and produces profit-centric reports with simple and easy-to-understand charts and projections. Farmers are able to visualize the impact of their choices and plan for an optimized production. The app also provides a standalone daily feed calculator for optimal, customized daily feeding.

Keywords: sheep, goats, web app, sustainability, decision support

1 Introduction

1.1 Current state of the European sheep and goat sector

The European sheep and goat sector faces great challenges, which must be properly addressed to avoid further marginalization of the sector in the European agrifood economy (Bernués *et al*., 2011, Dubeuf & Sayadi, 2014). One of the most pressing issues is the fact that incomes for sheep and goat farmers are among the lowest in the agricultural industry and depend heavily on public support (De Rancourt et al., 2006, Dýrmundsson *et al*., 2006). Moreover, production costs are continuously increasing; primarily for feedstuffs; secondarily for fuel, labor and animal health (Massot-Marti, 2008). At the same time the sector is characterized by a low level of innovation and adoption of smart technologies (Massot-Marti, 2008).

The notion is that the majority of sheep and goat farmers do not follow an established methodology regarding the management of their enterprises. The latter

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

frequently leads to farms, which operate inefficiently and with reduced productivity and profitability. Sustainability assessments at a Global, Mediterranean and Northern European level have clearly shown that such farms rely on public subsidies to remain economically sustainable (Dýrmundsson *et al*., 2006). These subsidies, provided by the European Common Agricultural Policy, have *decreased* both production in economically less viable areas and the competitiveness of the sector as a whole (ANT International, 2011). A considerable number of sheep and goat farms, taking advantage of previous per-head sheep and goat subsidy schemes, have been modeled to aggressively maximize flock size without accounting for the negative consequences in business and ecological sustainability (overgrazing, land erosion, financial inability to sustain the flock on purchased feedstuffs etc.). However, such schemes have already been phased out and replaced by grants paid to farmers who own land rights. The above operational model, although viable in the past, cannot guarantee any more the survival of the sheep and goat sector. Moreover, farmers are not ready for future challenges such as the adjustments needed for removal of Common Agricultural Policy payments (Johnson, 2004). The prevailing view is that only farms which take up innovative solutions to modernize and rationalize their modus operandi with an emphasis on flock size, management of feeding and grazing residues are likely to successfully face these hardships and remain in business (Bernués *et al*., 2011).

1.2 The current state of art in sheep and goat farm management solutions

In some countries and regions, technology and innovations are widespread in sheep and goat farming. However, in general, the European sheep and goat sector is characterized by a low level of innovation. Precision feeding, novel feedstuffs (Molina-Alcaide & Yáñez-Ruiz, 2008), genetic characterisation of local breeds, parasites control and farm management (electronic identification; Caja *et al*., 2014) are potential innovations which however, have not been tested extensively on sheep and goats (Dubeuf, 2014).

In terms of farm management, there is notable shortage of suitable tools that would facilitate sheep and goat farmers to make management planning decisions based on the analysis of relevant data and information and to apply well proven methods for production optimization and profits maximization. Such tools include RISE (Hani *et al*., 2003), Cool Farm tool (CFT, 2015), MOTIFS (Meul *et al*., 2008) and PG tool (Gerrard *et al*., 2012) as well as a number of Australian tools (THE FARM TABLE).

Most of the existing sheep and goat solutions are operating offline (the farmer has to purchase the software once and install it on-farm) and can be characterized as either:

- Complicated/time-consuming: These herd management solutions offer historical per-animal records for health, performance and breeding and produce the relevant reports. Note that regular data entry into such systems takes several hours and is discouraging for the farmer.

- Specialized/isolated: Many smaller stand-alone solutions have been developed to address specific needs such as feed formulation, GPS-enabled animal tracking and stand-alone financial and accounting suites.

However, none of the existing solutions offer tangible decision support capabilities. They do not focus on planning advice for profitability in terms of revenues and expenses, while their archaic user interfaces and the financial and time investment required by the farmer has kept adoption rates extremely low.

2 Objectives

Taking into consideration the issues above, our team has designed and developed Happy Goats (Figure 1), an innovative solution that tackles specific barriers hindering the evolution of the sheep and goat sector. Happy Goats is a model-driven decision support web app for sustainable small ruminant farming. It drives impacts in 3 distinctive dimensions:

- *facilitate sheep and goat farmers of all types and sizes to make annual management planning decisions by running various what-if scenarios*: With Happy Goats, farmers create future scenarios which take into account flock size, production, feeding, grazing, labour, costs and income based on required and optional (default values provided) information about their farm. In return, the model estimates critical information such as energy and protein calculations, predicted milk production, the effect of different feed practices, subsidies and profitability. All of the above are illustrated with simple easy-to-understand charts and projections, which help farmers visualize the impact of their choices and plan for an optimized production.
- *support the optimization of milk and meat production in sheep and goat farms:* Happy Goats offers simple human-readable advice based on energy and protein balance, yearly animal weight change, milk production change and other parameters. This way it helps farmers towards optimal production and higher profitability while also eliminating dependence on public subsidies.
- *provide added value to the offerings of consultants who support sheep and goat farmers:* As farmers are not so keen on adopting new technologies, Happy Goats addresses additional actors of the sheep and goat value chain, mainly veterinarians, Zootechnics professionals/consultants and co-operatives. These groups can benefit by offering their clients a new and innovative product, which can improve the quality of their services and create long-term relationships between farmers and consultants.

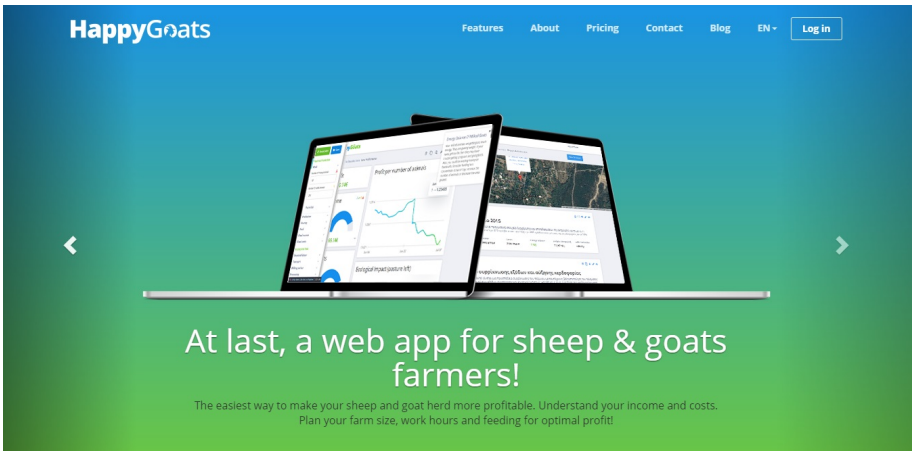


Fig. 1. Happy Goats website

3 Software development

Data from the database of the Laboratory of Animal Husbandry were used to set default values and acceptable ranges for those parameters that characterize a farm (flock size, milk yield, ration, grazing, product prices, costs, etc.). An algorithm was developed based on energy and protein requirements of different categories of sheep and goats, according to their production stage, in order to assess nutritional management and its impact on farm economics. Default values for forage and concentrate feeds as well as the equations for calculating nutrient requirements of animals were obtained from existing literature (Alderman & Cottrill, 1993, CSIRO, 2007, McDonald *et al*., 2010). Based on the above, a web-based application was developed allowing users to enter data into designated web forms. Data input is checked for correctness and then compared with theoretical minimum and maximum limits per category. The data of each farm is centrally collected and stored securely on the cloud. Thereafter, the latter data are processed with a model algorithm, which provides results that serve as a guide to management decisions.

4 Software features, impacts and benefits

1: Profit-centric reporting –factors which affect profitability: Happy Goats requires the user to enter information regarding all important farm aspects such as flock size, milk production, processing, feeding, grazing, work hours, land size, prices and detailed cost factors (Figure 2) and with the use of an energy and protein based algorithm it provides results shown in Euros. In particular, the app estimates the total farm income, costs and profit as well as profit per ewe in relation to production

estimates such as milk change and weight change of lactating ewes (Figure 3). It also provides charts of various income and cost components as well as feed costs and variable costs per animal category (Figure 4). Therefore, farmers may now understand their cost structures in depth, identify which factors affect profitability and be incentivized to utilize additional sources of income. Moreover, it generates simple to understand projections such as flock size vs profit and concentrate fed to lactating ewes vs profit (Figure 5). These projections help farmers understand the dynamics of their farm with a special emphasis on optimal flock size and feeding practice. Taking into consideration all the above, farmers benefit through tighter control over revenues and expenses, ability to plan for increased profitability with similar or lower costs and elimination of dependence on public subsidies.

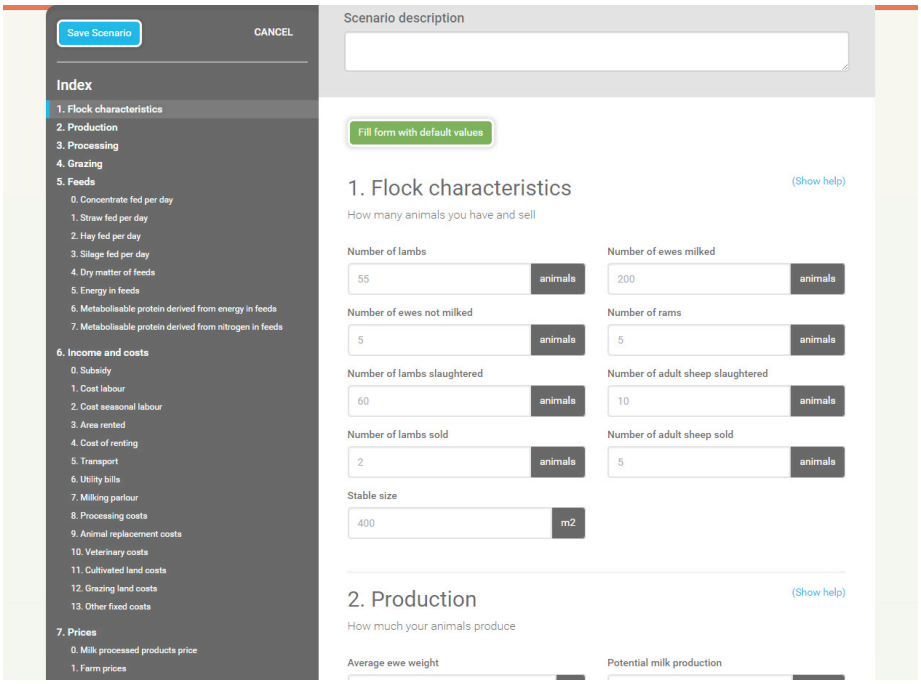


Fig. 2. Create / edit scenario form. Here, the farmers are asked to enter all of their farm data in terms of production goals, feeding and grazing, incomes, costs and prices, using an easy and intuitive web interface.

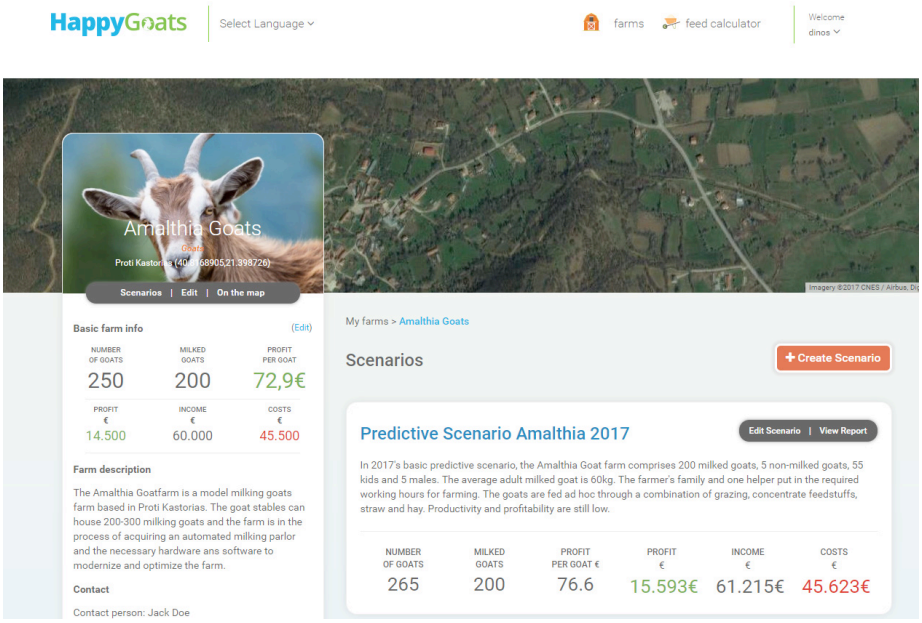


Fig. 3. Overview of a farm: Basic farm data: income, costs and profit per animal. **Farm scenarios** calculated projected values such as milk production change and weight change of lactating animals, based on their energy and protein balance.

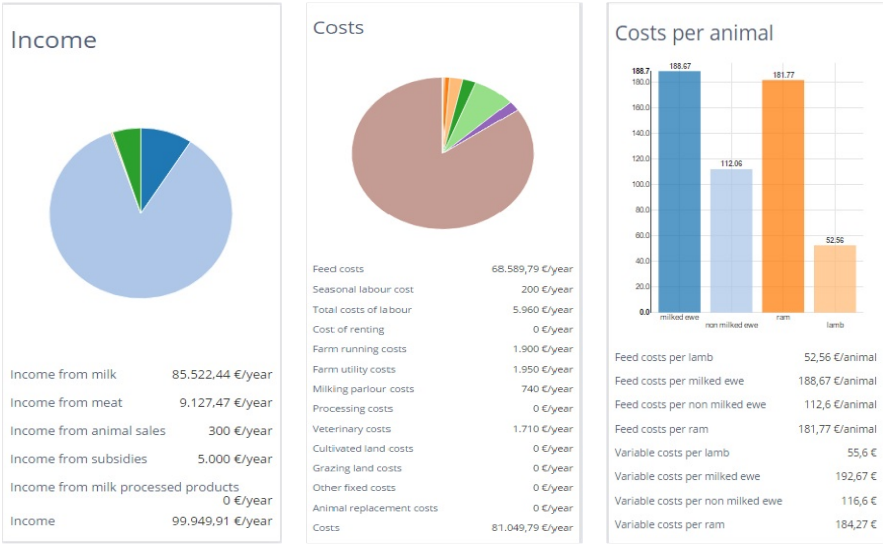


Fig. 4. Section of the report page; Graphical representation of farm income & costs and costs per animal.

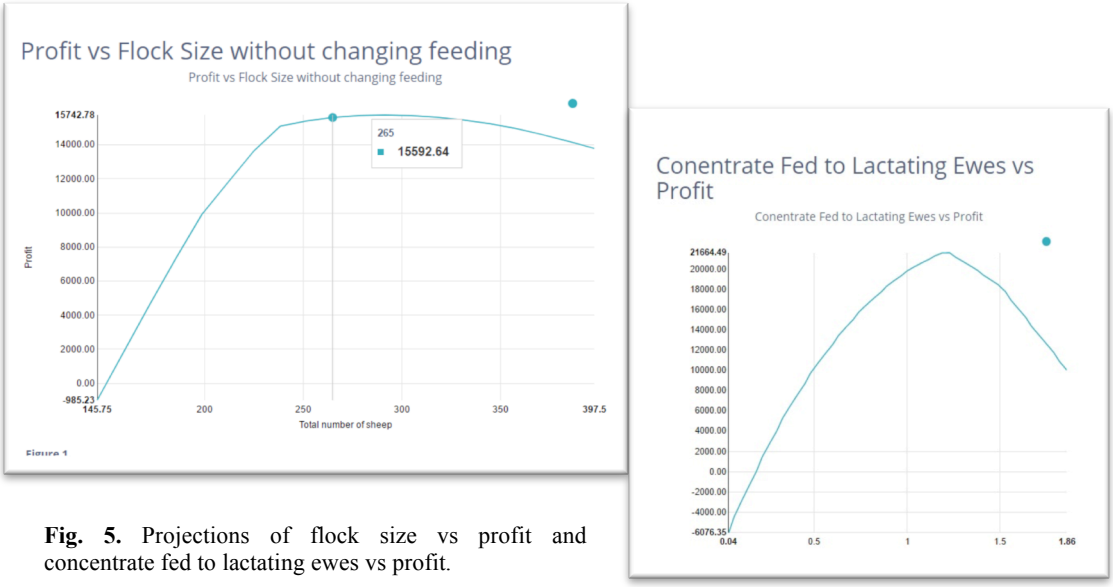
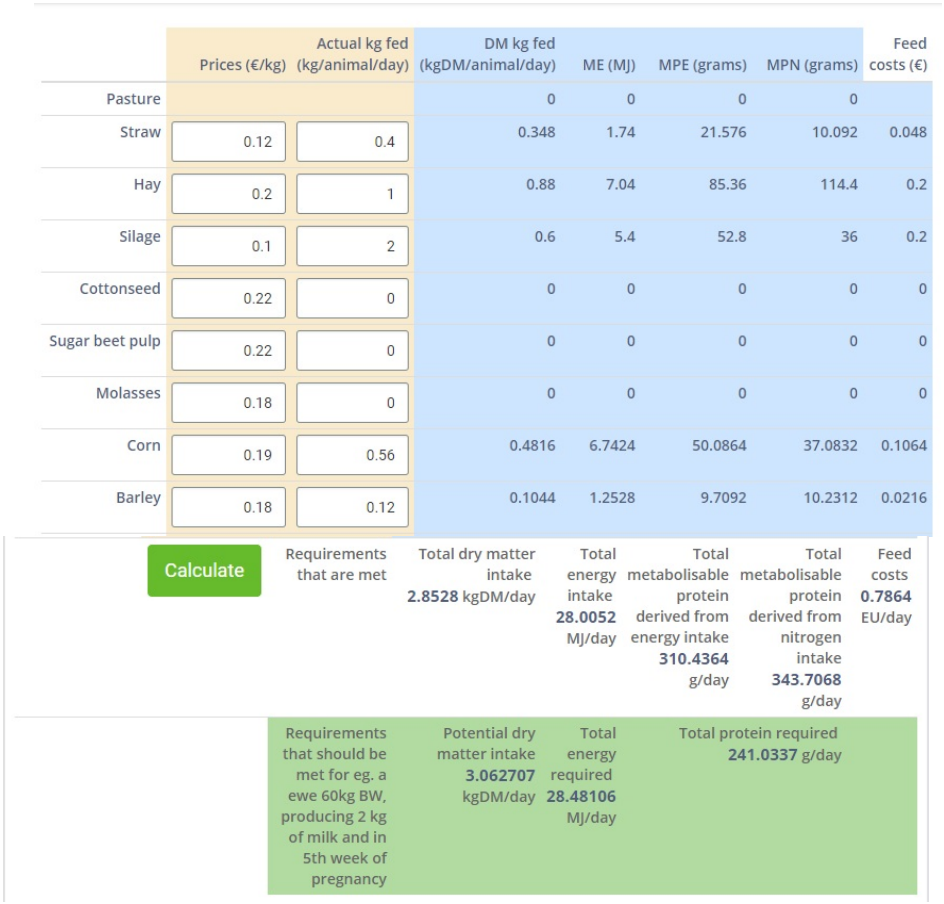


Fig. 5. Projections of flock size vs profit and concentrate fed to lactating ewes vs profit.

2: What-if scenarios: The app provides an action plan by simulating different what-if scenarios for the future. The users can freely experiment with all important factors which affect profitability and create/compare many different scenarios until they are satisfied. Moreover, they are provided with human readable advice which helps them towards testing more viable solutions. Through this process, farmers are able to make management planning decisions which will eliminate farm inefficiencies and optimize production.

3: Daily feed calculator: Happy Goats provides a standalone feed calculator (Figure 6) which can be used by consultants to develop daily feed rations for all animals (ewes/goats, rams/bucks and lambs/kids). The user inputs information regarding animal weight, milk production goal and week of pregnancy (for females) and daily weight gain (for young animals). Based on the above the model calculates energy and protein requirements. Then, the users experiment with amounts to be fed from a range of forages and concentrate feedstuffs, taking into account both their nutritional values and their current costs, in order to develop an optimized and customized daily feed ratio. Hence, Happy Goats daily feed calculator can help farmers optimize animal feeding while minimizing feeding costs.



	Prices (€/kg)	Actual kg fed (kg/animal/day)	DM kg fed (kgDM/animal/day)	ME (MJ)	MPE (grams)	MPN (grams)	Feed costs (€)
Pasture			0	0	0	0	
Straw	0.12	0.4	0.348	1.74	21.576	10.092	0.048
Hay	0.2	1	0.88	7.04	85.36	114.4	0.2
Silage	0.1	2	0.6	5.4	52.8	36	0.2
Cottonseed	0.22	0	0	0	0	0	0
Sugar beet pulp	0.22	0	0	0	0	0	0
Molasses	0.18	0	0	0	0	0	0
Corn	0.19	0.56	0.4816	6.7424	50.0864	37.0832	0.1064
Barley	0.18	0.12	0.1044	1.2528	9.7092	10.2312	0.0216

Calculate

Requirements that are met	Total dry matter intake **2.8528** kgDM/day	Total energy intake **28.0052** MJ/day	Total metabolisable protein derived from energy intake **310.4364** g/day	Total metabolisable protein derived from nitrogen intake **343.7068** g/day	Feed costs **0.7864** EU/day

Requirements that should be met for eg. a ewe 60kg BW, producing 2 kg of milk and in 5th week of pregnancy	Potential dry matter intake **3.062707** kgDM/day	Total energy required **28.48106** MJ/day	Total protein required **241.0337** g/day

Fig. 6. Standalone feed calculator with results.

5 Development and progress

Happy Goats was developed within EU's FI-PPP program (SmartAgriFood2 accelerator). In 2015 the development of the original prototype app was completed. It went through a process of competitive selection and based on its solid functionality and business pitch made it to the final phase of the EU business accelerator project. In 2016 Happy Goats underwent several field trials in Greece and Austria and is now in the go-to-market phase.

6 Conclusions

Happy Goats is a decision support web application, which introduces for the first time the concepts of profitability versus flock size optimization and efficient management for small ruminant farms in Europe. With this concept, the app goes beyond the few existing competitive products, which focus on finances or animal breeding, without adopting any comprehensive methodology to come up against the troubles that have been afflicting the sector. With Happy Goats, farmers will be able to estimate both financial figures such as income and costs and production related figures such as required feed for their goals of milk and meat production. Thereby, farmers will be able to better respond to the sector's challenges. Furthermore, Happy Goats can benefit additional actors of the sheep and goats farming value chain by diversifying and deepening their services offering.

Acknowledgments. In its current evolution, Happy Goats is a collaboration between the Laboratory of Animal Husbandry, School of Veterinary Medicine of the Aristotle University of Thessaloniki and Integrated ITDC, a software company. Happy Goats is based on SSRF-DSS, an EU-funded project through the SmartAgriFood2 accelerator with the collaboration of ZALF (Muncheberg, DE) and the Institute of Social Ecology (Vienna, AT).

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