30 *Actas Portuguesas de Horticultura*

VIII Congresso Ibérico de Ciências Hortícolas

Organização:

Associação Portuguesa de **Horticultura**

Sociedad Española de **Ciencias Hortícolas**

2020

FICHA TÉCNICA

Título: VIII Congresso Ibérico de Ciências Hortícolas

Coleção: Actas Portuguesas de Horticultura, N.º 30

Propriedade e edição
Associação Portuguesa de Horticultura (APH)
Rua da Junqueira, 299, 1300-338 Lisboa
http://www.aphorticultura.pt

Editores
Jose Alberto Pereira
Nuno Rodrigues
Ana Cristina Ramos

Grafismo da capa: Musse Ecodesign

ISBN: 978-972-8936-37-2
Ano: 2020

Overview of greenhouse horticulture in Portugal: technology and environment

Costa, J.M.[1], Reis, M.[2], Palha, M.G.[3], Passarinho, J.A.[3], Carvalho, S.M.P.[4], Almeida, D.[1], Nunes L.[2] & Ferreira, M.E.[3]

[1]LEAF - Linking Landscape, Environment, Agriculture and Food, Instituto Superior de Agronomia, ULisboa, Tapada da Ajuda, Lisboa, Portugal, miguelcosta@isa.ulisboa.pt, dalmeida@isa.ulisboa.pt
[2]Universidade do Algarve, Faculdade de Ciências e Tecnologia, 8005-139 Faro, Portugal, mreis@ualg.pt, lnunes@ualg.pt
[3]INIAV, I.P. Av. República, Nova Oeiras, Oeiras, 2784-505 Oeiras, Portugal, graca.palha@iniav.pt, jose.passarinho@iniav.pt, elvira.ferreira@iniav.pt
[4]Faculdade de Ciências, Universidade do Porto, Rua Campo Alegre, 687, 4169-007 Porto, Portugal, smcarvalho@porto.ucp.pt

Abstract

Total greenhouse production area in Portugal is about 3,000 ha with a tendency for expansion, and tomato is the most important greenhouse crop. Protected cultivation in Portugal modernized in recent decades but remains heterogeneous in terms of technology, yields and management. The sector organizational structure and technological trajectory is characterized by increased greenhouse area per grower and higher volume/covered area ratio, and soilless cultivation has expanded. Therefore, less expensive alternatives may arise as the common solution for the sector. Most of the greenhouse area (about 75%) corresponds to single and multiple plastic tunnels with semi automatic or automatic climate control. The use of glasshouses with fully controlled environment remains minor, due to the high costs of equipment, energy consumption, and limited expertise and technical support for local conditions.

Greenhouse horticulture has an undesirable environmental impact which must be properly monitored and minimized, while guaranteeing its socio-economic benefits. In addition, there is more strict environmental EU legislation and stakeholders are more informed which puts pressure on the greenhouse industry in order to use more efficiently resources and minimize its environmental impact. However, the Portuguese sector still lacks relevant quantitative information and standards on performance indicators, e.g. resource use efficiency (e.g. water, energy) and related economic/environmental performance. A SWOT analysis is presented for the most important greenhouse production areas in Portugal and guidelines are suggested for more competitive and environmental sustainable greenhouse production.

Keywords: Mediterranean, protected cultivation, sustainability, water use, SWOT.

Protected cultivation geography and labour

In the beginnings of the 1970's there were about 100 ha of greenhouses in Portugal, mostly localized in Algarve (south of Portugal). Nowadays, the total area is estimated to be around 3,000 ha. About 70% of this area is used to grow fruits and vegetables (F&V) and the remaining area to ornamentals. The three most important production regions are Lisbon and Tagus valley (LTV), Algarve, and the North (Entre Douro & Minho). Vegetable production is concentrated in the LTV region and in Algarve. Tomato, lettuce, small fruits (e.g. strawberry and raspberry), melon, and green beans are the most relevant F&V. Ornamentals (mainly cut-flowers) are produced in LTV region

(e.g. Montijo, North, and Alentejo (Odemira)). Carnation, rose, and gerbera are the most important ornamental crops. The horticulture sector is based on small farm units (< 1 ha), family owned and operated with low degree of specialization (several crop species) and limited economic resources. The largest greenhouse enterprises are mostly located in south Portugal, and are highly focused on exporting. Just like other agricultural sectors, the unqualified work is paid at 3-5 €/hour depending on the region which is still competitive as compared to EU countries but not with countries like Morocco (about 1€/hour). The recent trend, consists in the use of immigrant labour (e.g. from Ukraine, Romania, Thailand and Brazil) to compensate labour shortage and the limited attractiveness of the activity by locals.

Greenhouse technology evolution

Low cost greenhouse structures and technologies were commonly used in the 1960's, in the Algarve, where environmental conditions were highly favourable (Table 1), and also in the region south of Lisbon (Montijo). Chapel type greenhouses, with wooden structure with lateral ventilation, alone or combined with roof windows and a plastic film cover were used. Sector's evolution involved the increasing use of steel structures in combination with the slow expansion of greenhouse area to the north. A large expansion occurred in the mid 1980's concomitantly with Portugal join the EU. Chapel type wooden greenhouses, were progressively replaced by single and multiple span plastic film structures (Meneses & Castilla, 2009; Meneses 2011). Nevertheless, old greenhouses type still persists in Algarve and LTV accounting about 10% of the protected cultivated area. Currently, single or multi-span tunnels plastic greenhouses represent more than 75% of the greenhouse area (Costa et al., 2012).

The last decade has been characterized by an increase in the greenhouse area per grower, more modern greenhouses, higher yields, and larger use of soilless cultivation. Glass covered greenhouses area is minor due to high installation costs (100-120 €.m^{-2}) which is 5-10 times larger than 10-20 €.m^{-2} for a multi-tunnel with a metal structure) (table 2). Recent projects promoted by both foreign and Portuguese investors near Lisbon (e.g. Alcochete) and in Alentejo (e.g. Odemira) have adopted glasshouse technology and there are plans for the expansion of about 180 ha in Alentejo, near Odemira, mainly for berry production, with emphasis on raspberry. In Algarve, berries are being produced in modern 6 m high plastic greenhouse structures, whereas in the Ribatejo & Oeste, lettuce is cultivated in floating system. Unfortunately, most of the modern technology (structures, climate control systems, pesticides, substrates, fertilizers, know-how) supporting these investments, is imported, and there is in some cases a limited incorporation of national added value. However, the number of Portuguese companies specialized in greenhouse equipment that start competing in the international market has increased, although in some areas there might be limitations regarding assistance to glasshouse systems.

Some Portuguese companies produce substrates (namely for pot plant production and for berries) and are actively exporting. These companies may also take advantage of the expansion and modernization of the greenhouse sector attending to the fact that fertigation and drip irrigation become more generalized and soilless cultivation tends to increase to overcome soil limitations (low fertility, high salinity, and soil borne diseases). The use of substrates is estimated to reach 10% of the total greenhouse area, with particular incidence in Algarve and LTV regions. The use of active environmental control, artificial lightning and carbonic fertilization is not significant. Heating is almost exclusively applied to cut flowers production (e.g. rose, gerbera) to guarantee quality during the winter period and also in plant nurseries, attending to the high costs of energy and heating equipment. Energy costs vary from 2.5-15 €/m^2, depending on the heating

system and on the temperature inside and outside of the greenhouse (Meneses & Baptista, 2009). Heating with natural gas costs around 1/3 of heating with diesel (Baptista et al., 2012). The use of thermal and light screens also follows the most modern structures and is commonly used in nurseries. There is a large dependency (if not a total one) on foreign suppliers of starting material (e.g. cuttings or "stentings" for cut-roses and seeds for vegetables). In short, the Portuguese greenhouse cluster is still small and quite unbalanced, with very limited national capacity of technology supply.

Trends in the environmental impact

Intensive horticulture involves the intensive use of energy, water, biocides, nutrients (use and runoff) and the production of large amounts of organic (e.g. crop residues) and inorganic residues (e.g. cover plastics, mulching films or inorganic substrates) (Costa and Heuvelink, 2000; Costa et al., 2014; 2017; FAO, 2013; Andrade et al., 2014; Van Ruijven et al., 2014; Quintas-Soriano et al., 2016). Protected cultivation can optimize crop water use efficiency and minimize run-off (Stanghellini, 1988). However, the deficient control of irrigation and fertilization practices combined with high evapotranspiration typical of dry and hot climate of southern Europe (e.g. Portugal, Spain, Italy) may favour situations of over-irrigation and consequent overexploitation (and pollution) of aquifers (EEA, 2009; WWF, 2009). Predicted climate changes will exacerbate this problem in the southern Europe due to the increases in air temperature and decrease in rainfall (EEA, 2012). Water prices tend to increase, as policy measures are adopted to rationalize its use. Meanwhile, the amount of extracted groundwater is not properly monitored. This practice will become unsustainable on the medium-long term in southern regions like Algarve or Alentejo, due to their dryer and warmer conditions and increased competition for water resources with other sectors like tourism, especially during the summer.

Rules to control soil and water pollution with nitrates involved the creation of nine vulnerable areas located in different regions under the scope of the EU-Water Directive. However, the region of Odemira in Alentejo should be classified as another vulnerable area attending to the intensive greenhouse horticultural production.

The use of greenhouse closed cultivation systems in Portugal is limited and is being implemented only in recent projects. However, the problem of inaccurate management and related run-off nutrient solutions is common in intensive horticulture in the Mediterranean countries (Muñoz et al., 2012) and needs better control to avoid soil and ground water pollution. Recycling of plastic, crop residues and substrates should be considered by Portuguese growers and authorities to minimize the environmental impact of greenhouse horticulture. The EU Waste Framework Directive from 2008 emphasizes the need to improve management of substrate residues (e.g. improving the reuse) and reduce the volume of substrate used per plant/crop (Diara et al., 2012). Cogeneration has still a minor use. Recently a partnership between a Portuguese energy company and a growers association permitted to install a new large cogeneration unit in Oeste (north of Lisbon). Integrated pest management is increasing, and the improved quality of greenhouse structures facilitates this practice.

The method of life cycle assessment (LCA) has been the preferred method to quantitatively compare greenhouse against field production (Roy et al., 2009). LCA accounts for many quantifiable externalities of agriculture, including climate change (emission of greenhouse effect gases), stratospheric ozone depletion, photochemical ozone formation, acidification of water bodies, nutrient enrichment human toxicity via air, soil and water, and ecotoxicity. However, waste production is seldom included in the analysis (Bernstad et al., 2016), therefore under accounting the production of vegetable

waste, greenhouse plastic and chemical containers. Also, LCA lacks in spatial and temporal depth, and is unable to assess sufficiently some environmental impact categories such as biodiversity, land use etc. and most economic and social impact categories, including food security, water security, energy security (Arodudu et al., 2017), and visual impacts (Rogge et al., 2008).

Greenhouse production compares favourably in most LCA inventory (consumption) categories per unit produced (Almeida et al., 2012; Page et al., 2012), namely, for fertilizer consumption, active pesticides, water requirements, and fuel consumption. Given the much higher productivity of greenhouse systems (kg/m^2), its consumption per square meter of occupied land is higher, though.

In what regards the impacts, the results are mixed, being the magnitude of the impacts mostly dependent on type of production system and operational variables (Page et al., 2012; Bartzas et al., 2015). For instance, Page et al. (2012) found high-tech greenhouses to have a larger carbon footprint, per kilogram of tomato produced (mostly due to heating requirements) than medium and low-tech greenhouses and of field production. On the other hand, the water footprint was comparable to that of field production, but much lower than medium and low-tech greenhouses. Opposite results were found when comparing field production and greenhouse in Spain and Italy (Bartzas et al., 2015)

Modernization of the greenhouse management together with the implementation of closed fertigation systems, especially in large production areas and better territorial planning, may help to minimize many of the environmental impacts of the sector, though a casuistic approach should be used when deciding for alternative production systems, balancing economic and environmental aspects.

Marketing and agro-logistics

Only 10% of the production value results from grower's organizations, in contrast with an average of 30% in the EU (MADRP-GPP, 2008; 2009), reflecting a poor commercial organization of the upstream supply chain operators. The number of growers associations is excessive (e.g. 898 agricultural cooperatives and 133 agricultural finance cooperatives), weakening the bargaining position of growers and restricting their contribution towards the improvement of governmental policies. Marked changes occurred in the retailing sector with the introduction of modern distribution in the mid 80's (super and hypermarkets). The market of ornamentals was characterized by the expansion of garden centres, florists and open-markets. Flower bunches are also starting to be sold in the super and hypermarket.

In parallel, the agro-logistics have experienced a deep transformation to support the activity of the large retailers and the exporting companies. Several logistic platforms were installed near the large consumer centres (Lisbon, Oporto). Cooling stores have also expanded and modernized. However, the use of appropriate pre-cooling technologies remains limited, with most of the products being room cooled (e.g. flowers). Some large retailers have their own group of growers and also their own logistic structure. Others contract specialized logistic providers. This is particularly important when dealing perishable products like F&V. The large distribution "smashes" production prices. However, it is also a fact that only some few Portuguese growers can supply the large retailers, and even those, can find sometimes limitations to guarantee uniform quality of F&V along the year. In certain occasions, prices from French and Spanish growers can be more competitive than the Portuguese ones with regards to fruits and vegetables, respectively.

Prospects and strategies

A brief SWOT analysis for Portuguese greenhouse horticulture is shown in table 3. Portugal has strengths (climatic conditions, labour costs, investment prospects, etc.), but also some weaknesses that need to be overcome. One is the lack of up-to-date statistics, which affects negatively data availability for analysis. Statistical data must translate the specific characteristics of the sector and their publishing rate should be compatible with the changes occurring, namely in the cultivated area, technology, productivity, starting material, infrastructures, auxiliary industry and markets. Specific annual enquiries to cropping systems and biennial enquiries on the technological infrastructures, use of inputs (e.g. water, nutrients, energy) and financial data (input costs, selling prices) would provide useful information about the sector. This sector requires more qualified labour, and more professional organization at different levels of the production chain. Consolidation and scale are required at the production level, via larger grower associations with professional technical and commercial management, especially if the focus is to supply the large retailers and the exporting market. Nevertheless, small greenhouse operations can still coexist to supply proximity markets (e.g. small markets, open market places) with high quality products. In fact, direct sales from small farmers to the consumers should be promoted, as a way to (re)vitalize the local commerce either in the large or small cities.

Consumers are increasingly concerned with more environmental sustainable production, which involves strategies to minimize the impact on natural resources (Quintas-Soriano et al., 2016). This applies in particular to those areas or operations in more sensitive areas (e.g. Odemira, in Alentejo) or in the vulnerable areas, more prone to water and soil contamination by nitrates due to soil characteristics (e.g. Póvoa de Varzim in the north of Portugal, or the Campina de Faro in Algarve) (Costa et al., 2014). Optimized irrigation facilities, monitoring of soil and water quality or the recycling of nutrient solutions need to be seriously addressed in future investments, especially in the large scale projects and incorporated in new environmental legislation.

The private sector should be more involved in technological innovation but lacks the support of competitive research structures, with enough critical mass to cover the major areas of horticultural research (Almeida, 2012). Public and private research activities with more active participation of the bank sector can be envisioned. Most of the larger Portuguese growers still struggle to enter the international markets, but the case of foreign growers in the country, with deep knowledge of supply chains, may be spread as an example. The clusterization of the sector should be promoted to increase its competitiveness, at both the production and the related auxiliary industry. The greenhouse cluster in the Spanish region of Almeria (Aznar-Sánchez & Galdeano-Gómez, 2011) is an example, although at a quiet different scale from the Portuguese reality.

The acquisition of specialized competences in the F&V cluster by the agency to promote foreign trade and investment (AICEP) would benefit the sector. Since 2010, a new private association (PortugalFresh) was set up to promote Portuguese F&V and flowers, by presenting national products in different professional fairs of the sector. Increased competition from the greenhouse production in Morocco, where labour costs are low and the recent agreement with the EU will increase tomato imports and of other vegetables from that country. This is a matter of concern to south European greenhouse horticulture (CIHAM, 2012) although there are still limitations regarding logistics, road infrastructures and water resources in Morocco.

Acknowledgements

We acknowledge João Caço for supplying information.

Referencias

Almeida, A. 2012. O desafio do conhecimento no sector das frutas, legumes e das flores. Revista Frutas, Legumes e Flores. Março 2012:42-47.

Almeida, J., Achten, W.M.J., Verbist, B., Heuts, R.F., Schrevens, E. & Muys, B., 2014. Carbon and water footprints and energy use of greenhouse tomato production in Northern Italy. J. Ind. Ecol. 18:898-908.

Andrade C.S., Palha M.G. & Duarte E., 2014. Biodegradable mulch films performance for autumn-winter strawberry production. Journal of Berry Research 4:193-202.

Arodudu, O., Helming, K., Wiggering, H. & Voinov, A., 2017. Towards a more holistic sustainability assessment framework for agro-bioenergy systems? A review. Environ. Impact Assess. Rev. 62:61-75.

Aznar-Sánchez J. & Galdeano-Gómez E. 2011. Territory, Cluster and Competitiveness of the Intensive Horticulture in Almeria (Spain). The Open Geography Journal, 4:103-114.
http://repositorio.ual.es/jspui/bitstream/10835/368/1/TOGEOGJ2011F.pdf.

Baptista, F.J., San Jose, E., Guimarães, A.C., Navas, L.M. & Meneses, J.F. 2012. Greenhouse energy consumption for rose production in different regions of Portugal: importance of set-point definition and energy use. Acta Hort. 927:123-129.

Bartzas, G., Zaharaki, D. & Komnitsas, K., 2015. Life cycle assessment of open field and greenhouse cultivation of lettuce and barley. Inf. Process. Agric. 2:191-207.

Bernstad, A.K., Cánovas, A. & Valle, R., 2016. Consideration of food wastage along the supply chain in lifecycle assessments: A mini-review based on the case of tomatoes. Waste Manag. Res. 35:29-39.

CIHAM. 2012. Press review. Current Events in Euro-Mediterranean Agriculture, Food and Environment March 2012.

Costa, J.M. & Heuvelink, E. (eds.). 2000. Greenhouse horticulture in Almeria (Spain): A report on a study tour 24-29 January 2000. HPC Group, Wageningen Univ., NL.

Costa, J.M., Palha, M.G., Ferreira, M.E., Vargues, A. & Almeida, D.P.F. 2012. Protected Cultivation in Portugal: an Investment for the 21st Century? Acta Hort. 927:139-148.

Costa, J.M., Reis, M., Passarinho, J.A., Palha, M.G., Carvalho, S.M.P. & Ferreira, M.E. 2014. Sustentabilidade sócio-ambiental da horticultura protegida em Portugal. In: "VII Congreso Ibérico de Agroingeniería y Ciencias Hortícolas: Innovar y Producir para el Futuro" (F.G.UPM, ed.), Madrid, pp 1805-1810.

Costa, J.M., Reis, M., Passarinho, J.A., Ferreira, M.E. & Almeida, D.P.F. 2017. Microeconomic and environmental sustainability of Portuguese greenhouse horticulture: a critical sssessment. Acta Hort. (in press).

Diara, C., Incrocci, L. & Pardossi, A. 2012. Reusing greenhouse growing media. Acta Hort. 927: 793-800.

EEA 2009. Water resources across Europe - confronting water scarcity and drought. European Environment Agency, Report No 2/2009, ISSN 1725-9177.

EEA 2012. Towards efficient use of water resources in Europe. European Envir. Ag., 2012. http://www.eea.europa.eu/publications/towards-efficient-use-of-water.

EU 2009. Agricultural Policy Perspectives. Member States factsheets 2009-Portugal, 12p.

FAO 2013. Good Agricultural Practices for greenhouse vegetable crops Principles for Mediterranean climate areas. FAO Plant Production and Protection Paper. http://www.fao.org/docrep/018/i3284e/i3284e.pdf

MADRP-GPP 2008. Estratégia nacional para programas operacionais sustentáveis de organizações de produtores de frutas e produtos hortícolas. http://www.gpp.pt/MA/PO_FH/Estrategia_Nacional_HF.pdf

MADRP-GPP 2009. National Strategic Plan Rural Development 2007-2013. http://www.gppaa.min-agricultura.pt/drural/PEN_Novembro_2009_EN.pdf

Meneses, J.F. & Baptista, F.J. 2009. Improving greenhouse heating in Portugal. Acta Hort. 893:209-216.

Meneses, J.F. & Castilla, N. 2009. Protected cultivation in Iberian horticulture. Chron. Hortic. 49 (4):37-39.

Meneses J.F. 2011. Estufas e abrigos na Península Ibérica: situação actual e perspectivas futuras. Revista da APH, 67:31-35.

Muñoz, P., Paranjpe, A., Montero, J.I. & Antón, A. 2012. Cascade crops: an alternative solution for increasing sustainability of greenhouse tomato crops in Mediterranean zone. Acta Hort. 927:801-805.

Page, G., Ridoutt, B. & Bellotti, B. 2012. Carbon and water footprint tradeoffs in fresh tomato production. J. Clean. Prod. 32:219-226.

Quintas-Soriano,C., Castro, A.J., Castro, H., & Garcia-Llorente, M. 2016. Impacts of land use change on ecosystem services and implications for human well-being in Spanish drylands. Land Use Policy 54:534-548.

Rogge, E., Nevens, F. & Gulinck, H., 2008. Reducing the visual impact of "greenhouse parks" in rural landscapes. Landsc. Urban Plan. 87:76-83.

Serviço Meteorológico Nacional 1965. O Clima de Portugal. Fascículo XXIII, Lisboa.

Stanghellini, C. 1988. Microclimate and transpiration of greenhouse crops. Acta Hort. 229:405-414.

Van Ruijven, J.P.M., Van Os, E.A., Van der Staaij, M. & Beerling, E.A.M. 2014. Evaluation of Technologies for Purification of Greenhouse Horticultural Discharge Water. Acta Hort. 1034:133-140.

WWF 2009. Water foot print for Portugal. WWF Mediterranean 2010. 33pp. http://assets.panda.org/downloads/water_footprint_portugal2010.pdf (Accessed on 20 July 2010.

Tables and Figures

Table 1 - Climate data for some relevant regions in Portugal and other foreigner competitors (Spain, The Netherlands and Morocco).

Country/Region	City/Town	T (ºC) (min. Jan)	**T (ºC) (max. Aug)**	RH (%) (Aug)	Frost (n.days)	Insolation (n. hours/year)	Rain (mm)
Portugal[1]							
Algarve[1]	Faro	9.0	24.0	63	1	3158	453
	Tavira	7.0	29.8	60	5	3135	545
Alentejo (coast)	Zambujeira Mar	6.0	19.5	72-88	6	2550	---
	Alcácer do Sal	4.7	28.0	67	32	2907	589
Lisbon-Tejo	Montijo *	6.0	28.0	70-75	20-30	>2900	---
Valley (Oeste)	Lisboa	7.4	29.2	70	2	2788	694
	Caldas Rainha	6.6	23.8	78	16	2457	608
	Dois Portos	4.9	27.0	74	20	2486	596
Centre	Figueira Foz	6.6	22.9	85	0	2627	627
	Mira	5.2	24.1	78	32	---	1003
North	Póvoa Varzim	6.0	23.0	72-80		2390	---
	Porto	4.9	23.3	79	4	2427	1110
	Santo Tirso	3.7	28.5	70	11	2384	1337
Spain[2]	Almeria	8.0	31.0	64	---	2972	196
The Netherlands[3]	Roterdam	1.0	22.0	---	---	1542	815
Morocco	Agadir	7.9	26.1	---	---	3037	292

Sources: [1]Serviço Meteorológico Nacional (1965); http://www.meteo.pt/. [2,3]http://www.climatedata.eu/climate, acessed at 22/05/2012; [2,3]Costa and Heuvelink (2000).

Table 2 - Non exhaustive characterization of the main structures used in greenhouse cultivation in Portugal and related technology, prices and trends.

Type of structure	Regions	Ventilation	Heating	Cogeneration	Cost (€/m^2)	Automation	Future trend
Tunnel (no vertical walls)	all	none or lateral	no	no	3-8	no	↓
Chapel type (low) wood	Algarve	lateral windows	no	no	6-8	no	↓
Chapel type, wood	LTV (Montijo)	lateral and permanent (roof)	no	no	8-10	for some crops	↓
Chapel type (wood and steel)	Centre	lateral and permanent (roof)	possible	no	10-12	for some crops	→
Multi-span (steel light structure)	all	lateral and/ or roof	yes	no	10-15	yes	↑
Multi-span (steel heavy structure)	all	lateral and/ or roof	yes	possible	15-20	yes	↑
Venlo type (glass, fully equipped)	all	roof	yes	possible	100-120	yes	→

Table 3 - Summarized SWOT analysis for the Portuguese greenhouse horticulture.

Strengths	Weaknesses
• Climate (mild winters) • Land price • Labour cost • Transportation infrastructure	• Lack of robust and up-to-date statistics • Labour availability • Know-how/Education level of players, technical-scientific capacity • Technical skills and limited use of diagnosis tools (soil and plant analysis) • Weak organization (growers and markets) • Credit for investment • Legislation/bureaucracy • Monitoring and law enforcement • Environmental impact (pollution, in particular in vulnerable areas and Natural Parks)
Opportunities	**Threats**
• Increasing demand/quality • Investment prospects (private and public) • Agricultural education programs/facilities • Portuguese market and the need of food security • North European market (lettuce, tomato, small fruits) • Modernization of structures is needs	• Foreign competition (Spain, North Africa) • Education, lack of professionalization • Appropriation of added value by the distribution • Pressure of urban areas (Ribatejo & Oeste, Algarve) • Climate change