Pesticide safety risk management in high value chains: the case of Turkey and Morocco

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Project number
245233
Project title
SUSTAINMED
Sustainable agri-food systems and rural development in the Mediterranean Partner Countries
Call (part) identifier
FP7-KBBE-2009-3
Funding scheme
Collaborative project

Deliverable D16

Pesticide Safety Risk Management in High Value Chains : the case of Turkey and Morocco

Due date of the deliverable: **May 2012**

Actual submission date: **May 2012**

Start date of the project: March 2010 **Duration:** 36 months

Organisation name of the lead contractor for this deliverable:
INRA- Institut National de la Recherche Àgronomique

Project co-funded by the European Commission within the Seventh Framework Programme (2010-2013)		
Dissemination Level		
PU	Public	PU
PP	Restricted to other programme participants (including the Commission Services)	
RE	Restricted to a group specified by the consortium (including the Commission Services)	
CO	Confidential, only for members of the consortium (including the Commission Services)	

Deliverable number: 16

Deliverable name: Pesticide Safety Risk Management in High Value Chain : the case of Turkey and Morocco

Work package: 5.4

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[1] Acknowledgements : We wish to thank Dr Yuksel Tuzel (Ege University) for her constructive comments and useful provision of information, Eng. Imane Bennani (Former ENA Meknes student) for excellent research assistance on field survey and Dr Lahcen Kenny (IAV Agadir) for organizing and introducing to key Institutional persons during team exploratory meeting.

EXECUTIVE SUMMARY

MOTİVATİON AND METHODOLOGY

Fresh produce pesticides safety risks have grown during the last twenty years, into a major concern of north European consumers (Codron et al, 2006) and governments. Although Mediterranean Partner Countries (MPC) consumers are not yet very demanding as regards to fresh produce safety, risks are significant and increasingly taken into consideration by MPC local governments and modern food chain operators.

Product standards (Maximum Residue Limits) and more recently process standards (Good Agricultural Practices, GAP) have turned into the most efficient solution to control and reduce the level of pesticides on fresh produce. Defined by a variety of public and private actors (Codron et al, 2007), they are implemented and controlled at different levels of the chain by public and private actors as well. Accordingly, safety control has turned into a key issue for the development of MPC fresh produce export and local markets.

Task 4 of Work Package 5 expands on safety control issues and give insights into how MPC fresh fruits and vegetables chains **organise to comply** with private and public, national and international safety standards and thus get access to export and modern domestic markets.

The deliverable deals with food safety control in the MPCs or more precisely pesticide safety risk management in high value chains of Morocco and Turkey. More precisely, it aims at identifying and analyzing:

- the **diversity of management schemes** implemented by local growers to comply with public and private standards, both in the export and domestic high value chains
- the **economic, organisational, and institutional drivers** of the diffusion of those standards in MPCs.
- the **individual determinants** of the adoption of specific pest management patterns and farm product certification.

To allow comparisons between value chains in the two countries, we choose to focus on the production of fresh tomatoes. In the fresh fruits and vegetables sector, tomato plays a key role. It is the dominant crop in terms of production, consumption and exports. Moreover, it is most likely one of the most advanced crops in terms of the sustainable use of pesticides, with the development of integrated pest management (IPM), which can be defined as "the rational application of a combination of biological, biotechnical, chemical, cultural or plant-breeding measures, whereby the use of plant protection products is limited to the strict minimum necessary to maintain the pest population at levels below those causing economically unacceptable damage or loss" (Directive 91/414/EEC). Conditions for IPM development have been quite propitious, since tomato is progressively more and more cultivated under greenhouses (Arno et al, 2009). Moreover, being the most important crop, it concentrates a high share of the research and extension effort. Among MPCs, Morocco and Turkey which are dominant players in the tomato industry, have contrasted features.

Our research methodology is based on a qualitative study of the two high value chains, complemented by a quantitative analysis of tomato growers' surveys, one conducted in the Antalya region (Turkey) with 186 greenhouse growers and the other in the Souss-Massa-Drâa province (Morocco) with 86 producers. At the mesoeconomic level, the case-study approach allows to identify the main drivers of the diffusion of standards in MPCs, and understand the conditions for small farmers inclusion in safety risk management schemes; whereas the microeconomic analysis will go more deeply into the heterogeneity of farms, preliminary field-trips suggesting that pest management patterns are unevenly distributed between producers. More precisely, the objective of the survey is to assess the structural, socio-demographics and environmental characteristics of farms associated with IPM and certification in both rural regions.

Since the early 1990s, research on IPM adoption at the farm-scale has flourished, drawing on seminal work on technical change and the application of discrete choice models in the field of agricultural economics. A first critical point is to define IPM, as they are many operational definitions according to crop, region, pest classes and government-sponsored programs (Fernandez-Cornejo, 1998; Kogan, 1998). Most of the decision models deal with the adoption of a single technique, generally scouting for invertebrate pests (Caswell et al., 2001; Fernandez-Cornejo, 1996; Fernandez-Cornejo and Jans, 1996; Fernandez-Cornejo and Kackmeister, 1996; Mcnamara et al., 1991; Yee, 1996). Other work try to explain the use of biological control (Caswell et al., 2001; Fernandez-Cornejo and Ferraiolli, 1999), crop rotations (Caswell et al., 2001) or cultural and pesticide-efficiency techniques (Fernandez-Cornejo and Ferraiolli, 1999). To avoid the shortcomings of binary response, some researchers try to measure the intensity of adoption, which is assessed from the number or IPM techniques (Lohr and Park, 2002; Maumbe and Swinton, 2000; Sharma et al., 2011), the magnitude of their use (McDonald and Glynn, 1994) or the total workforce dedicated to IPM (Beckmann et al., 2006). Numerical, count or categorical data are used to model adoption. Other works study the diffusion of IPM with duration models, the dependant variable being the lag of adoption (See for example Fuglie and Kascak, 2001).

GAP certificates are production standards combining sustainable pest management and product traceability with other sustainability dimensions such as labour welfare or waste management. The most famous is GlobalGAP (formally know as EurepGAP), a private standard set up in 1997 by European retailers members of the Euro-Retailer Produce working group (Codron et al, 2005; Asfaw, 2010; Souza Monteiro and Caswell, 2009). Studies on the adoption of GAP certificates avoid those measurement problems, since certificates are precisely defined by public or private regulations (GlobalGAP, Fair Trade, Integrated Fruit Production, etc.) and allow for a clear divide between adopters and non adopters (Asfaw et al., 2010; Burton et al., 1999; Cazals et al., 2009; Dorr and Grote, 2009; Kersting and Wollni, 2011; Souza Monteiro and Caswell, 2009; Mzoughi, 2011).

Table 1 summarized the main findings of the farm-scale centred economics literature on pest management. For integrated pest management (column three), the positive effect of education, short trainings and the access to extension services confirm that IPM is a complex, human capital and information-intensive technology (Carpentier, 2010; Fernandez-Cornejo et al., 1998). Farmer age has a negative effect, which suggests that older producers have fewer incentives to invest and may be more reluctant to accept newer techniques, even if they are more experimented than younger which should foster the master of complex techniques. Results confirm that off-farm activities compete for on-farm managerial time and may present a constraint to IPM adoption (Dorfman, 1996; Fernandez-Cornejo, 1998).

Farm size, by far the most widely investigated factor of IPM adoption, generally increases the probability of adoption or the speed of diffusion. There are different explanations for this important result. Given the fixed transaction and information costs associated with innovation, there may be a critical threshold on farm size (Just et al.; 1980, Fernandez-Cornejo et al., 1994). Also, large farms have more resources to manage complex processes (Carpentier, 2010) and size could be correlated to other factors, such as wealth or access to credit (Feder et al., 1985). Revenues are also sufficient to offset the financial risk of experimentation with multiple practices (Lohr and Park, 2002).

Table 1. Characteristics of growers with specific pest management patterns.

		IPM adopters	**GAP certified**
Farmer	**Age**	-	0
	Education	+	+
	Short trainings	+	+
	Off-farm activity	-	-
	Access to technical assistance/consultants	+	+
Farm/Capital	**Farm size**	+	-
	Importance of family labor	+	NA
	Ownhership of land	0	NA
	Irrigation	+	+
	Crop diversification	0	NA
Marketing	**Marketing contracts**	0	0
	Producer organisation membership	NA	+
Environment	**Soil quality/land productivity**	+	+
	Pests and diseases pressure	+	NA

+: in most studies, increases the probability of adoption/the speed of diffusion.
-: in most studies, decreases the probability of adoption/the speed of diffusion.
0: mixed results.
NA: variable not included in studies surveyed.

Other variables associated with IPM are crop irrigation and biophysical environmental factors such as land quality, good soils (Caswell et al., 2001; Yee, 1996) and generous rainfalls, where greater pest and diseases pressure may be expected (Fuglie and Kascak, 2001). Other factors studied show mixed results (for example, crop diversification).

Literature on the adoption of GAP certificates (last column) shows results similar to those of IPM literature, although farm size has a negative effect on GlobalGAP adoption in Kenyan and Thai studies (Asfaw et al., 2010; Kersting and Wollni, 2011). Moreover, farmers' organisation is a determinant of adoption, as members of large producer organisations (Souza Monteiro and Caswell, 2009) and farmers that are affiated for a long-time to such organisations (Asfaw et al., 2010) have higher probability to adopt GlobalGAP. The literature review and a preliminary field work conducted by the team in fall 2010 helped build the hypothesis about IPM/GAP adoption and tailor the farm questionnaire (see the full questionnaire for Turkey in annex).

The reminding of the executive summary will be organized as follows. Section 2 (Turkey) and 3 (Morocco) present the main insights of country reports, from the presentation of the tomato industry to the main results of greenhouse grower's surveys. Section 4 conclude by contrasting the two high value chains and extending further the reflexion on the management of fresh produce pesticides safety in MPCs and Turkey.

TURKEY

This section expands on safety control issues in the Turkish tomato chain at the export and domestic market level. A general picture is given based on interviews and secondary data. We then focus on growers' adoption of IPM practices and its determinants. To that purpose, a survey was conducted in spring 2011 by 186 growers, selected at random in the three main districts of the province of Antalya, which is the lead region of production of greenhouse tomato in Turkey.

Tomato exports from Turkey (more than 540 kT) which have drastically increased in the last twenty years (2009 exports are five times those of the 90's decade) have been first concerned by safety issues in the early 2000's (rejection of a shipment of peppers at the EU boarder in 2001). Those concerns have been rapidly increasing during the last decade with the integration of Eastern countries, traditional customers of Turkey, into the European Union and the higher severity of control at the boarder of Russia, by far the first importer of tomatoes from Turkey. It has led public and private actors to favor or to implement different types of policies and strategies. Integrated pest management practices including appropriate chemical control have been fostered and disseminated by the Ministry of Agriculture (MARA) with some FAO/WB funding from the late 90's. Growers of all kinds and not only large scale growers have been impacted. Further on, large scale farmers have gone through a Global Gap certifcation process even though the number of certified growers is still very low. More recently, product standards (Maximum Residue Limit, MRL) are getting progressively enforced thanks to the upgrading of existing laboratories of analysis and increased public and private investments in new laboratories.

The local market is not yet highly concerned by such issues, Turkish consumers being moderately demanding as regards to fresh produce safety. Besides the IPM program launched by the government at the production level, recent initiatives have been taken by a few modern retailers who want to differentiate from traditional markets and are including safety as a strategic goal in their marketing. However, market incentives remain weak for growers, in particular to small-size growers who cannot sell directly to supermarkets or to exporters and have not yet the dynamic cooperatives or producers unions that could bypass brokers. The most salient initiative is a recent public regulatory initiative which aims at better pesticides traceability in the chain through a series of controls, in particular prescription of pesticides to be used by licensed public or private engineers, control and licensing of pesticides dealers, mandatory spraying record keeping by growers and certificate of approved pesticides required at the wholesale market from growers.

Unlike Morocco where tomato growers are medium or large size growers, the average Turkish tomato grower is a small farmer with small farm and greenhouse size (less than 0.7ha of greenhouse vegetable per grower). Most greenhouses (77%) are located in the South of Turkey, in particular in the Mediterranean region where the climatic conditions are favourable for protected cultivation with almost no heating (simple wood/coal heater or sprinkler on the roof to protect from freezing). As a result, greenhouses are simple structures with either glass or plastic covering and harvest may be made throughout wintertime.

Crop technology is still elementary (almost no soilless culture although drip irrigation is generalized) and pest and disease management still mostly basic. Only a very few growers used biological auxiliaries or are Global GAP certified. However, growers are becoming more sensitive to use some simple and effective strategies like yellow traps. Government IPM and chemical control promotion, exporters and modern retailers' actions and recent law for better traceability have created grower awareness to IPM issues and opened perspectives for better pest and disease management.

Our survey by a sample of 186 growers of the Mediterranean region was aiming at giving a precise and clear picture of the level of development of the conventional and alternative practices of pest and disease management in Turkey. Face to face interviews based on a closed questionnary with growers have been realized during spring 2011. Growers have been asked about structural characteristics (farmer, farm, production, marketing, cooperative organization) and behavioral characteristics as regards to pest and disease management (pest and disease monitoring, pesticide application decision making, recording, chemical control and alternative methods like preventive control, physical control, mechanical control, biological control.

Monitoring practices are quite diversified. While pest and disease monitoring and chemical treatment recording are progressively adopted and compliance with the delay of treatment before harvesting satisfied, growers are still very dependent on pesticides suppliers for treatment decision making (92% declare being moderately or strongly influenced by suppliers' advices). Other participants in the decision making are private or public consultants (41%) while half of our sample use field observations and knowledge of history of pest management. To design a typology of farmer behaviour, we are thus led to use different classifications of monitoring practices: three groups of monitoring frequency (once a week, two to four times a week and every day), three groups of recording (no recording, simple and full recording) and four groups of decision making (with or without external advice not including pesticide dealer advice and with or without autonomy).

Table 2 : Growers' characteristics in the four groups of influence of the treatment decision making

		external advice		no external advice	
		autonomous	non autonomous	autonomous	non autonomous
Farmer	Young Age	+		+	
	Education			+	
	Experience		-		
	Coop member		+		
Size/Capital	Farm size	+		-	-
	Greenhouse size	+			-
	% of glass				-
Productivity	Off farm activity	-		+	
	Specialisation			+	
	Technology	+		-	
Risk perception	Pest pressure	+		-	
Marketing	better valuing	+			-
Performance	Yield	+		+	-
	Income	+		+	-

A first analysis of the determinants gives interesting structural characteristics for the groups of decision making and recording. The latter are quite similar to those of alternative methods (see further). The former puts foward structural criteria like land and capital size, technology (level of intensification), marketing (better valuing), age, education, risk perception and experience and cooperative membership. The two groups with autonomy are younger and have better performance than the others. What makes a difference between them is size, technology/diversification and risk perception, the group with external advice regrouping larger scale, more specialized growers with higher productivity and higher disease pressure sensitivity. Group with no autonomy and no external advice are small size farmers with low level of capital, traditional marketing and poor performance. The fourth group (non autonomy and external advice) regroups growers with less experience and more cooperative membership, size and performance being intermediate. Most important is that there is no clear relationship between groups of decision making and groups by level of IPM.

Alternative control practices that have been identified include IPM practices such as resistant varieties, traps (yellow sticky traps, blue traps, pheromons), biological auxiliaries or natural enemies, hygienic precautions (equipment cleaning, wall spraying), equipment installation (curtains or insect nets, footbaths) and mechanical methods (elimination of contaminated plants, weeding in and outside the greenhouse). Some practices are well disseminated (more than 80% of adoption) : yellow sticky traps, eliminating the first contaminated plants and putting curtains at the doors. Three levels of IPM have been defined: i) growers with a high level of IPM using biological control, pheromons or footbaths and all the well disseminated practices; ii) growers with a low level of IPM using none of the "elite" practices (biological control, footbaths, pheromons) and not having yet adopted some of the well disseminated practices; iii) growers with an intermediate level of IPM.

Table 3: Growers' characteristics in the three groups of IPM level

	Level of IPM	High	Intermediate	Low
Farmer	Young Age	+		
	Education	+		
	Experience	-		
	Coop member	-		
Size/Capital	Farm size	+		
	Greenhouse size	+		-
	% of glass	+		-
Productivity	Off farm activity	-		+
	Specialisation	+		-
	Technology	+		-
Risk perception	Pest pressure	-		
Marketing	better valuing	+		-
Performance	Yield	+		-
	Income	+		-

A first analysis of the factors that may influence such IPM behavior puts forward the same criteria as in the decision making groups. IPM high level and low level growers differ mostly by size (farm and greenhouse), capital (percentage of glass versus plastic greenhouses), crop specialisation, technology (harvesting period, crop specialisation, type of tomato, etc), marketing skills (better valuing practices), the growers with high level of IPM having higher levels of structural criteria.

Moreover, the growers of this group feature higher level of education, are younger, have less experience and are less involved in cooperatives. The two groups (high and low) also have contrasted performance, the high level resulting in higher tomato yield and higher income.

We also studied the environmental performance in terms of pesticide use with criteria like the number of treatments and the number of overdoses (application of a pest protection product at a higher rate than the recommended one). Growers declaring not using pesticides for controling pest and diseases are a minority : 19% of the growers do not spray any pesticide against pest, 26% do not spray against diseases, 18% do not spray at all. Pest and diseases with higher number of growers using pesticides to control them are white flies (66% of the growers), mites (63%) and mildew (62%). For all other pests and diseases, growers are less than 50% to use pesticides. This is the case in particular for Tuta absoluta, a pest that has emerged recently and which is the most threatened: only 24% of the growers declare using pesticides against Tuta. The average number of spraying per grower using pesticides is almost 25. Average numbers for pest and diseases spraying are respectively 16 and 10. The target with higher average number of spraying is by far White flies with 9,6 applications/per grower (using pesticides to control White flies). Most other targets have between 4 and 6 applications.

Pesticides applications exceeding the standard dosis by more than 50% have been found for the pest/pesticide binoms Tuta-Agremec, White Flies-Mospillan, Mites-Agremec and Aphids-Decis and for the disease/pesticide binoms Mildew-Topas, Botrytis-Signum, Oidium-Signum, Oidium-Shavit and Rust-Signum. Within these couples, those with highest number of growers no complying with the standard are Mites-Agremec (53 growers with overdose), White Flies-Mospillan (40 growers with overdose) and Botrytis-Signum (15 growers with overdose). Statistics of overdoses per grower have been elaborated on the base of the 12 pesticides most commonly used (those with a percentage in the column “% of use”). Growers who spray pesticides (the vast majority, 90%), have been ranged according to the number of overdoses declared along the 12 couples (target-pesticides) above mentionned. Four groups of equivalent size may be distinguished: growers with total compliance (25%), growers with only one overdose (24%), growers with two overdoses (20%) and growers with more than two overdoses (21%). Among the 122 growers with overdose, 72 only have overdose for pest, 5 only have overdose for disease and 45 have overdoses both for pest and disease.

Still missing is a correlation analysis making a link between groups of IPM behavior and environmental performance obtained as measured by number of applications and number of overdosis. Econometric analysis will be useful as well to have a better understanding of the determinants of IPM adoption and of the impact of IPM on environmental performance and economic results (yield, income).

In conclusion, although Turkish consumers are not yet very demanding as regards to pesticides, public and private actors have significantly contributed to the development of the level of safety in the fresh produce industry. Main drivers of the development of IPM in Turkey have been for the last decade i) a sharp increase in export safety requirements due to a rise in safety requirements from countries like Russia or new EU-integrated countries; ii) initiatives of some modern retailers which are however still handicaped by the lack of dynamic marketing cooperatives; iii) government active intervention through regulatory measures (2010 traceability Law), subsidies for IPM inputs/equipments, training of tecnicians and growers, licensing of public/private prescribers, accreditation o laboratories, increased control of input suppliers whose influence on growers decision is still decisive. The bottom line of such a development is a widespread dissemination of alternative farm practices but a still low rate of GAP certification.

MOROCCO

This section expands on safety control issues in the Moroccan tomato chain at the export and domestic market level. A general picture is given based on interviews and secondary data. We then focus on growers' adoption of Integrated Pest Management and certificates of good agricultural practices such as GlobalGAP, Nurture or organic farming. To that purpose, a survey has been conducted in the main districts of the Souss-Massa-Drâa region, which is the lead region of production of greenhouse tomato in Morocco.

Morrocan FFV chain has a long history of **export-oriented production**, especially of early vegetables. For example, more than 100 k tons of tomato are exported every year by the Kingdom since the 1960s. In recent years, the volume of tomato exports has kept growing, from 236 kTons in 2004 to 421 kT in 2009. If the preferential access to EU market is an opportunity for Moroccan production, the EU 2005 obligation of traceability puts a pressure on exporters and growers. Parallel to this regulatory framework and since the beginning of the 1990s, there is **a multiplication of private standards** imposed by customers and particularly hypermarkets. Those private standards usually more constraining than EU and national regulations. With this kind of quality standards increasingly constraining, especially safety standards, the access to the export market becomes more selective and tends to only concern companies that are able to comply with. In this case, some of these companies have international strategies and establish in France to better control the transit of their products. But, the majority of exporters market their products by the intermediary of French importers, who are then, due to responsibility rules, at the core of safety control devices. The strategies of these importers as regards to the safety control are thus a crucial factor for the valorisation of tomato (Codron et al, 2007).

The local market is not yet highly concerned by such issues, Morrocan consumers being not very demanding as regards to fresh produce safety and guided firstly by price. Moreover, the traditional retail sector is still strongly anchored in consumption habits, and the institutional context, which obliges any FFV to transit by wholesale markets, penalise modern retail chains in their integration of the supply chain and their strategy of quality differentiation. Safety public institutions in charge of the fresh produce sector, relatively weak until the mid 2000s, are increasing their control at the production level. ONSSA, an independent agency under the supervision of the Ministry of Agriculture, is in charge of implementing the 2007 Food Safety Law, which includes requirements for growers. The agency also promote good plant protection practices, the introduction of record keeping for pesticide applications and the promotion of biological control.

Unlike Turkey where tomato growers are small farmers (less than 0.7 ha of greenhouse according to our Antalya survey), the average Moroccan tomato farm is a large operation, 70 ha with 54 under greenhouse. In the Souss-Massa region, most of greenhouses are made of Eucalyptus wood or galvanised steel (Canary Island types). In terms of water management, drip irrigation is today generalised in all the farms. Soilless cultivation is little developed. Altogether, IPM is well endorsed by Moroccan producers, in particular because of the very strong orientation towards the European market.

To assess more precisely **patterns of pest management**, we conducted a survey of 86 growers in the Souss-Massa. It aims at giving a precise and clear picture of the level of development of the conventional and alternative practices of pest and disease management in Morocco. Face to face interviews based on a closed questionnaire with farm owners and managers have been realised during 2011. Growers have been asked about their structural characteristics and their behaviour as regards to pest management: pest and disease monitoring, pesticide application decision making, recording, chemical control and alternative methods like preventive practices and biological control.

Alternative control practices that have been identified include IPM practices such as resistant varieties, traps (yellow sticky traps, blue traps, pheromones), biological auxiliaries or natural enemies, hygienic precautions, equipment installation and mechanical methods. Morocco has a much higher level of IPM practices than Turkey, almost identical to the one existing in France or Netherlands. Basic tools such as the use of yellow traps and insect nets (curtains), the elimination of the first contaminated plants, equipment cleaning, weeding and greenhouse walls washing and spraying, the use of pheromons, are almost generalized (between 97 and 100% of the sample). Footbaths are also largely diffused (86%). More than two-third (71%) use biological auxiliaries and most of the farms are either already GlobalGAP certified (53% since more than 5 years) or under the process of being certified.

To allow **comparison between adopters and non-adopters**, a summary of cross-sectional data is presented in the table thereafter. Note that these preliminary findings should be completed by rigorous univariate statistical test and econometrics.

Farmers that have adopted **biological auxiliaries** head much larger farms, whatever it is assessed by total labour (50 workers against 17), farm size (89 ha against 23) or area under greenhouse (67 ha against 18). Data suggest that they are a little older and better educated, and have more frequently other sources of income than tomato. Their greenhouses are less tomato specialized and more likely to be externally audited (28% against 0%), which confirms the association between external control and the adoption of alternative practices.

Table 4. Characteristics of growers with GAP and elite IPM practices.

		Bio auxilliaries (Yes)	**Blue traps (Yes)**	**GlobalGAP (Early adopters)**
Farmer	**Age**	+	+	+
	Education	+	+	+
	Other income	+	+	+
	Coop member	-	+	
Size/Capital	**Land in property**	+	-	
	Workforce	+	+	+
	Farm acreage	+	+	+
	Greenhouse acreage	+	+	+
Productivity	**% Greenhouse**	-	-	+
	Specialization	-	-	+
	Yield	-	+	-
Risk perception	**Pest presure**	+	+	+
	Disease pressure	+	+	+

We find the same characteristics for farms with **blue traps**, although the difference with other farms is less important for external audit, farm area and greenhouse size. Total labour is nevertheless still more than twice the amount of farms with no blue trap (48 workers against 22). Cooperative membership is positively associated with blue trap adoption but negatively with auxiliaries.

Going to **certification**, we note that early adopters of GlobalGAP are older, more educated, and have more frequently other sources of income. Their farms are much larger: 108 ha on average, against 49 ha for "followers" and 30 ha for farmers that are still not certificated. But, contrary to adopters of elite IPM practices, their greenhouses are also the most specialised in tomato. From the self-evaluation of risks by growers, we built a synthetic indicator for all tomato pests, and another for all diseases. The survey suggests that early GG adopters and growers with elite IPM practices perceive a higher pressure from pests and diseases.

Conclusion. Moroccan consumers are not yet very demanding as regards to pesticides residues, but the FFV chain has a long history of export-oriented production, especially the early vegetables sub-sector. During the last decade, GlobalGAP certification and external audit have been implemented in most surveyed farms, as a prerequisite to access food safety-demanding European markets, for legal and commercial reasons. The main driver of the development of IPM and GAP in Morocco has therefore been the export market. The tightly vertically integrated supply chain was a determinant factor to implement quality management simultaneously at the greenhouse and station scales. Indeed, most farms own or are affiliated to a FFV packer, itself integrated into exporting groups tied to French and other EU markets.

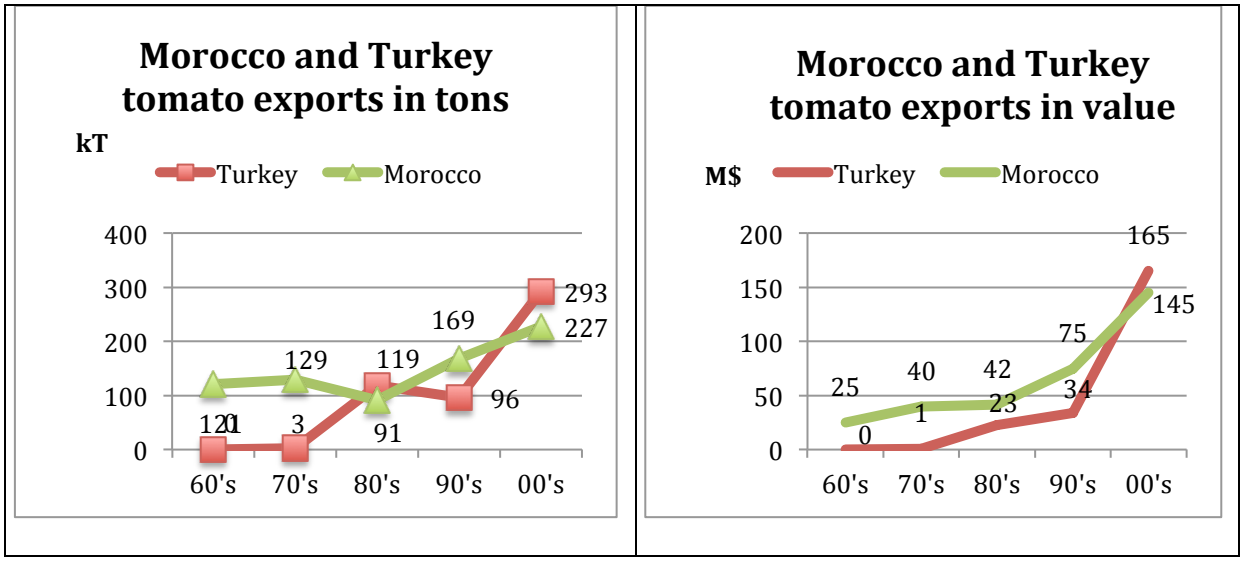
Farm large size and growers/managers'skills undoubtedly help to implement knowledge-intensive cultural practices and managerial procedures. This feature is in sharp contrast with the Turkish case, where production is more oriented towards domestic consumers, with much smaller farms and longer FFV chains. Other more recent drivers include i) government intervention through regulatory measures and the promotion of good agricultural practices, ii) initiatives of some modern retailers which are however still hampered by the structure of wholesale markets and the lack of local demand for safety attributes.

CONTRASTİNG TURKEY AND MOROCCO

Main drivers of IPM and certificates adoption are country specific and farmer specific. In each of the two country reports, we have focused on drivers related to farm and farmer heterogeneity, showing how individual characteristics like for instance farmer education, farm capital, crop technology or marketing may influence chemical or alternative control practices. In this section, we focus on country specificities (characteristics and determinants) of safety risk management. We first present safety related differences in export markets and domestic markets, then differences obtained from our grower survey in average farmers' structures and safety behavior. It is worth mentioning that natural conditions in terms of pest and disease pressure are quite similar between the two regions under scrutiny in our research, as suggested by Hanafi and Papasolomontos (1999).

Export markets and safety. Turkey and Morocco are among the top tomato production and exportation countries in the world. As regards to production, Turkey is amid the top 10 tomato growing countries since the beginning of the 1960s. During the last decade, it climbed three places in world ranking from 6th to 3rd place while Morocco got from the 24th to the 16th place. Turkey's production is about 10 milion tons (including tomato for processing) while Morocco's production is over 1 million tons (see table in Annex). Regarding exports, Morocco has the longest experience with exports while Turkey has turned into a significant exporter of the same level as Morocco in the 80's.

Figure 1. Morocco and Turkey tomato exports (in tons and value).



Morocco whose main customers are France and other countries of the European Union, must achieve much higher standards of quality and safety[2] than Turkey who was first oriented towards countries like Middle East countries and Eastern European countries with low levels of standards.

However, due to a change in customer portfolio and a rise in safety requirements of its main customers (Russia and EU new members), Turkey has significantly upgraded the safety level of its exports. This may be noted by comparing the unit value first of Turkey and Morocco (figure 1), second of Turkey and its challengers in the Western Asia market, Jordan and Syria (figure in Annex).

Domestic markets and safety. With a higher GDP per capita (US$ 14517 vs 5052; IMF 2010-11), Turkey has a stronger potential for domestic high value chains than Morocco. However, although supermarkets, supported by public liberalization policies, have grown very quickly over the last decade, their share in the produce market is still weak (about 20% in Turkey, less than 10% in Morocco).

[2] It is worth noting that Morocco who is much better than Turkey at complying with MRLs, may be in trouble with countries like Russia where quarantine is at stake. In 2010, 135 cases subject to quarantine have been detected in Russia on Moroccan produce (mainly citrus), which is eight times higher than the number of detections from other citrus exporting countries (Turkey, Egypt, Spain) (www.kommersant.com)

The price difference between domestic markets adds to the price difference between foreign customers to make the Moroccan price gap (between the home price and the export price) wider than the Turkish one. As a result, most Moroccan exporters most often ignore the domestic market while Turkish shippers tend to target more and more both the export and the domestic market. While Moroccan supermarkets complain about the lack of motivations of large scale export-oriented growers to supply them, Turkish supermarkets complain about the small size of the tomato growers and the lack of performant marketing cooperatives. One of the major limiting aspects for small farmers is the volume marketed, no supermarket wanting to negotiate small volumes with a multitude of small farmers. While dedicated wholesalers have developed at the initiative of some supermarket chains, the Turkish government is encouraging the development of marketing cooperatives (Lemeilleur and Codron, 2011) but their market share is still very low.

Traditional retailing whose market share is still 80% in Turkey and more than 90% in Morocco is mostly supplied by intermediaries through wholesale markets. There have been significant public initiatives to modernize wholesale markets. In Turkey, where small farmer production (about 0.5 ha greenhouse per grower) is overarching, the wholesale market system aims at better price transparency and higher small farmer bargaining power and keeps being highly regulated. However, it is often considered as too rigid and not appropriate to foster technological innovation at the production level (Lemeilleur and Codron, 2011)

Although consumers of the two countries are not yet very demanding as regards to pesticide safety and the domestic market structure is not yet favorable to the development of IPM practices, there has been a dynamic development of public safety regulation for the domestic market in the last decade. In Morocco, where market mechanisms have been the key drivers for compliance of the exports to the safety requirements of foreign customers, national regulation (in particular 2007 Food Safety Law and creation of ONSSA in 2009) is emerging in the wake of such external constraints and tries to progressively adapt non export oriented production to international safety standards. In Turkey, public safety regulation which has first aimed to strenghten exports and upgrade safety of export-oriented production, now also targets the domestic market and small farmers : ambitious policy measures are implemented at all levels of the chain to improve safety and traceability. In conclusion, we observe that Morocco and Turkey have quite contrasted institutional and economic features framing the individual grower management of safety risk.

Farmers' structures and safety. From our grower survey in the two main fresh tomato production regions of Morocco and Turkey (Souss Massa and Mediterranean Region), we observe that structures are quite contrasted (see table 5).

Table 5: Contrasted characteristics of farmers and farms in Souss Massa and Antalya

FARMERS and FARMS	Morocco	Turkey
Greenhouse size (ha)	54 ha	0.7 ha
Tomato specialization (% under greenhouse)	57%	88%
Farms with family labor (% Cies)	47%	98%
Farm head with University Education	37%	15%
Manager with University Education	76%	2%
Own packing plant	34%	2%
Audit required by customer or certificate	83%	17%
Residue control plan required by customer	98%	9%
Yield (loose tomato, kg/m2)	19 kg/m2	11 kg/m2

The average farm in Souss Massa is of the "industrial" type while the average farm in Antalya is of the "family" type . The greenhouse size of the former is one hundred times larger than the size of the latter. In Souss Massa, farm heads have higher education and hire managers with University diploma, which is not by far the case in Antalya. As a consequence of large greenhouse size, many Souss Massa farmers have diversified their production under greenhouse and have forward integrated into packing. This is not the case of Antalya tomato growers who sell on spot markets and are highly tomato specialized under the greenhouse. Eventually, performance in terms of tomato yield is significantly higher in the Souss Massa region (19kg/m2 vs 11kg/m2).

Different types of safety risk management practices may be considered : i) monitoring and recording as rational practices in chemical spraying, ii) alternative control practices to chemical control, iii) integrated crop management with some indirect impact on safety management and iv) safety labels and GAP certificates. As expected given the sooner and higher exposure of Morocco to safety demanding customers, Moroccan Souss Massa growers are much more advanced in risk safety management than Antalya growers.

Table 6: Contrasted safety risk management practices in Souss Massa and Antalya

Category of	Pest management patterns	Turkey	Morocco
Rationale Chemical Spraying Management	high monitoring frequency >2/week	79%	
	own plant observations ("head farmer autonomy")	41%	100%
	Private/public consultancy for treatment decision	41%	17%
	autonomy from input supplier in treatment decision	8%	74%
	Spraying delay before harvesting	99%	
	treatment recording	76%	99%
	Treatment recording on computer	3%	35%
	Residue self control plan	-	16%
Integrated Pest Management IPM	Resistant varieties	97%	100%
	Yellow traps	88%	100%
	elimination of contaminated plants	87%	100%
	curtains for doors	87%	100%
	weeding	76%	100%
	equipment cleaning	75%	99%
	wall spraying	60%	97%
	blue traps	34%	63%
	pheromons	24%	97%
	footbath	17%	86%
	Biological auxiliaries	3%	71%
Integrated Crop Management ICM	Bombus bees	96%	
	Soil water in excess control	90%	63%
	Rotation	34%	
	Climate control automatisation	4%	
Label, GAP certificate	GAP certification	4%	83%
	Global GAP since more than 5 years	0%	53%
	Global GAP option 2 (group certification)	0%	40%
	Tesco certification	0%	9%
	AB certification	0%	3%

While basic IPM practices such as frequent pest and disease scouting, compliance with spraying delay before harvesting, treatment recording, the use of resistant varieties, of yellow traps, of insect curtains for doors and openings, the elimination of contaminated plants, equipement cleaning, wall washing, have been adopted by a vast majority of growers in both countries, only a minority of Turkish growers are familiar with practices already well disseminated in Souss Massa such as the use of pheromons, biological auxiliaries and footbaths at each entrance of the greenhouse. Likewise, only a minority of them manage to keep away from a decisive influence of pesticides dealers in treatment decision. Last, Global GAP certificates which are widespread in Souss Massa still only concern for the present a few large scale growers in Antalya.

If globally Souss Massa growers have managed to reach the level of their European competitors, there is still potential for practices upgrading, in particular regarding the use of biological auxiliaries (still 29% not using), the voluntary implementation of self residue control plans, the use of computer for recording treatments and sharing information online with affiliated or buyers.

In conclusion, we can say that IPM practices have well disseminated in the two countries although with differences in the level of completion and sophistication, Moroccan Souss Massa growers being much more advanced than Turkish Mediterranean growers.

A variety of factors have been identified to explain differences in safety risk management : a first group of factors above mentionned that are country specific and related to export/domestic markets features and public/private safety regulation, and a second group of factors that are related to farms and farmers heterogeneity within each country. This second group of factors includes individual characteristics such as farmer socio-demographic characteristics (age, education, experience, cooperative membership), farm characteristics (greenhouse size or land size, off farm activity, crop specialization, greenhouse technology), marketing strategy and risk perception of pest or disease pressure (see the two country executive summaries).

Perspectives. From an academic point of view, our research has to go beyond the descriptive analysis to perform an econometric analysis for testing the influence of individual and institutional or organisational parameters on IPM adoption. Further work is expected also on the impact of IPM adoption on performance. Indicators that may be used are agronomic yields, economic income and pesticide use (number of treatments, number of overdoses). Such data have been collected for the research. However, there is need for validation of such data, in particular regarding pesticide use. From a policy point of view, two relevant issues could be highlighted in a further research. In Turkey, there is need to assess the impact of the challenging and promising 2010 public safety regulation and see to what extent it has influence on small farmer IPM adoption. In Morocco, since the most basic IPM practices have been already adopted, potential for better compliance with public and private safety standards of foreign customers may exist on the side of supply chain organization, in particular in grower vertical and horizontal coordination.

1. SAFETY RISK MANAGEMENT IN TURKEY

1. A. MOTİVATİONS: SCOPES AND AİMS OF THE STUDY

In Turkey, tomato to be consumed in fresh has been selected as the reference crop for our research program. Four main arguments justify such a choice. Tomato is the dominant crop in the vegetables industry, tomato's export market share is significant, tomato has been concerned by the development of pesticide safety risk management and tomato owns similar characteristics in Morocco, the other country under survey in WP 5.4.

In Turkey, tomato exports have been first concerned by safety issues, since the early 2000's. Those concerns have been rapidly increasing during the last decade and led public and private actors to implement different types of policies and strategies. Process standards (Integrated Pest Management, IPM and Good Agricultural Practices, GAP) and more recently product standards (Maximum Residue Limit, MRL) have turned into efficient solutions to control and reduce the level of pesticides on fresh produce at different levels of the export chain.

The local market is not yet highly concerned by such issues, Turkish consumers being not very demanding as regards to fresh produce safety. Some initiatives are taken by modern retailers who want to differentiate from traditional markets and are including safety as a strategic goal in their marketing. However, market incentives remain weak to growers, in particular to small-size growers who cannot sell directly to supermarkets or to exporters.

Another driver of IPM/GAP development has been the government initiative with some WB/FAO funding to disseminate by technicians and growers from the late 90's research findings on chemical control and IPM. Such a dissemination program has created high producer awareness of safety issues and helped to implement basic IPM measures. Growers of all kinds and not only large scale growers have been impacted.

This part of the report will expand on safety control issues in the tomato chain at the export and domestic market level. A general picture will be given based on interviews and secondary data. We will then focus on growers' adoption of IPM practices and its determinants. To that purpose, a survey has been conducted by 186 growers, selected at random in the three main districts of the province of Antalya, which is the lead region of production of greenhouse tomato in Turkey.

We will proceed as following. In a first section, we will give some information on the fresh tomato industry in Turkey (production, marketing, distribution and consumption) and on pesticide safety regulations in Turkey (organisations and laws, traceability, ipm and gap) with a focus on public/private control both at the export and domestic level. In sections two and three, we will present the methodology and the findings of our face to face survey achieved in the region of Antalya by 186 tomato growers. In section two, we describe our population with some statistics on farmers, farms, greenhouses, tomato production, tomato marketing. We then identify the various forms of safety risk management by focusing on safety pressure as perceived by farmers, information and monitoring practices, chemical control practices, alternative control practices and third party control. In section three, we propose indicators of IPM and chemical control practices in order to establish a typology of practices. We then identify some structural factors influencing practices and make a link with performance as measured by the number of treatments and the number of pesticides overdoses.

1. B. FRESH MARKET-ORİENTED TOMATO İNDUSTRY

Tomato production

Historically, the **agricultural sector** has been Turkey's largest employer and a major contributor to the country's GDP, exports and industrial growth. However, as the country has developed, the importance of agriculture has declined relative to the rapidly growing industry and services sectors. Although the share of agriculture in the Turkish economy has tended to fall over a period of several decades due to the increase in industrial and services sectors, it still accounts for a relatively larger share of total output and employment than in many other countries (Anon., 2007).

Horticulture is the leading sub-sector of Turkish agriculture and an area for potential export growth. Total vegetable production was estimated at over 20 million tonnes produced on. About 2.7% of total vegetable production was exported fresh, 2.3% was sold to processors, and the rest was consumed fresh.

Tomato production: It is a highly demanded fresh produce in domestic market. It composed more than one third (33,9 %) of the total fresh vegetables production in 1984 and 43 % in 2010. On national base, tomato production increased for nearly 2,5 times between 1984 and 2009, from 4 million tons to 10,7 million tons (http://www.tuik.gov.tr).

According to 2010 data (http://www.tuik.gov.tr), fresh tomatoes compose 52% of total under cover production. On the other hand, greenhouse tomatoes are about 40 % of the total fresh tomatoes grown in Turkey excluding tomatoes for industrial use.

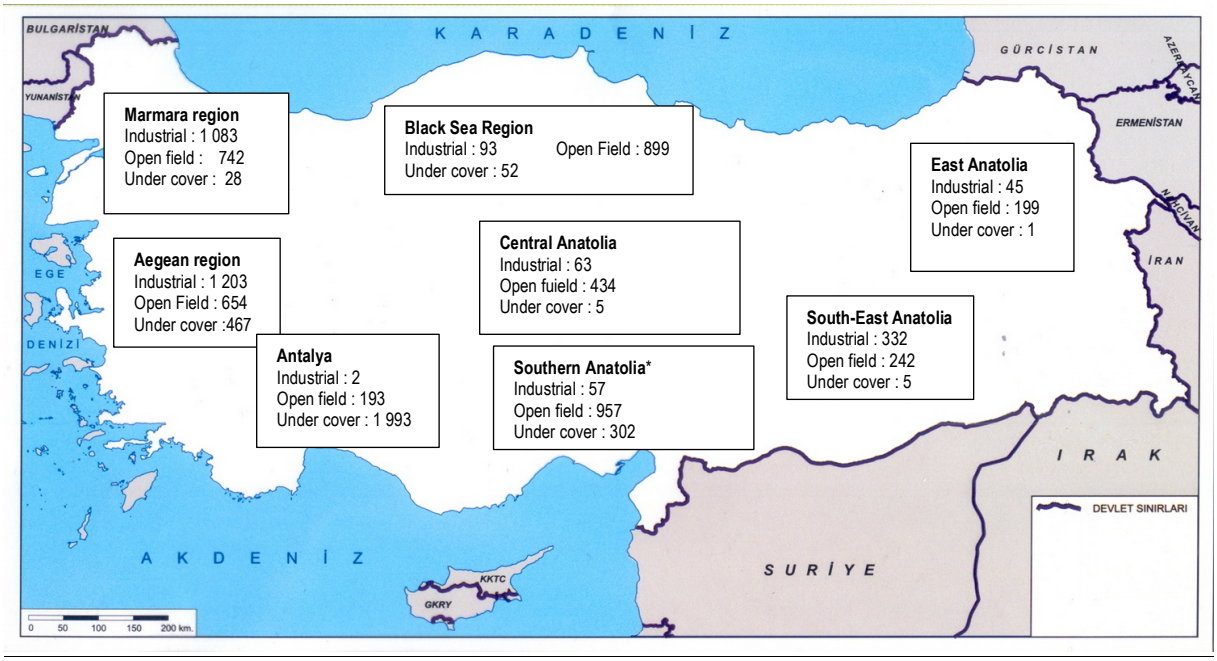
Greenhouse and tomato localisation

Fresh produce localisation: Turkey's natural endowments permit the production of a great variety of horticultural and arboreal produce. Tomatoes, comprising an important part of the total volume of fresh vegetables produced (cf. table 1), are grown throughout the country, and especially in the Western (Marmara and Egean coasts) and Southern Anatolia (Mediterranean coasts). In South Eastern Region with the opening of new dams, fruits and vegetables production showed a drastic increase since the last decade while in Central Anatolia, Tokat-Amasya region is distinguished also by an important horticultural potential.

Tomato production localization: As it was mentioned earlier, it is produced all over the country. However the axes of Bursa-Balikesir in Marmara coasts, Izmir –Manisa-Aydin- Finike in Western Anatolia, Antalya and Mersin-Hatay in Southern Anatolia Sanliurfa in South Eastern Anatolia, and Tokat in Central Anatolia are important production pools (Figure 1).

Figure 1 : Distribution of tomato production in volume by main regions of Turkey in 2010

1000 tons



Note : (*) Southern Anatolia data exclude Antalya province figures
Source : Authors' work composed by data from http://www.tuik.gov.tr

Greenhouse vegetable localisation: Vegetables are produced both on open fields and under cover. Regional specialisation that was mentioned earlier is even more apparent with regard to vegetables production under protected cover (Table 1, and Figure 1).

Table 1 : Distribution of greenhouse surface by type of greenhouses and by counties of the Antalya province in 2010

District/town	Total greenhoouse surface (ha)	Glasshouse surface (ha)	PE greenhouse (ha)	High tunnel (ha)	Low tunnel (ha)
Akseki	0,4		0,4		
Alanya	2 100,0	375,0	1 395,0	85,0	245,0
Elmalı	300,0		300,0		
Finike	1 018,0	210,0	410,0	365,0	33,0
Gazipaşa	2 610,0	1 262,0	400,0	832,0	116,0
Demre	1 603,0	501,0	1 102,0		
Kaş	1 800,5	610,5	637,4	552,6	
Kemer	19,7	5,2	11,2		3,3
Korkuteli	30,9		30,9		
Kumluca	3 710,0	670,0	3 040,0		
Manavgat	795,2	32,0	277,2	156,0	330,0
Serik	2 850,0	1 400,0	1 400,0	45,0	5,0
Aksu	2 789,5	692,7	2 085,8	11,0	
Döşemealtı	6,5	0,3	5,7	0,5	
Kepez	1 169,0	513,5	653,0	2,5	
Konyaaltı	297,5	242,8	0,7	54,0	
Muratpaşa	466,7	186,2	280,5		
Antalya total	21 566,9	6 701,2	12 029,8	2 103,6	732,3
Turkey total	56 380,5	8 077,2	23 054,3	8 152,1	17 096,9
Antalya's share in total	38,3%	83,0%	52,2%	25,8%	4,3%

Source : http://www.tuik.gov.tr

Protected cultivation includes the production in the greenhouses and under low plastic tunnels. Total protected cultivation has reached to 56 380,5 ha in 2010. Area under low plastic tunnel is 30% (17 096,9 ha) of the total while the rest (39 283,6 ha) is occupied by greenhouses (http://www.tuik.gov.tr). The protected cultivation area has increased, however while the increase was drastic in 1990s, it was more stable in 2000s.

77% of greenhouses and 92.3% of low plastic tunnels is located on the south coast of the country where the climatic conditions are favourable for protected cultivation without any additional heating (Table 2).

Table 2. Distribution of protected cultivation (ha) in 2008

	Glasshouse	PE greenhouse	High tunnel	Low plastic tunnel	TOTAL	%
Mediterranean	7 525	17 355	5 116	17 131	47 128	86.9
Aegean	691	2696	603	484	4474	8.3
Blacksea	2	660	430	466	1557	2.9
Marmara	2	360	481	10	854	1.6
Central Anatolia	0.3	58	46	0	104	0.2
East Anatolia	0	14	15	7	35	0.1
South east	4	26	6	28	64	0.1
TOTAL	**8 225**	**21 168**	**6 696**	**18 127**	**54 216**	100

Source : *TUIK, 2012, http://www.tuik.gov.tr*

Vegetable growing with 92,3% of the total greenhouse area stands first, ornamental plants (3%) especially cut flowers occupy the second place and these are followed by fruits (4,7%). In 2010, among the vegetables, tomato with 49,6 % of total vegetable production under cover is the most prominent while cucumber, watermelon (in particularly under low plastic tunnels), pepper, eggplant, squash, melons and other vegetables are grown over rest of the area (Table 2). Lettuce growing has an increasing tendency, as well.

Geenhouse farms: In 2001, there were about 47 thousand agricultural holdings practicing vegetables production under protected cover, of which 59 % are situated in Mediterranean region, 17 % in Aegean region and 10 % in Marmara-Central North regions (DIE, 2004). In parallel, 50 % of the land under cover is in Mediterranean region, 24 % in Marmara-Central North region and 9 % in Aegean region. So, Mediterranean region steps out as the most important production pool followed by Marmara-Central North regions which are highly capitalistic (24 % of the land under protected cover against only 10 % of agricultural holdings) while Aegean region, like the rest of the country, seems to shelter small and very small agricultural holdings Figure 2, gives a general idea about the geographical coverage of these agricultural regions.

Table 3 : Regional distribution of agricultural holdings that practice vegetables production under protected cover and the total land sown

Agricultural regions	Total number of holdings	%	Total area sown (ha)	%
Turkey	***47 085***	***100, 0%***	***32 277***	***100,0%***
Mediterranean region	27 612	58,6%	16 145	50,0%
Marmara	2 423	5,1%	4 177	12,9%
Central North	2 302	4,9%	3 791	11,7%
Aegean region	8 057	17,1%	2 924	9,1%
Central South	719	1,5%	2 651	8,2%
South-East	787	1,7%	1 022	3,2%
Black Sea region	3 817	8,1%	768	2,4%
Central East	1 128	2,4%	584	1,8%
North-East	240	0,5%	215	0,7%

Source : Authors' work based on DIE, General Agricultural Census, Village Information 2001, Ankara, 2004

Greenhouse tomato localisation : **Antalya's leadership**

Fresh **tomatoes** compose about half of the total production of fresh vegetables and around 2/5th of the under protected cover production. On the other hand, greenhouse tomatoes are about 15 % of the total fresh tomatoes grown in Turkey (Sevgican and al., 2001).

Turkish **greenhouse** production continues to show very rapid expansion as in all Mediterranean countries. A distinction must be forwarded concerning the open field and undercover tomato production. Undercover fruits and vegetables production gained a particular importance since the beginning of the 1980s with the application of specific governmental encouragement measures. Some regions, like Antalya province and Izmir hinterland, already practicing greenhouse fruits and vegetables growing became real production pools of counter-season greenhouse tomatoes. So, while Bursa-Balikesir, Tokat and Manisa stepped out as specialising in open field tomato growing, Antalya, Izmir, and to a lesser extent, Hatay-Mersin specialised in greenhouse growing. Recent production in Sanliurfa province (South-East Anatolia) concerns more open field tomato growing than greenhouse investments. Consequently, soilless greenhouse tomato production is most practiced in Izmir and Antalya (Kumluca and Finike) regions. Fethiye which is a small town attached to Mugla county has also important investments in greenhouse construction and challenges specialised towns of Antalya province (Kumluca, Finike).

Table 4 : Under-cover tomato production by principal region (NUTS1) in 2009/2010 (tons)

Regions	Glass	Plastic	Low tunnel	High tunnel	Total
South Anatolia	749 375	1 237 289	96 125	94 698	2 177 487
Aegean	88 547	316 950		8 649	414 146
Western Black Sea	40	3 954	1 744	27 633	33 371
Eastern Marmara		15 268	600	5 070	20 938
Western Marmara	2 640	118	21	213	2 992
Central-East Anatolia	1 170	1 020	128	327	2 645
Eastern Mediterranean		1 551		394	1 945
Western Anatolia	60	1 461		115	1 636
İstanbul		709		437	1 146
Central Anatolia	300	223		164	687
North-East Anatolia		310		158	468
Turkey total	842 132	1 578 853	98 618	137 858	2 657 461

Source: Author's work based on TUIK databank (http://www.tuik.gov.tr)

Antalya's horticultural characteristics : Greenhouse production in Turkey began in 1940s in glasshouses built in Antalya province , which is still the centre of such production due to the very favourable climatic conditions for protected cultivation. According to 2010 statistics, 81.8% of the glasshouses and 48.5% of the plastic houses of the country were located in Antalya. Greenhouse production provides not only income to owners but also many employment opportunities. The Mediterranean Region is the greatest greenhouse area and Antalya is the major province of this type of production.

Table 5 : Antalya Province Greenhouse Vegetable Production in 2010 (tonnes)

Products	Greenhouse type				Total greenhouse production
	Glass	Plastic	High tunnel	Low tunnel	
Tomatoes	719 124	1 137 959	135 375	500	1 992 958
Cucumber	290 387	221 070	4 300		515 757
Bell peppers	52 774	130 084	2 455		185 313
Eggplants	55 103	63 192	13 925	2 313	134 533
Sweet peppers	25 578	24 881	750		51 209
Zuccinis	933	27 666	5 708	14 211	48 518
Melons	4 244	26 097	30		30 371
Beans (fresh)	12 616	5 809	1 673	200	20 298
Watermelons	2 470	7 785	1 415	8 400	20 070
Lettuces	1 620	7 078	2 200	850	11 748
Parsley	7	9	8		24
Rocket	5	8			13
Purslane	3	4			7
Cress		4			4
Total	1 164 864	1 651 646	167 839	26 474	3 010 823

Source ; http://www.tuik.gov.tr

The vegetables produced most extensively are tomatoes, cucumbers and peppers. Vegetable production is mostly carried out as a family business.

Tomato, cucumber and pepper are dominant in greenhouse production, with the share of 91 % in the total protected area. Among the four crops, tomato production takes the biggest share, of 66,2 %.

Production in plastic greenhouses is increasing as this type is cheaper than production under glass, more modern than tunnels and easy to operate. Tomato production under glass or plastic is made in a single or double cultivation system. In a single product system, the same product is cultivated.

Conclusion : Two trends can be pointed out in conclusion to this section that outlines the fresh tomato production and markets in Turkey :

Under cover production of fresh tomatoes has high development potential in Turkey and probably their positive trends will continue in the near future

Exports start to be a strategic target for Turkish tomato growers and exporting firms while exports towards Western European countries are gaining shares in total Turkish exports. This direction bring along important pressures on Turkish agricultural holdings as well as exporting firms to be in line with international sanitary and phytosanitary norms and thus improve the quality of their export produce.

These trends conduct us towards a broad description and analysis of rules and regulations at national and international level that organise and supervise the production and marketing activities.

Greenhouse technology

Evolution: Protected cultivation has an important role in horticultural activities. Although the first greenhouse was constructed in 1940 in Antalya, greenhouse production started to be widespread in the 1960s. The important milestones were the introduction of plastics into agriculture (1960s), the rise in oil prices resulting in the increase of heating costs thus enhancing protected cultivation due to mild climate conditions that makes the production possible under very simple shelters (1970s), technological improvements in plastic covering materials (1980s), governmental subsidy (1990-1995), introduction of high tech greenhouses with soilless culture (1990s) and the arrival and extension of sustainable production techniques widespread (2000s) (Tuzel and Oztekin, 2006).

Two main greenhouse types can be identified according the technology level, structure and size (Tuzel and Gul, in press).

Low-technology greenhouses: They have very simple structure with plastic or glass covering, poor climate control and, very often, roof sprinkler irrigation system or simple heaters only to protect the plants against frost damage. Conventional growing methods are used in those small scale greenhouses. Therefore synthetic chemicals are used intensively. some biological control (limitation due to poor climate control)

High-technology greenhouses: The investment cost is very high. They are generally built with galvanised iron support structure and glass or PE as covering material. More advanced growing technologies, including hydroponics, are used in those greenhouses. IPM techniques are applied and generally EUREPGAP/GlobalGAP protocol is followed for certification process. Also they have climate control system (central heating system, forced ventilation, shading, evaporative cooling, and etc. humidity control). 300ha is heated with geothermal water. High pressure fogging systems are used commonly.

Climate control: In the **conventional** greenhouses there is no regular heating. Short season crop production is preferred in order to avoid from cold weather. Also roof sprinkler irrigation and simple firewood stoves and in recent years pulsed air boiler (with LPG, wood, fuel, etc) are used only to protect the plants against frost under conditions when temperature falls below 3-5C. In hot season shading -generally white washing- is used to reduce the solar radiation resulting in temperature

decrease in the greenhouse. Insufficient ventilation is still one of the most important problems in old glasshouses and particularly in the small-size plastic houses. However, roof ventilation ratio has increased to 10-25% in recent years (Tuzel & al., 2005).

Irrigation: Drip irrigation is used in the greenhouses. By the use of drip irrigation, water loss is decreased to the minimum and fertigation is being applied.

Fruit-setting methods: The use of bumble bees is gradually increased. While the number of hives used in the growing season of 1997-1998 was 3500, it increased in 2006-2007 to 65000 hives (only Koppert) and it is expected to reach 75-80.000 for this growing season (Ali Eroglu, per. Comm.).

Soilless culture: Production is still generally made in soil, but there is an increasing interest in the use of soilless culture techniques to overcome the problems originated from soil. The soilless cultivation area at the farmer level has increased from 20 ha in 2000 to 180ha in 2008 up to 700 ha in 2012 http://www.tse.org.tr/docs/standard-ve-ekonomik-teknik-dergi/nisan-2012-dergi.pdf?sfvrsn=2. Soilless greenhouse tomato production is most practiced in Izmir and Antalya (Kumluca and Finike) and Muğla (Fethiye) regions. (Yuksel and al, 2008)

Tomato local marketing

Consumer preferences and purchasing patterns: Turkish domestic market is very important, as Turkish people are large consumers of fresh fruits and vegetables. FFV are the basis of the Turkish diet, accounting for 20% of total food expenditure, with 100 kg and 230 kg of fruit and vegetables, respectively, consumed per person every year (Saunier-Nebioglu, 2000). Despite two financial crisis that Turkey endured during this period from 1994 to 2002 (1998 and 2000 financial crisis), there is a slight increase that can be observed in the consumption per capita of fresh produce. A significant factor must be pointed out concerning the Turkish consumer, it is highly price sensitive and most of his preferences, even for the high income classes, are mainly guided by the consumer prices of food produce as well as of processed products.

General food retailing. Hyper and supermarkets are increasing drastically their market shares, not only in urban centers in Western Anatolia, but also in other large cities of the country. Cumulating only 11% of the total food retailing amounting to an estimated 19 billion US dollars in 1996, these large supermarkets climbed up to 37% of the total food retailing market summing up 25 billion US dollars for 2002 and 65% for an estimated total sales of 35 billion US dollars in 2009 (**http://gain.fas.usda.gov/Recent%20GAIN%20Publications/Retail%20Foods_Ankara_Turkey_1-3-2012.pdf**). Discount stores are the most frequented among the large retailers as a whole. At the same time, the share of traditional grocers fell from 68% to 32% and that of markets (self-service stores) from 16% to 7.7% (**http://www.pwc.com/en_GX/gx/retail-consumer/pdf/turkey.pdf**).

Fruit and vegetables retailing. Open street markets are still powerful challengers to supermarket chains in fresh fruits & vegetables retailing. 80% of the FFV is purchased on open street markets and only 20% from large retail stores (as reported by interviewed authorities[3] and

[3] Interviews of Mr. Nadir Aykut, Agricultural engineer working at the Agricultural Government Office of Menderes district of Izmir; Mr. Ahmet Ekiz, Director of the City Hall of Izmir; Mr. Okay Sentoglu, Coordinator of the Open Market of Karsiyaka Municipality, Izmir and Mr. Sinan Ataman, Regional Office of Food Safety ControlMinistry of Agriculture, realised in October 2003 within the framework of Ecoponics project, financed by EU and leaded by Munich University

Carrefour buyer, Oct 2010). Consumers prefer, in large cities as well as in smaller towns, open street markets, driven by the belief that the produce sold at street bazaars is coming directly from the producers' farm, so it is fresher and cheaper. However large retailers seem to challenge the open market sellers and green grocers on two main factors : a strategy based on price-competition and focusing their advertising policy on the freshness and the high quality of their products, whilst they enrich the range of their supply by imported fruits and vegetables or by supplying early produce *(Coudel, E., 2003)*.

Market organization is difficult in the Turkish FFV domestic market because of the **fragmented structure** of the horticultural holdings and the lack of standards and quality control. Small scale growers with less than 1 ha are the dominant group while the thin minority of large scale growers is mostly export-oriented. Fresh produce standardization limits to basic standards (such as size, color and appearance) and is implemented by only a few supermarkets (Codron et al., 2004)[i].

Wholesale Market Law. The Turkish government has taken note of the role of horticulture and its high potential for value added production and income leverage for small farmers. One of its goals in the FFV sector is therefore to increase small farmers' market power and to prepare them for new market requirements. The major policy measure that has been taken with this in mind is the 1995 Wholesale Markets Law (Law 80, Decree 552). This law stipulates that FFV growers must use wholesale markets to deliver produce for the domestic market – except for farmers who sell for food industries or export, or if they sell less than 500kg or 1 ton of products a day (the legal maximum weight is decided by the local government) (Figure 1).

Brokers/Commissioneers. The 1995 Wholesale Market law has also established commission agents on these wholesale markets, as a necessary intermediary between FFV growers and retailers. These intermediaries act as brokers and facilitate transactions on behalf of farmers. The commission payment is legally between 3 and 8% of the total sale. Market transactions have furthermore become more transparent through the publication of average daily prices and the obligation to record the volumes contracted and the price obtained on the invoice.

2010 Safety law. The traceability/safety law that has come into force in March 2011 (see further) obliges all buyers including exporters to provide the wholesale market authorities with a certified list of the pesticides used by the growers who supply them (see further). Buyers are exempted from this constraint if growers are Global or Turkish GAP certified. This law is a major change for exporters who were not obliged before to pass through the wholesale market. The 2010 law also introduces some flexibility since it permits all types of buyers (exporters or national buyers) to source directly from producers without having to pass through a commissioneer. In this case, they pay a higher tax to the municipality (2%[4] instead of 1%).

Marketing cooperatives promotion. The government has passed a number of policy measures to promote the marketing organisation of small landholders. However, the number of marketing cooperatives remains very low and selling through a broker remains the overarching form of intermediation (Lemeilleur et al, 2010).

[4] City Hall tax is 1 or 2%, grower income tax is 2% and social security tax is 2%. Those 5 or 6% taxes add to the 3-8% commissioner tax (when the product is sold through a commissioner).

Modern retailers'sourcing. They complain about the lack of organization of small-size growers. Most of them were used to procure from city halls. With the new law, they tend to source more and more directly from growers or dedicated intermediaries. For instance, Carrefour who 100% procured from city halls until 2008, is now purchasing 40% directly from growers (Carrefour Izmir FFV chief buyer, Oct 2010) while Kippa Tesco contracts with 30-40 dedicated wholesalers who procure from small-size grower and gives priority to Turkish Gap (ITU) products (Izmir Kipa quality manager, Oct 2010).

It is worth mentionning that only 35% of the fresh tomatoes that are sold by the producers are handled in the wholesale market. The remaining 65% are either sold to exporters (5%), to food industries (20%) or on the domestic "street" market (40%). Actually, the latter figure includes tomatoes sold on local markets exempted by the wholesale law, and tomatoes transported illegally from one region to another. Moreover, despite municipality efforts to create new wholesale markets, farmers located in remote areas (farther than 30 kilometers from the wholesale market, according to our data) do not have easy access to wholesale markets and prefer to sell locally to private merchants or to organize in local cooperatives to obtain access to wholesale markets. (Lemeilleur and Codron, 2010).

Tomato export markets

Export volumes and destination countries

Tomato has a share of 14% in fresh fruit and vegetable export while citrus has the highest share in export with 37%, followed by fresh fruits (36%) and vegetables (27%). (Fig. 5 & 6).

Until the mid-1980s, exports were rather a function of production surpluses. The main part of the production was oriented towards the domestic market for the satisfaction of national demand and only surpluses were oriented toward export markets. Encouragement measures applied by successive governments from mid-1980s to our days literally boosted the export produce, even if the recent data show that for 2000-2003 period, only 2,2 % of the total tomatoes are exported (Table 1, Table 8).

As a result of this national strategy, Turkey appears to have the most important increase among the top ten exporting countries as well as among South and East Mediterranean countries when we take into consideration the evolution from the 1960s to our days. A negative point shades this remarkable development : when exports in value are taken into account, Turkey loses five places in world ranking to go back to nineth place, while some Western countries like Canada, or Belgium or Italy that are behind Turkey in the world ranking of exports in quantity gain important points thanks to the high value of their export-tomatoes.

This situation is directly linked to an overall export strategy that most of the exporting firms have adopted since the mid-1980s that targeted the emerging economies of East and Central Europe, Balkans, Middle East and Arabic countries for their exportations. Such a strategy ran counter to most of the investments necessary for the establishment of international standards demanded by the European Union in general and particularly by Western European countries (Germany, U.K., France). On the other hand, they could diversify their markets where they had lead positions in most of the cases.

Nevertheless, this trend changed **since the beginning of the 2000s**, as the share of the exports toward Western European countries is gaining important points in Turkey's total tomato exports. On the other hand, Central and Eastern European countries are the newcomers to EU and in this wise, apply the international quality standards for their imports of fresh produce. High value of exports forwarded to

Western European countries as well as the extension of the application of international norms and sanitary and phytosanitary measures (SPS) are good arguments to change the attitude of a number of exporting firms vis-à-vis the **necessary investments to improve the quality** of their export tomatoes.

Table 6 : Evolution of Turkish exports by main regions of destination (1986-2009)

Regions of destination	1986-	1990-	2000-	2006	2007	2008	2009
Russia Federation	-	17,5%	38,0%	55,0%	61,4%	59,3%	48,3%
New EU members (1)	0,4%	34,1%	35,2%	19,2%	21,7%	20,3%	27,0%
Black Sea and Central Asia (2)	-	0,8%	0,9%	1,1%	1,5%	6,3%	10,2
MENA (3)	97,7%	43,3%	18,6%	6,2%	4,2%	6,0%	7.6%
Balkan & non EU ECEs (4)	-	2,7%	7,9%	11,4%	5,7%	4,1%	3,5%
Western Europe (5)	1,9%	4,2%	7,2%	5,2%	3,7%	2,9%	2,2%
Rest of the world, unspecified	n.s.	0,1%	0,1%	1,9%	1,7%	1,6%	1,2%
Total exports (metric tons)	141 033	108 575	277 077	304 373	372 093	439 730	542 258

(1) Belarus, Bulgaria, Croatia, Cyprus, Czech Republic, Chezchoslavia, Estonia, Hungary, Latvia, Lithuania, Malta, Poland, Romania, Slovakia, Slovenia, Moldova Rep.
(2)Azerbaijan, Georgia, Kazakhstan, Kyrgyzstan, Turkmenistan, Ukraine, Uzbekistan
(3) Algeria, Bahrain, Iran, Iraq, Israel, Jordan, Kuwait, Lebanon, Qatar, Saudi Arabia, Syria, U.A.E.
(4) Albania, Bosnia & Herzegovina, Serbia and Montenegron The Former Yugoslav Republic of Macedonia, Yugoslav SFR, Moldova Rep.
(5) EU-15, Switzerland, Norway
Note : statistics prepared on the base of "exporter reports"
Source : Authors' work based on FAO statistics(Trade Matrix), www.fao.org

In spite of the positive trend concerning the exports to Western European countries (EU 15 plus Norway and Switzerland), geographical proximity prevails concerning the shares of the top 5 importing countries (Table 4). In fact, Russian Federation, Bulgaria, Romania, Ukraine, together with Saudi Arabia account for 83,6 % of the Turkish tomato exports realized between 2007 and 2009. These countries better award the physical attributes of export produce (colour, size, firmness) than its sanitary quality, a fact that still gives an edge to Turkish exporters not to trace their product along the production and supply chain.

Table 7 : Share of the 15 main importing countries in Turkish exports of tomatoes (2007-2009 average)

Importing country	Turkey exports	Share	Importing countries	Turkey exports	Share
Russian Federation	250 478	55,5%	Germany	6 023	1,3%
Bulgaria	50 772	11,2%	Honduras	5 587	1,2%
Romania	34 512	7,6%	Belarus	5 058	1,1%
Ukraine	23 404	5,2%	Poland	4 962	1,1%
Saudi Arabia	18 040	4,0%	Croatia	4 254	0,9%
Republic of Moldova	9 740	2,2%	Georgia	3 711	0,8%
Iraq	9 053	2,0%	Azerbaijan	2 431	0,5%
Bosnia and Herzegovina	7 575	1,7%	**World total**	**451 360**	**100,0%**

Source : Authors' work based on FAO statistics www.fao.org

Turkey EU market opening strategy : general trade preferences

Turkey attends to become a full **Member of the European Union** since the beginning of the 1960s. After the signature of the Ankara Agreement in 1963 between Turkey and the EEC, Turkey became an associated member of the European Community with the sight of a check-list covering 22 years to prepare the Turkish economy and society to a full membership. Turkey applied then for full

membership in 1987 and in 1996 the Turkey-EU Customs Union took effect. Along with these politico-juridical developments, Turkey liberalised its market for goods and took the necessary steps to be in line with EU rules and regulations, with the exception of agricultural sector which was not included in the Customs Union. However, a number of preferential agreements regulate agricultural trade between Turkey and the EU.

In parallel to these institutional changes, Turkey started to apply the **structural adjustment policies** as early as in 1980s and market opening strategy became the most outstanding feature of the development planning of successive governments.

Turkish agriculture, one of the most sustained and supported agriculture of the developing world, underwent a tremendous change according to this **recent liberalisation** strategy. Most of the support prices applied to field crops and traditional agricultural products diminished and disappeared during the last quarter of the 20th century. In this respect, the Agriculture Reform Implementation Project (ARIP), that came into effect at the beginning of 1999, aims to reform the price support system, abolish the input subsidy policies and introduce direct aids to landholders as the major Agricultural Support Mechanism (OSKAM and all., 2004).

In parallel, **encouragement measures** are applied to **exportable** agricultural produce. In this wise, fresh **fruits and vegetables** benefited considerably from these policy changes. These encouragement measures comprised, at the mid-1980s, tax refund for export produce, exemption of customs duties, credits to exports, pre-financing programs (TOZANLI, 1987). They brought in a number of "short-term profit" seeking persons that established very small scaled exporting firms in order to benefit from these pre-financing programs. This situation created a real bottleneck in the sector until recently.

Turkey attempts to be **in line with the EU legislation and the WTO Agreements** regarding the customs, anti-dumping and countervailing measures, standards and other technical regulations (OSKAM and all., 2004). In this wise food safety and quality standards as well as sanitary and phytosanitary measures gain a particular importance, essentially for exporting firms.

Tariff barriers for tomato exports: less favourable than for Morocco

Two **protection tools** are applied to tomatoes exported from Third countries toward the EU Market : *ad valorem* duty and a minimum entry price (trigger price). All imported products with a price lower than the minimum entry price are taxed by a specific duty. This specific duty is calculated as the difference between the import price and the trigger price.

The **trading preference** that the EU applies to tomatoes imported from Turkey is much less favourable than the rates that benefits Morocco. Resulting from a good negotiation that Morocco concluded with the EU, a general framework of tariff contingency is applied to tomatoes imported from Morocco for the period from October to April with a preferential entry price of 46,1 euros/kg and an *ad valorem* duty of 0 %. Above this contingency, the regime for MFN is applied.

The import regime applied to Turkish export tomatoes are based on the entry price of the most favoured nation (MFN), with *ad valorem* duties being abolished, composing the preference for Turkish tomatoes (Eumed-Agpol Project, 2005). This regime can be stated as follows (Table 8) :

Table 8 : MFN regime applied by the EU to tomatoes imports from Turkey

	January-March	April	May	June-September	October	November-December
Trigger price (euro/100 kg)	84,6	112,6	72,6	52,6	62,6	62,6
Ad valorem duty	8,8	8,8	14,4	14,4	14,4	8,8
Maximum specific duty	29,8	29,8	29,8	29,8	29,8	29,8

Source : Eumed-Agpol Project, CIHEAM-IAMM, UMR MOISA, Montpellier, 2005

Turkish exporting firms must keep in mind these trading preferences and tangle with seasonal differences in order to obtain a good value for their fresh export tomatoes. However, richness of natural endowments and relatively less expensive labour are determining factors for the price competitiveness of Turkish tomatoes in Western European markets. Remains the problem of being in conformity with quality standards and international food safety measures.

1. C. SAFETY REGULATİON

Safety Organizations and Laws

MARA. Since the 1950s, food quality control is organised and carried out by the Ministry of Food, Agriculture and Livestock under the responsibility of "General Directorate of Food and Control". This "bureau" coordinates a number of testing laboratories; carries out administrative procedures, applies food standards and controls the prices of food products. Its operations are both at national and regional levels (YALCIN and al., 2002).

TSE. On the other hand, The Turkish Standards Organisation (TSE), established in 1960, adopted ISO guidelines for its certifications since 1994. Within the framework of harmonisation procedures, TSE adopted about 90 % of EU standards as Turkish standards. Export produce must be in conformity with TSE standards as well as EU standards. TSE has its own laboratories deliver certificates concerning the sanitary quality of food produce.

Legislation history. Turkey had an old legislation dating from 1957 that was continuously updated since the mid-1980s. But these changes could no more respond to new expectations of European consumers in search for safe and healthy food. Simultaneously, Customs Union with the EU, together with WTO obligations and guidelines, brought along new juridical constraints before Turkish authorities. In order to be in line with international food legislations and food safety standards, a number of rules and regulations were adopted : the decree number KHK/560 on "*Production, Consumption and Inspection of Foodstuffs*" in 1995; the *Turkish Food Codex Regulation* in 1997, *Food Regulation* in 1998 and finally, the *Directive on Private Food Control Laboratories Establishment and Functioning* in 2000 (YALCIN and al., 2004). A number of different decrees and directives came along with these main juridical milestones.

Food Law 2010. Finally, in 11 June 2010 the law n° 5596 on "Veterinary Services, Plant Health, Food and Feed" generally known as the "Food Law" was enacted, annulling the law n° 5179 of 27 May 2004. This new law on *Production, Consumption and Control of Foodstuffs* includes and broadens the contents of the precedent decrees, regulations and directives. It regulates food safety, quality and traceability of food stuffs; controls and coordinates food processing and marketing units, accredits private laboratories to carry out tests and controls concerning the sanitary quality of food. It has equally specific clauses concerning the regulation and control of organic agriculture (www.tarim.gov.tr).

Regulation at the production level

Food Law and Pesticides. The part of the Food Law on Turkish Food Codex lists the maximum level of pesticides residues and growth hormones. The Ministry of Food, Agriculture and Livestock is responsible for the definition of a list of authorized pesticides[5] and for the control of the use of pesticides. All pesticides must be **registered** by the Ministry of Agriculture. Moreover, Along with the Ministry of Agriculture, responsible for checking the quality of food produce, Ministry of Health is responsible of the control of the **hygienic conditions** prevailing in the processing plants and, together with local municipalities, of the monitoring of the food products at retailing stage (IGEME, 2002).

The communiqué on the **importation of agricultural chemicals** entered in force on the first Janauary, 2011 and the regulation on the **control of plant protection chemicals** entered in force on the 20th May, 2011 regulate all national and international trade of agricultural chemicals in regard to the environment protection. By these rules and regulations[6], the State authorities control the **sale of agricultural chemicals** by producing and marketing companies and their **use** by agricultural landholders. The main aim is to improve traceability in the food chain and to promote good agricultural practices.

Regulation for better traceability to the grower

So far, there was no traceability obligation in Turkey. The importers loose traceability at the packing level. The exporters'association keeps records of exporters but not of farmers that supply them (Ekin Taskin-2011). With the new law, the government tries to establish some traceability at the grower level, with some obligations such as chemical prescription, data recording, sale certificate at the fresh produce market level. New regulation also concerns chemical product sellers and fresh produce traders.

Chemicals must be prescribed: The growers must pass through a public or private consultant in order to buy the necessary chemical products. This is part of the traceability system. By the same token, the Ministry aims to separate completely prescription from chemical selling. Consultants must be agricultural engineers with a specific agreement of the Ministry of Agriculture. Such an agreement is opened to public and private consultants. Consultants are supposed to go to the field and visit the farm before making any prescription on the use of chemical products. However, some of them having a very good knowledge of local specificities such as soil composition or main varieties used locally, tend to prescribe without having any field visit.

Spraying record keeping has become compulsory for marketing since 2010. MARA who had first issued a regulation on 27/12/ 2003 concerning the "Application of controlled Protected Cultivation", revised it on 25/08/2010 and called it "Regulation on the Registration of the Protected Cultivation". However, it is mostly applied for export, and little by those growers who only sell on the domestic

[5] Following a recent revision of the list, 150 molecules have been removed. It is worth mentionning as well that the use of methyl bromide is banned since 2007.

[6] Other applications concerning the enregistred and controlled agricultural production are comprised in the 2008 regulation on "Registration and surveillance of agricultural chemicals" as well as in the 2009 regulation on "Principles and Procedures of the Prescription and Sales of Plant Protection Products". MARA targets to control every step that is included from the production to marketing stages of vegetable products with regard to the use of agricultural chemicals according to the Technical Instructions on the use of Plant Protection Products and according to the application and control techniques of other agricultural chemicals. By these rules and applications, the Turkish Agricultural Ministry makes mandatory the supply of vegetable products that are conform to the Turkish Food Codex and to the residue rates of pesticides/insectides; that are consumer user and environmental friendly and that are traceable. (www.antalya-tarim.gov.tr/index_tr.asp?mt=-11&in=24)

market. Control is made by the Vegetal Protection Office of the Regional Food Safety Investigation and by the Control Office of the Ministry of Agriculture. Moreover, fresh produce samples are taken on the plant before harvesting for analysis and detection of pesticides residues and growth hormones. There is also some analysis looking for heavy metals, realised only if there is a specific demand from the buyer.

Certificate for selling products. Since 2012, a certificate of approved pesticides is now requested for sale in the City Hall. To that purpose, growers i) need prescription from an AgMinistry engineer or a licensed private consultant to buy pesticides, ii) may only buy from licensed pesticides dealers and need an invoice issued by such dealers; iii) must register in a check-list provided by local government, every single chemical product that has been used (with the quantity that has been sprayed) and iv) must have the list of used chemicals approved, after harvesting, by the regional/local directorates of the Ministry of Agriculture.

Input suppliers control: Companies and shops that supply modern agricultural inputs to farmers (seed, plants, parent animals, bulbs, pesticides, insecticides, hormones, fertilizers, veterinary products) are under control. Since 12th of June, 2009, and according to the regulation n°27256 on "prescripted pesticide treatments", they have the obligation to keep trace of what has been sold (quantity, name and address of the buyer).

Traders control: Traders have been informed on the new procedure and are expected to facilitate the circulation of certificates required by the government from the growers. It is worth mentioning that City Hall management that was until the new regulation, under the control of the Ministry of Trade and Industry, will be from now on supervised by the Ministry of Agriculture as well.

Regulation for better agricultural practices

New regulations that came in force in 2010 and 2011 aim to rise grower awareness of pesticides issues and to develop some kind of integrated pest management (IPM). For the more advanced growers, in particular those most concerned by export, a Turkish GAP, similar to Global GAP has been created and may be acknowledged by a certification procedure.

IPM history. Most vegetal IPM research, training and extension programs were launched by the Ministry of Agriculture in the 90's with some funding of World Bank and FAO/UNDP. The tomato IPM program was initiated in 1999 and implemented on 12has. The aim was to reduce national dependency on agricutural pesticides and to avoid the detrimental effects of these chemicals on theenvironment, human and animal health, and on the marketability of the production. A IPM dissemination project was launched through intensive training programs for both technicians and growers. At first, research entities were strongly involved in the program. Short courses have been organized for agricultural engineers and technicians of Ministry of Agriculture and Rural Affairs, and demonstration studies were carried out in farmers‟ greenhouses.

More precisely, the ipm greenhouses were visited weekly throughout the season by technicians together with other local growers. The pests and natural enemies were identified, population densities were determined and decisions were made on thresholds and control measures. Chemical methods were improved (pesticide selection, timing, dosis, etc.) and alternative methods were progressively implemented (yellow sticky traps, insect proof nets, grafted seedlings, soil bio-fumigation or solarization... and more recently biological natural enemies).

After growers gained an experience in 3-5 years, the pilot area was changed. But the first involved growers stayed in contact with the local agricultural directorate to get the help and keep tuned with tecnical progress. Pesticides/biological auxiliaries dealers and private consultants also participated in the dissemination movement through applying IPM in some greenhouses. Eventually, brochures and booklets related to IPM in protected culture were distributed to the growers and information was put in a place in internet. (Nilgun Yasarakinci, **2009** http://www.scribd.com/doc/16191931/IPM-in-Turkey)

Consultancy and technical aid are now carried out at a larger scale by the private sector and the public administration at the same time. The **agricultural engineers of the Ministry of Agriculture act as consultants** without getting any payment. The objective of the Ministry is however to gradually **transfer this assistance activity to the private sector in the future.** A 500TL/year (~**250€**) subsidy for **private agronomical and ipm assistance** is currently granted to growers who do not benefit from the assistance of a public engineer of the Ministry of Agriculture. A private consultant may work for until 50 growers. The **targeted group of growers** is formed by landholders that have between 1 to 15 ha. Cooperatives which regroup small-size growers (less than one ha) cannot benefit from this subsidy for the time being.

IPM subsidies for growers. MARA issued on the 23th April, 2012 and published in Official Gazette dating from the 7th May, 2012, subsidies for producers who are registred within the System of Protected Cultivation. These subsidies concern the use of colonies of bumble bees (2 colonies per 0,1 hectare and 60 TL per colony); the use of tulle (80 TL per 0,1 ha); use of predators (250 TL per 0,1 ha) and pheramon and traps (100 TL per 0,1 ha). (http://organik.tarim.gov.tr/resimler/20120507-3.htm)

Moreover, greenhouses with more than 0,1 ha of surface and doted with necessary conditions for controlled protected cultivation, can benefit from low interest rates accorded by the National Agricultural Bank and Agricultural Credit Cooperatives for 50% of an infrastructural investment between 250 000 and 3 000 000 TL, and for 25% of the total investment for a loan between 3 and 10 millions TL. They also can benefit from business loans for 50% of a total investment of 250 thousand TL and for 25% of an investment between 250 thousand ans 10 million TL. (www.antalya-tarim.gov.tr/index_tr.asp?mt=-11&in=24). Eventually, those producers that are enregistered within Protected Cultivation System are payed back 50% of their insurance fees according to TARSIM (Agricultural Insurance Pool of the Ministry of Agriculture) rules.

IPM promotion and market intermediaries. The vast majority of fresh produce must be sold on City Halls through commissioneers. For social, economic and legal reasons, commissioneers have very few incentives to promote quality and safety by paying a premium or sharing the cost of necessary equipment. Cooperatives could be a driver to incentivate the adoption of IPM practices by growers. However, their market share is still very weak despite the recent authorizations given to credit cooperatives and producers'associations to market the products of their members (Lemeilleur & Codron, 2010).

IPM project balance and perspectives. The balance is quite positive. On the one hand there has been a drastic reduction of pesticide consumption (30%, mostly in the Aegean Region, according to Tulin Kilic, Bornova institute of Research on Crop Protection, oct 2010). On the other hand, IPM awareness has been created. Although the IPM program couldn't apply thoroughly, some alternative methods are widely used. In conventional greenhouses, soil solarization is adopted extensively by the growers at Mediterranean coast. Use of grafted seedlings is also increasing in this respect. Yellow sticky traps are used commonly. Introducing bumble bees for pollination gave rise to increase in IPM in conventional greenhouses since the bees are sensitive to pesticides. On the other hand, in modern greenhouses, IPM

has been implemented. Soilless cultivation is common as growing technique, bumble bees are used for pollination, and natural enemies are released to control some pests. (Tuzel and Gul, press)

Major limitations pointed out by Nilgun Yasaraknici (2009) are insufficient tecnical assistance, complexity of some control or decision (sampling technique, threshold for treatment,etc.), grower dependence on pesticides retailers, weak economic incentives. Perspectives opened by the 2010 regulation on traceability (prescription for buying pesticides and certificate for sale) and by the installation of biocontrol foreign companies should give higher momentum to the development of ipm in the greenhouse tomato production.

Turkish GAP. GAP certification has come to agenda at the start of 2000's with a demand coming from Europe. To remain competitive, lead exporters had to be in line with the Global GAP constraint imposed by most large North European food retailers. In line with Global GAP, a new regulation was issued by the Ministry of Agriculture and Rural Affairs in September 2004, to encourage the application of *Good Practices in Agriculture.* A GAP Committee (ITUK) was created to coordinate and supervise safety controls and certification activities and to monitor the evolution of GAP standards all over the world. ITUK works in close relationship with Regional Directions of Agriculture depending on the Ministry of Agriculture and of Rural Affairs (www.haberim.com/ic.php?id=29587).

GAP criteria. In 2010 and 2011, a series of new regulations have brought better insight concerning the GAP criteria and its application. A four chapter booklet enlightens these criteria according to HACCP protocol. For fruit and vegetables growing, the criteria cover a long range of applications and practices concerning the use of certified seeds and plants, soil fumigration, pre-panting intervals, substrates that are used, the quality of water used, microbial control and other necessary steps to be taken against any risk of water pollution, use of fertilisers and manure. Other criteria concern the harvest and post-harvest operations and concentrate on the hygiene analysis (on persons and product) during the operations of harvesting, handling, loading, packaging and stocking. The certified product must respond to every step of the traceability protocol. Other criteria enlighten the protocol on integrated agricultural techniques (Regulation on good agricultural practices, 7th December 2010; regulation on plant protection dating from 30th October 2011).

GAP certificate promotion. The law No. 5957 on the regulation of the trade of fruits and vegetables that came in force on March 2010 stipulates that producers having the (Turkish) GAP certificate will benefit from a 50% cut of the wholesale market tax. **Low interest rate loans** and subsidies (750 TL/ha for greenhouses since 2008) are provided as well. Accordingly, those horticultural holdings that apply good practices have the obligation to keep a check-list and report on the fertilizers, pesticides and insecticides that they use and in return will be continuously informed on the new methods and techniques in this domain. According to a cooperative manager (Izmir region, 2010), incentives to get the certificate may be mitigated in exporting firms with group certification by weak certification bodies control: " *Once they get the certification, there is no affective control to see if the produce that they buy is in conformity to the Global GAP check-lists. They announce that their growers are GAP certified even if they are not so and nobody comes to see if it is true or not. So growers who do not invest for Global GAP certification can also sell their produce at the same price to these exporting firms as the cooperative members".*

GAP statistics. In 2004, according to BCS company data, out of a total of 326 growers certified in Turkey, 63 were tomato greenhouse growers. At the regional level of Antalya, which is the lead region for greenhouse tomato, there has been recently a sharp rise in the number of certifications from 54 growers in 2007 to 83 growers in 2008. According to the same statistics, certified growers are

medium-large size growers since the average greenhouse area is around 2 has per grower. According to a 2012 published professional journal, there would be currently 5094 horticultural growers with Turkish GAP certificate (http://www.tse.org.tr/docs/standard-ve-ekonomik-teknik-dergi/nisan-2012-dergi.pdf?sfvrsn=2). This figure includes all types of horticulture growers, with or without greenhouse. Other Professional journal mentions for the same horticultural sector, 4540 certificates in 2012, i.e. seven times the number of certificates that was existing five years sooner (http://www.dunya.com/mobi/news_detail.php?id=150344)

Public/private control of exports

New safety requirements on international markets

Until the late 90's, Turkey paid little attention to safety issues when exporting fresh produce. A survey of large Turkish exporting firms shows that most of them were preferring to export to little demanding countries like East and Central European and Balkan countries or Arab States. As a result, little attention was paid to safety except for the minority that was trying to export to Member States of the EU (Codron et al, 2005).

A key date for the rise of safety awareness in the fresh produce export industry in Turkey has been 2001 with the rejection by the European customs of a Turkish shipment of peppers with pesticides in excess. Although the economic impact was small, the event made all the private and public actors form a national movement towards an upgrade of the safety standards. Good agricultural practices have been fostered by the government (see infra, GAP policy measures in 2004 and 2010), the infrastructure of control and residue analysis has been strengthened while exporting firms have reconsidered their marketing strategies, including in their portfolio countries or customers with substantial safety requirements. This national movement also benefited to the national market and the development of IPM practices in the fresh produce sector, whatever the size of the growers.

EU import safety constraints have induced significant changes in the Turkish tomato export industry and indirectly in the tomato domestic industry. Those changes have been **supported by the Turkish government**. the government has reactivated the existing food safety regulation and implemented a **new law of Good Agricultural Practices** with high recommendations to conform to Eurep Gap standards.

National statistics show that Turkish exporting companies have opted for a **strategy of geographical diversification**, with a large variety of country customers in Balkan countries, Gulf countries and Western, Central and Eastern Europe. Of interest is the fast increasing share of EU countries which stand among the most demanding customers as regards to safety quality.

A survey of 25 exporting firms (Codron et al, 2005) shows that a majority of the exporting firms have some concern for **safety issues** and accordingly implement a variety of measures (Eurep GAP or some other GAP, tracing, residue analysis…). Safety measures are taken according to their most demanding customers and aim at complying with the requirements of the country of destination and sometimes additionally with the specific requirements of a given customer. Other finding was that firms selling to safety demanding customers tend to backward integrate into farming production or to contract with independent growers to secure safety control.

Border fresh produce rejections for safety issues

Tomatoes are currently little concerned by rejections at the EU borders : only 4 cases out of 394 total rejections have been reported reported by RASSF (Rapid Alert System for Food and Feed) from 01/01/2008 to 28/10/2011 (http://ec.europa.eu/food/food/rapidalert/index_en.htm).

Rejections on Bulgarian border

28/01/2011 : presence of oxamyl (0.15 mg.kg – ppm) returned to dispatcher
06/05/2011 : presence of procymidone (0,08 mg/kg – ppm) destructed
11/05/2011 : rejection because of the presence of oxamyl (0,031 mg/kg – ppm) destructed
20/05/2011 : presence of tetradifon (0,031 mg/kg – ppm) destructed (tomatoes should be distributed in Romania)

Unexpectedly, it has been recently more difficult to export to Russia than to EU, although Russian MRL are lower than EU ones (Ekin Taskin, 2010). Turkey which is the Russia core supplier of tomatoes, had been continuously violating the Russia safety requirements regarding FFV. In June 2008, Russia made a decision to ban issuing of import quarantine permissions and imposed temporary restrictions on fresh produce imports from Turkey. In April 2009, a memorandum was signed between the two countries, in which Turkey commits to inform Russia about issued phytosanitary certificates for plant products, pesticides used for production and storage and about unscrupulous firms supplying Russia. No incidence has been reported since that date.

Likewise, **Saudi Arabia**, by changing and reinforcing its regulations on sanitary quality standards, became more regarding vis-à-vis Turkish imports of fresh produce and rejected on 25th August, 2011, an important volume of tomatoes imported from Turkey, on the base of non-conformity to its new commercial and sanitary quality standards. From now on, better sorting, packaging, and labeling are required.

The **private sector** is more and more conscious about this constraint and exerts a **great pressure on public authorities** to take the necessary steps in order to improve the existing conditions. One of the initiatives has been to invest in private control laboratories (see further).

Quality control procedure for compliance with international standards at the customs level

The export procedures inTurkey are arranged by Articles 150 and 151 of Section IV, titled “Export Procedures” of Customs Law N°4458. Together with other decrees, regulations, notifications and circulars, it defines the functions of public authorities concerned and the principles of the exportation for public interest (IGEME, 2002).

Export procedure is based on the **declaration of the exporting firm**[7]. These are post-harvest produce, conditioned and packed for exportation. The quality control concerning the conformity of the produce to national and international standards is realised **within the 24 hours** starting from the declaration of the exporting firm because of the perishability of fresh produce. The control is generally realised at the Customs stage by the expert-engineers of the General Directorate of Standardisation for Foreign Trade and only afterwards that a **conformity document will be delivered to the exporter**.

[7] Interview with Mr. A. Suat EKICI, Director of the Regional Directorate of the Western Anatolia Region of the General Directorate of Standardisation for Foreign Trade of the Ministry of Economy realised at 20th of October, 2003

Safety control laboratories for export

There is no extended control service in Turkey. As explained here-above, small State laboratories and recently accredited private laboratories carry out these controls with the help of a **limited number of expert engineers**. But the most important bottleneck of the food chain seems to be formed at the level of infrastructure. Besides the fact that the existing **technical capacity is not sufficient** to carry out efficiently and rapidly the necessary controls, the existent number of expert – engineers specialising in these sanitary quality controls is far beyond the recommended number. Turkey recently benefited from the **EU's financial aid** of a total of 14 million euros, in order to improve its testing materials, accreditation systems and instruct more expert-engineers. Amid the different initiatives within this project, the construction of the National Food Reference Laboratory in Ankara was planned and the Reference Laboratory opened on 20 November 2011 (www.perakende.org).

Public laboratories. In Turkey, there are 40 State owned and managed laboratories where samples are analysed (Table 6). There is a rather even regional distribution of these laboratories with the exception of Western Anatolia which accounts for 38 % of the total number of testing laboratories. In Aegean region, there are 5 laboratories established in Aydin, Denizli, Afyon, Mugla and Izmir with a total staff of 20 agricultural engineers covering the whole Aegean region[8]. This task necessitates agricultural engineering diploma. Neither laboratory assistants nor agricultural technicians are admitted as food safety inspectors to work in these laboratories. In Mediterranean region of the country, all of the six provinces have, each of them, their own laboratories. It is evidence that, Turkish Ministry of Agriculture, advantage the regions which are, not only important production pools of fresh vegetables but which are also important export centres.

Table 9 : Number of testing laboratories in charge of the analysis of pesticides residues and other aspects of sanitary quality of foodstuffs

Socio-economic regions of Turkey	Provincial Direction of Agriculture	Provincial Direction of Control and Protection Laboratory
Black Sea region	13	7
Central Anatolia	13	6
East and South East Anatolia	27	8
Mediterranean region	6	6
Western Anatolia (Marmara+Aegean regions)	22	13
Turkey	81	40

Source : Authors' work based on information diffused by Ministry of Agriculture, www.tarim.gov.tr

Private laboratories. The lack of laboratories for the sanitary quality control has led some of the exporting firms, in close collaboration with local NGOs (Province Chambers of Commerce; Regional Exporters' Unions, Municipalities) to invest in the foundation of **private control laboratories**. This has been possible since the promulgation of the Directive on *Private Food Control Laboratories Establishment and Functioning* in 2000. 50 private laboratories specialized in pesticide residues have been created in this context (Ufuk)

Laboratory accreditation. Six out of the 40 provincial laboratories of the Ministry of Agriculture were accredited by Turkish Accreditation Organisation (Türkak). These accredited laboratories are situated in Ankara, Istanbul, Izmir, Bursa, Mersin and Samsun. Laboratories in Turkey are **accredited for only some active agents** and only very few of them are accredited for the 300 active agents that

[8] Interview with M. Muharrem OZDESTAN, Director of the Food Safety Investigation and Control Office of Izmir Prefecture of Ministry of Agriculture, 23th of October, 2003

concern the fresh produce sector. As a result, when there is a need for an overall control, Turkish laboratories are not sufficient, and traders have to take their samples to **foreign laboratories** in order to have a rapid and complete analysis (Nurhayat Bayturan, general manager of an inspection body, 2010).

The increase in the number of accredited testing laboratories and the improvement of analytical capability will undeniably eliminate delays before marketing, and reduce the risk of divergences between analyses undertaken by different laboratories, the rejection of samples and the destruction of products (EU Flash, 20 October 2005). However, it must be mentioned that **all these control systems are directed to export produce and no control is realised concerning the produce marketed in domestic market**.

Public/private control at the national market level

Responsibility regime in Turkey:

In accordance with harmonisation processes that Turkey undertakes to its pre-adhesion to EU, Turkey applies the principle according to which, if the producer of a product is not known or can not be designated, the responsibility in case of irregularity or defection observed, the sourcing person or/and the retailer is pointed out as the ultimate responsible in front of the law. Only if the sourcing person or retailer can, in a reasonable period of time, identify and design the producer of the product, he can be acquitted and will not be charged of prison.[9] In this wise, it can be attested that the « responsibility principle » is quiet similar to that practiced in France which stipulates that it is the first operator who introduces the product to the country who is responsible face to laws. If this operator is the retailier that markets the product under its own label.

Public and private safety control in the national fresh produce chain

Despite the improvement of the food legislation since the mid-1990s, the adoption of the new food law in 2004 and the legislative infrastructure to control the food quality, the general feeling in Turkey is that there is **no official and serious control** concerning the food safety of **fresh produce sold in domestic market**. The Turkish consumers are not yet sensitive to food safety concerns and a great majority is not regarding a high sanitary quality of the food that they purchase. Facing this reluctance from the consumer, administrative staff exhibits no serious initiative to establish a narrow and regular watch system concerning food safety. Seldom controls are realised further to scarce consumer complaints. These controls are mostly directed to post-harvest produce and concern the marketing chain. Samples are taken on the trucks during the transportation of the fresh produce, or at their arrival to the City Hall (wholesale market hall), or grocery stores, greengroceries, supermarkets[10].

Nonetheless, **recent evolutions** show that these practices are also changing. **Consumer complaints** of these last years concerning the sanitary questions of food produce expose **retailers** to the threat of being punished if there is a **law pursuit**. [11] Consequently, **large retailers** have become very careful in

[9] MEGEP, Project on reinforcement of professionnal learning and education system, Financial responsability insurance of the product in marketing and retailing, Milli Egitim Bakanligi, Ankara, 2008, 36 p.

[10] Interview with M. Muharrem Ozdestan, Director of the Food Safety Investigation and Control Office of Izmir Prefecture of Ministry of Agriculture, 23th of October, 2003

[11] For instance, in 2009, the Carrefour FFV purchase director **was sued** and threatened with prison because of residues in excess detected on a batch of pears without traceability to the producer. Interview with Hunkar Ulnlu, chief buyer of Carrefour Karsiyaka, Izmir, 2010, October 7th

their fresh produce sourcing and prefer to buy either from large producers/exporters that are certified by private labels (GlobalGAP, BRC, Tesco standards….) or from dedicated wholesalers who collect produce from small-size growers and commit to establish some traceability and to send residue analysis to the retailer. This is the case for instance of Kipa-Tesco who procures from 35 suppliers that are regularly audited, achieves 120 residue analysis per month and traces 50 to 60 % of fresh produce on sales[12].

One of the large retailers, Migros Turk, realised, in 2010, a partnership with the Ministry of Agriculture, to buy certified fresh produce. Producers who agree to enter into partnership with Migros receive higher subventions. In 2010, 5 000 producers became contractors of this large retailer and obtained their certificates. Producers practicing under-cover agriculture receive 900TL per hectare while those practicing open field horticulture receive 300 TL/ha. Migros Turk, that sells approximately 250-300 thousand tons of fresh produce per year, can have an important impact on the extension of certified practices among the horticultural producers of the country (http://www.gidabilimi.com/haberler/1-son-haberler/2967-iyi-tarim-uygulamari-konusunda-bakanlik-ve-migros-isbirligi-yapti).

[12] Interview with Mahir Müderriszade, quality manager of Kipa-Tesco Karsiyaka, Izmir, 2010, October 7th

1.D. GROWER SURVEY DESCRİPTİVE ANALYSİS

Survey Methodolgy for Data Collection

Our analysis focuses on Antalya region because it reprensents 85% of the total greenhouse tomato production. This region contains sixteen provinces; due to financial and material constraints, we considered Kumluca, Serik and Aksu which concentrate more about half of total tomato production of Antalya region, half of total number of greenhouse tomato growers and half of greenhouse tomato area (See Table 2)

Figure 2 : Antalya Map by Districts

We interviewed a total of 186 farmers randomly selected and distributed in three groups whose size was proportional to the total number of farmers registered in each province. Given that there is no province specificity as regards to climate, pest or disease pressure, organization or institutions, we consider the whole sample without any province distinction. Addresses were obtained through the Sub-Directorate of Ministry of Agriculture of Kumluca, Aksu and Serik Province. A number of adresses that proved obsolete could not be used.

Table 10 : Weight of the three largest districts in Antalya province regarding greenhouse tomato

Districts	growers (N)	%	area (hectares)	%	production (10^3 tons)	%
Kumluca	7000	20,0	2800	19,5	315	17,4
Serik	5000	14,3	1977	13,7	278	15,3
Aksu	4609	13,2	2556	17,8	330	18,2
subtotal	16609	47,4	7333	51,0	923	50,9
Total Antalya	**35052**	**100**	**14390**	**100**	**1811**	**100**

Table 11 : Proportional distribution of the sample volume by the selected disticts in Antalya province

Selected Districts	Number of growers in district	%	Number of growers in sample	%
Kumluca	7000	42,2	79	42,5
Serik	5000	30,1	55	29,6
Aksu	4609	27,8	52	28,0
Total	**16609**	**100**	**186**	**100**

A seventeen pages questionnary was used for the face to face interviews with growers. It was based on information collected during a five-days exploratory mission in Turkey made of field visits and interviews of key informants on safety/ipm issues in the fresh produce sector (see in Annexe ? the program of our exploratory mission). The questionnary was translated in turkish. The survey itself was conducted by Professor Murat Yercan of the Aegean University with the help of four students. It lasted ten days. Each questionnary was then checked by the Turkish supervisor and shared with the Sustainmed team.

The aim of the grower survey has been to i) caracterize the current average state of pest management practices, highlighting on the one hand, chemical control and on the other hand alternative practices of control such as ipm or icm; ii) evaluate the diversity of such practices and the key factors of such a diversity.

Main proxies of pest management practices that have been included in the questionnary are :

- Chemical control: sources of knowledge, head farmer participation, frequency of plant observation, sources of influence in the treatment decision making process, treatment recording,
- Alternative pest control (ipm): footbath, curtains, weeding, equipment cleaning, wall spraying, yellow and blue traps, pheromons, biological auxiliaries
- Integrated crop management: climate control automatisation, soil water in excess control, rotation, bombus bees
- Environment control: public and private consulting, third party control, certification

Main proxies of the determinants of pest management practices that have been included in the questionnary are:

- farm characteristics: land size, tenure, crop diversification, income
- greenhouse characteristics: size, covering material, heating system, roof sprinkler, drip irrigation, other equipment
- farmer characteristics: age, education, experience, labor structure, off farm activity, cooperative membership,
- tomato production : variety, crop calendar, yield,
- tomato marketing: on farm sorting, delayed or cash payment, marketing channel, average price obtained

Farming systems

Farm characteristics

Farm Size: Among the growers interviewed, almost 50% were holders of small holdings with a total land size ranging from 0,1 to 1 ha, 22,6% had medium size holdings (1-2 has) and 29% had large holdings (> 2 has) with some of them having more than 20 has. The average holding size is 2,43 ha with an average of 0,71 ha of greenhouse and 0,59 of tomato cultivated under greenhouse.

Table 12 : Greenhouse growers distribution by land size category

	N	%	Ave	Std.	Min	Max
Landsize						
• < 1 ha	90	48,4	0,55	0,25		
• 1-2 ha	42	22,6	1,52	0,27		
• >2 ha	54	29,0	6,26	5,30		
All	**186**	**100,0**	**2,43**	**3,78**	**0,1**	**23,5**
Greenhouse size						
less than 2,5	30	16,1	0,17			
2,5-5	71	38,2	0,34			
5-7,5	37	19,9	0,58			
7,5-10	15	8,1	0,82			
more than 10	33	17,7	2,08			
All	**186**	**100,0**	**0,71**	**1,02**	**0,1**	**10,0**
Tomato size	**186**	**100,0**	**0,59**	**0,80**	**0,1**	**6,6**
Crop speicalisation						
• Greenhouse size/farm size			**54%**	**36%**	**3%**	**100**
• Tomato size/greenhouse size			**88%**	**22%**	**20%**	**100**

Legal status: five farms have a non standard legal status (3 limited company and 2 co-inc)

Land tenure: A vast majority of the growers (179 out of 186) own at least a part of their holding. While 151 of these land owners have full property, 28 growers have additonal land to their own land with renting or sharecropping. Among the very few growers with no ownership, 3 are very small-size growers (0,4 ha) sharecropping their land and 4 are very large size growers (7 ha on average) renting their land.

Table 13 : Greenhouse grower population distribution by tenure type

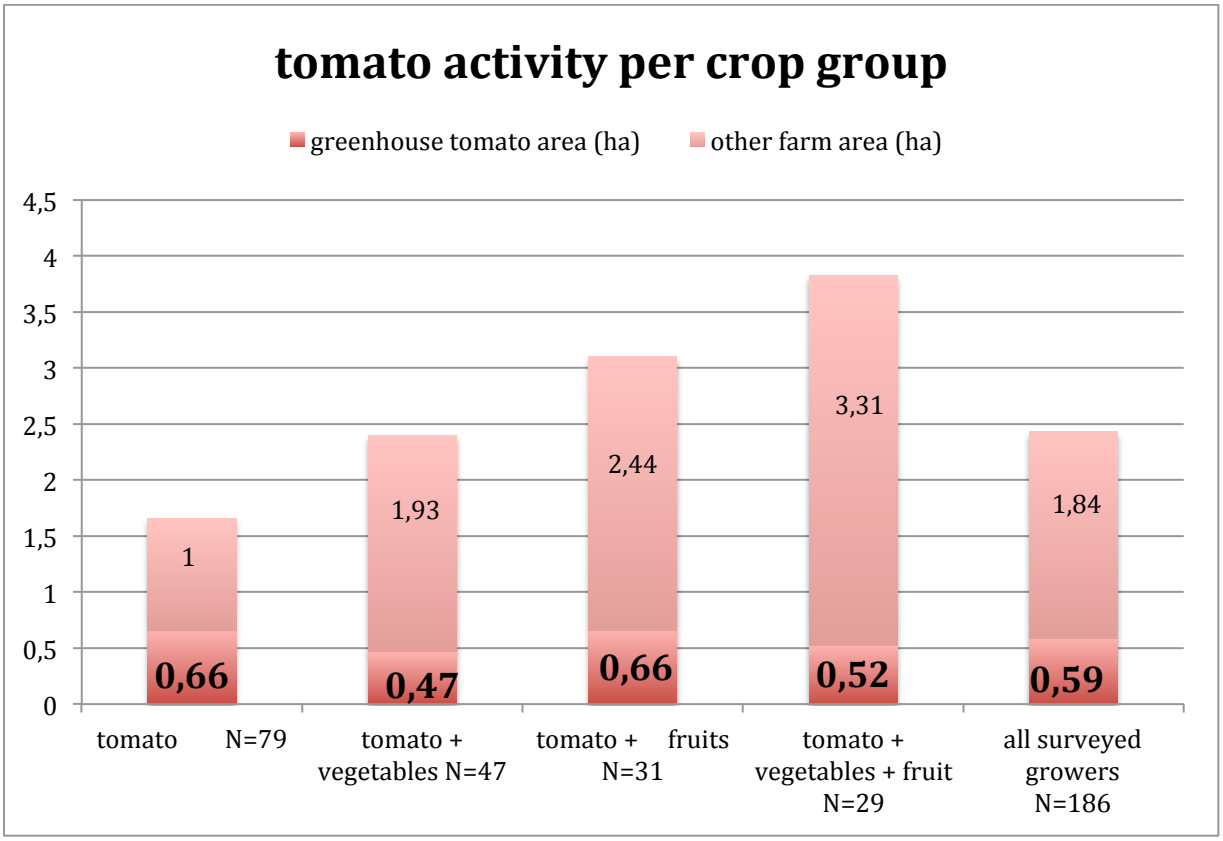
Types of land tanure	TOTAL LAND		LAND FOR TOMATO	
	Mean (ha)	N	Mean ha	N
Ownland	2,0	151	0,57	163
Renting	7,0	4	1,64	5
Sharecropping	0,4	3	0,31	8
Ownland-renting	6,6	16	0,47	6
Ownland-sharecropping	1,4	11	0,93	4
Ownland-renting-	4,3	1	-	-
Total	**2,4**	**186**	**0,59**	**186**

Greenhouse crops. About two thirds of the growers (63%) only produce tomato in greenhouse. The remaining growers (37%, 69 growers) have green pepper (25 growers), eggplant (11 growers), melon (10 growers), watermelon (8 growers), gherkin (7 growers), zucchini (4 growers), green beans (2 growers) and lettuce (1 grower).

Open field: Main crops cultivated undergreenhouse or in open field are fruit and vegetables. While 79 of the growers have only tomato, 31 growers have fruit in addition to tomato, 47 have vegetables in addition (to tomato) and 29 growers have both fruit and vegetables in addition to tomato. Moreover, 28 tomato growers (15%) are producing other open field products (mainly wheat, maize, cotton).

Grower structure differentiation by fruit and vegetables activity. In table herebelow, we can see that growers with fruit, vegetables and tomato have both the largest land size (3,3 ha) and the largest greenhouse size (0,66 ha). Growers having only tomato have the smallest land size (only 1,0 ha) but the largest greenhouse size (0,66 ha) like the previous growers, which means that they should have high productivity tomato. Also, growers with vegetables have lower land size and less greenhouse area than growers with fruit, which is quite logical since vegetable cropping is usually more time-consuming that fruit cropping.

Figure 3 : Tomato activity per crop group



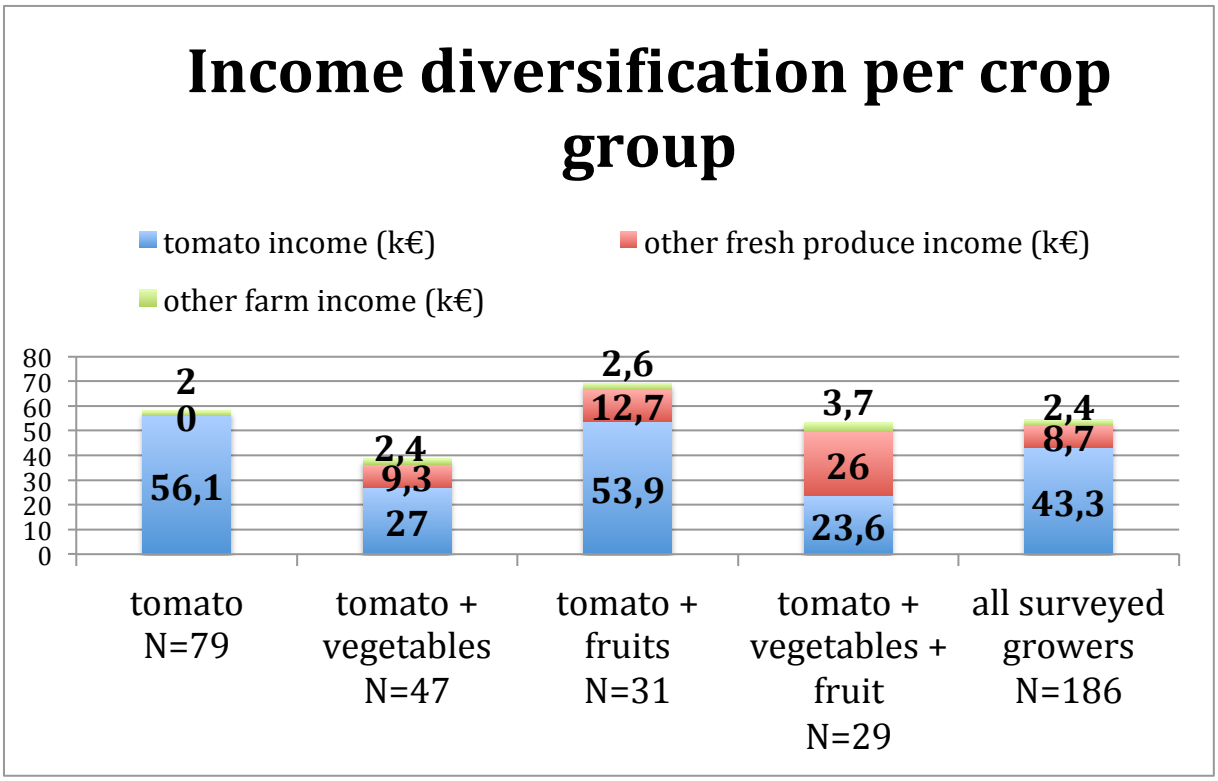
Sources of income: Total income was estimated around 108 247 TL (€54 332) for 2010. 95,6% of this income is generated by crop production, while non-agricultural incomes and government transfers (subsidies, pensions, etc.) count respectively for 2,7 and 1,2 % of total income. Animal production is almost absent in the area (only 8 growers) and wages from other farms are low and concer a minority of grower (16 growers).

Income figures in table herebelow assume that only part of the growers have other income sources than crop production. Accordingly, the distribution of income for the whole group of growers tends to underestimate the role played by some income sources like non agriculture income or animal production for growers benefiting from such sources.

Table 14 : Distribution of income per source

Income Sources	N	Average Income (k€)	Total Income of growers concerned (k€)
Crops	186	52,0	9 664
Animal production	8	2,9	23
Wage from other farms	16	1,3	21
Government subsidies	58	1,1	65
Non-agriculture income	36	7,6	272
Retirement and other pensions, other transfers	19	3,1	59
Total income	186		10 104

Figure 4 : Income diversification per crop group



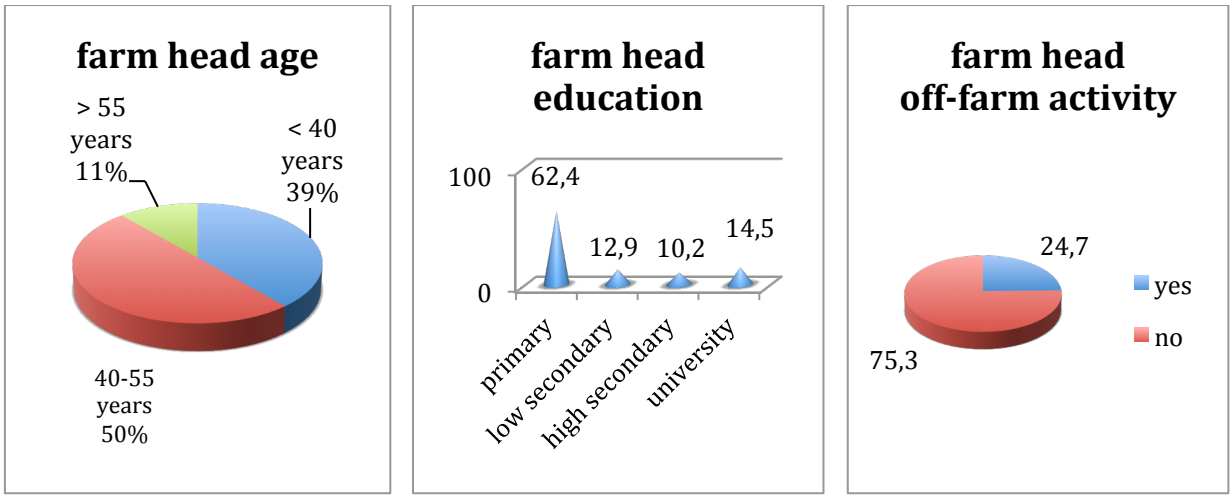
Income derivating from tomato production has by far the highest weight in total income (80% of total income). Other fresh produce income is 16% while other income is only 4, 4%. Tomato income weight may significantly vary between groups, from 96% in the group with only tomato to 44% in the most diversified group (tomato + other vegetable + fruit).

Farmer characteristics

Age. While the average farmer head is 42 years old, the youngest is 24 and the oldest 70. 39% of the growers are less than 40 and 11% more than 55.

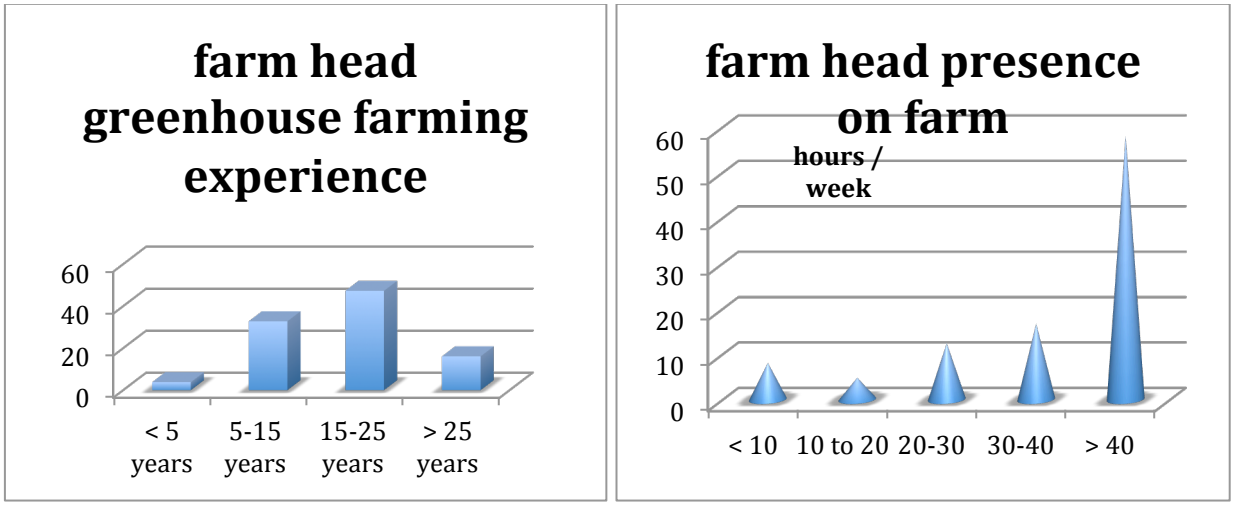
Education: Farm head education varies from primary level to university level with a majority of them (62%) having only primary level. As expected, young growers tend to have a higher level of education.

Figure 5 : Farmer characteristics of the survey sample



Experience: Growers have different greenhouse farming experiences. A vast majority (96%) have more than 5 years experience and 70% more than 15 years experience.

Figure 6 : Experience of the farmers of the survey sample



Off-farm activity and farm head presence on farm. Only one fourth of the growers have off-farm activity. A vast majority of the growers (75%) spend more than 30 hours per week on the farm and 58 % more than 40 hours per week. As expected, there is a clear link between off-farm activity and presence on the farm. By contrast, there is no correlation between farm head age, farm head education and off-farm activity.

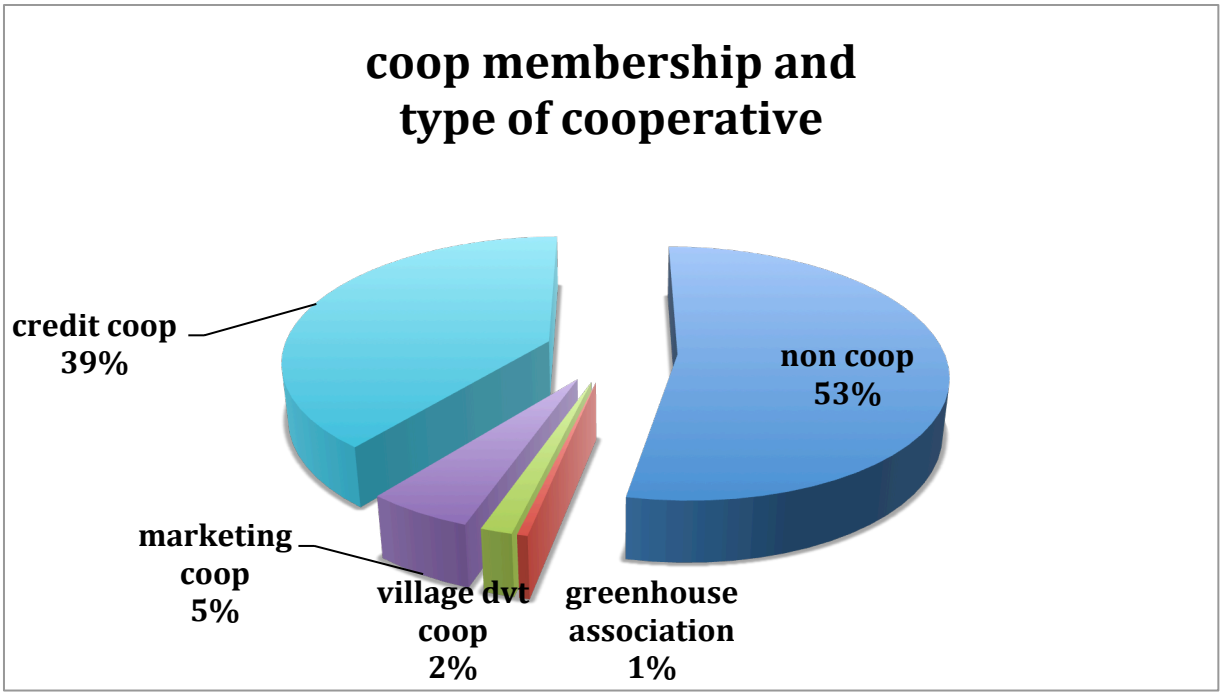
Labor: The amount and distribution of the labor force used in the fams is given in the table herebelow. Average number of full time workers is 5,4, breaking down into 2,4 family labor, 2,3 seasonal labor and 0,7 permanent labor. Farms with permanent non family labor are the minority (15 growers) and by far the largest ones. Farms with only family labor which represent 31% of our sample, are the smallest ones with 2,6 family persons. With the exception of two companies (with status of limited liability company), all farms are family farms, based on family labor.

Table 15 : Labor structure

Labor structure	farms		Average labor (full time person)				Average area (ha)	
	N	%	Family	Permanent	Seasonnal	Total	Total area	Tomato area
Family	57	31	2,6			2,6	1,29	0,29
Family & Seasonnal	101	54	2,5		2,9	5,4	1,80	0,48
Family & Permanent	15	8	2,0	4,8		6,8	4,79	1,03
Family/Seasonnal/Permanent	9	5	2,2	4,6	9,3	16,1	9,59	1,72
Non Family labor	4	2		5,3	17,7	22,9	9,58	3,48
Total	**186**	**100**	**2,4**	**0,7**	**2,3**	**5,4**	**2,43**	**0,59**

Cooperative membership: Almost one half of the growers (47%) have cooperative membership. A vast majority of them (84%) are members of credit cooperatives whose main function is provision of cash credit and selling of inputs. Only 5% of the total of growers sell products through marketing cooperatives. Private dealers are dominant in the distribution of inputs to greenhouse growers. However, the cooperative share is significant for fertilizers (19%), fuel-oil (17%), plastic coverage materials (12%), pesticides (9%), plants (9%) and waterpipes (8%).

Figure 7 : Cooperative membership of the farmers of the survey sample



It is worth noting that greenhouse farm size has no influence on cooperative membership. In each category of greenhouse size, there are equivalent proportions of members and non members.

Table 16 : Greenhouse size and Cooperative Membership

		Coooperative Membership		Two-sample t test for area cultivated
		yes	no	
greenhouse size (ha)	less than 0,25	15	15	***
	0,25-0,5	34	37	***
	0,5-0,75	17	20	***
	0,75-1,0	6	9	***
	more than 1,0	15	18	

*** the average area cultivated is the same considering the farmer is (or isn't) member of a cooperative

Greenhouse characteristics

Most growers have less than one ha of greenhouse. While the average **size** is 0,71 ha, the minimum size is 0,1 ha and the maximum size is 10 has.

Table 17:. Coverage material by greenhouse size (ha)

	Glass		Plastic		Glass & Plastic		All	
	N	Mean	N	Mean	N	Mean	N	Mean
less than 0,25	11	0,17	17	0,18	2	0,20	30	0,17
0,25-0,50	20	0,34	33	0,34	18	0,35	71	0,34
0,5-0,75	9	0,57	18	0,58	10	0,59	37	0,58
0,75-1,00	1	0,90	4	0,80	10	0,82	15	0,82
more than 1,00	2	3,90	12	2,48	19	1,63	33	2,08
Total	**43**	**0,52**	**84**	**0,68**	**59**	**0,88**	**186**	**0,71**

Greenhouse coverage material. Plastic tends to be the dominant coverage for greenhouses in the area although glass is used in a significant proportion. Growers with only plastic greenhouses (84) are two times more numerous than growers with only glasshouses (43), while there is almost one third of the growers (59) having both glass and plastic greenhouses. A main advantage of plastic is the lower initial cost of investment while growers have to face higher costs of replacement due to the limited duration of the material. Accordingly, it is not surprising that on average, growers with only glasshouses have less greenhouse surface than growers with only plastic houses (0,52 ha vs 0,68 ha). However, it is worth noting that growers with both coverage have on average more surface (0,88 ha) than the other ones.

Iron local made construction is cheap and mostly preferred in the area. Almost all growers interviewed construct their greenhouses with the iron made material both for plastic and glass coverage materials.

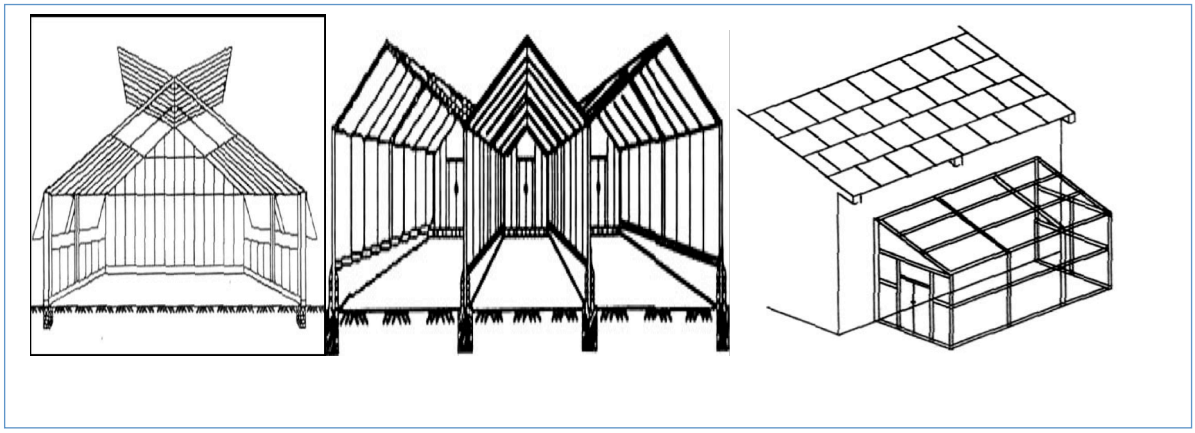
Most of the growers preferred to have single shape of greenhouses then multi chapel comes behind. Single shape of greenhouse is much more preferable with the glass coverage materials while plastic material was mostly preferred by the multi-chapel types of greenhouses.

Table 18 : Greenhouse shape by coverage material

Shape of greenhouse	Type of greenhouse coverage			All types of
	Glass	Plastic	Both Glass	
Single	55,8	46,4	32,2	44,1
Multi-chapel	27,9	44,1	32,2	36,6
Both single and multi-chapel	9,3	4,8	32,2	14,5
Adjacent	7,0	2,4	1,7	3,2
Both single and adjacent	-	1,2	1,7	1,1
Multi-chapel and adjacent	-	1,2	-	0,5
Total	**100,0**	**100,0**	**100,0**	**100,0**

Single shape greenhouse is commonly used for small size of greenhouses. It has an only one roof and there is no connection with the other greenhouses. Multi-chapel greenhouse is a shape which is typically connected by a series of roof to create a single airspace. Adjacent greenhouse relies on a nearby building, such as a house, to provide structural support. It stands directly adjacent to the building with the greenhouse's frame attached to an exterior wall.

Figure 8 : Greenhouse shape by coverage material



Heating system. A minority of growers (14 growers) don't have any heating system except the other passive protection methods being used. All the others have some elementary **heating system** (ordinary stove) that they use occasionally under freezing conditions. Most of them are using wood and coal as a source of heating energy. 25 growers with heating system have a **roof sprinkler** on the top of the plastic greenhouse to better prevent the effect of freezing. Roof springler is a system which is used to fix inside temperature by rainning in he roof. It is used occasionally under potential freezing conditions.

Table 19 : Heating systems

	Glass		Plastic		Glass+plastic		Total	
	N	%	N	%	N	%	N	%
Wood	30	75,0	57	78,1	38	64	125	67,2
Coal	3	7,5	12	16,4	17	29	32	17,2
Gas	1	2,5					1	0,5
Wood & coal	6	15,0	5	6,9	3	5	14	7,5
Wood & electricity					1	2	1	0,5
Total with heating system	40	93,0	73	86,9	59	100	172	92,5
Total without heating system	3	7,0	11	13,1			14	7,5
Total	**43**	**100,0**	**84**	**100,0**	**59**	**100**	**186**	**100,0**

Drip irrigation. All the growers are using drip irrigation methods. While this is good news for natural resources sustainable management, it has other positive externalities for plant nutrition, plant protection and soil preservation.

Soilless culture. Only five farms use soiless technique. Most of them are large farms with size ranging from 1,7 ha to 8,0 ha.

Tomato production

Tomato type. Ninety per cent of the growers are producing loose classic type of tomato while 7% produce cluster tomato. Small-size tomatoes like cocktail and cherry are produced by a minority (7 growers, that is 3,7%).

Table 20 : Distribution of growers per type of tomato

Types of tomato	N	%
Loose Classic	167	89,8
Cluster	12	6,5
Cocktail	5	2,7
Loose Classic and Cluster	1	0,5
Loose Classic and Cherry	1	0,5
Total	**186**	**100,0**

Tomato cropping calendar. Most growers (74%) are doing single long period production starting autumn and finishing end of spring. The remaining growers (26%) do not have any soil occupation during the coldest period (january-february) and are harvesting tomato in fall (7,5%), spring (1,1%) or both fall and spring (17,2%). Of course, growers with only one production in fall or spring, usually grow other crop such as pepper, melon, zuchini under greenhouse in the other period.

Table 21: Farmer distribution by production period

Production Period	Number of	%
Single production (from autumn to end of	**138**	**74,2**
Double production (autumn and spring)	32	17,2
Production only in autumn	14	7,5
Production only in spring	2	1,1
Total	186	100,0

Tomato yield. The yield depends on the type of tomato (loose and cluster have equivalent yields when other factors are similar while coktail and cherry have lower yields), on the length of the harvesting campaign, on the season (spring and fall have higher yield than winter due to the number of days of sunshine) and last but not least, on the grower productivity.

Table 22 : Tomato Yield by Production Period (kg/m2)

	Loose classic	Cluster	Cherry	cocktail
Single production	11,0	19,1	6,0	11,0
Double production	11,9	15,3	-	-
Production only in autumn	7,8	4,9	-	8,7
Production only in spring	8,2	-	-	-
Total	**11,0**	**16,4**	**6,0**	**10,1**

It is worth noting that growers with double production harvest more times than growers with single long period production (27 vs 21 in our survey). This may help interpret the higher yield of loose tomato for double production (11,9) than for single production (11,0). Yield data also show that cluster tomato has higher yield than loose tomato while in experimental conditions, all other factors being equal, yields are more or less equivalent. A reason of such a difference is that cluster are grown by large-size efficient growers (2,4 ha greenhouse, that is four times the average greenhouse area).

Factors influencing the plantation date. Growers have been asked about reasons for plantation date (Q53). Although the number of answers is limited, two reasons seem prevalent: climatic conditions (fear of freezing damages) and market opportunity (see further the excellent prices of tomato in fall 2010). Of course, in the conditions of Antalya production, both factors are uncertain from one year to another.

Other factors of significant influence (moderate score =3) are heating costs and safety risk management. As already mentionned, most greenhouse cropping sytems in the climatic conditions of Antalya only use heating as a protection against freezing and may not be compared to the high tech greenhouses systems implemented by large companies that use regular heating as a tool for regulating the climatic conditions. As a result, heating is most often, only temporary and does not impact so much the total cost.

Table 23 : Factors influencing the choice of the plantation date

1) Never effective 2)low effective 3)moderate effective 4)rather effective 5) strong effective	N (answers)	Mean
Demand, commitment with our customers (plantation dates are chosen according to?)	186	2,31
Technical and farm management constrains)	186	2,28
Safety risk management	186	3,08
Packing requirement	186	1,38
Heating cost	186	3,13
Climatic conditions	41	4,98
The time that the supply of product is low or unsufficient in the market, early market opportunity	53	5

Note : Other minör factors mentionned by farmers are the time when tomato exporting is intensive-such as march, april; the planting time for the second product in the same greenhouse; the time when diseases and pest may emerge

Tomato marketing

Volumes on sale. Given the small size of farms, volumes on sale per grower do not exceed some dozens of tons (60 tons for the median grower). While 5% of the growers sell less than 10 tons, 2 firms are selling more than 400 tons.

Grading and packing. While sorting and grading is mostly done by growers (80%) on farm before selling, packing is only done by five large companies who have their own packing station. In the vast majority of cases, packing is left to merchants or brokers. Arguments given by growers for not packing tomatoes are the cost of investment, the lack of knowledge about market preferences, the lack of grower marketing organization and the willingness of merchants and brokers to do it on their own.

Marketing channels. The main transaction is done in a vast majority of cases (175 growers) in the city hall with commissioners. Other marketing channels that are used for the main transaction or additional transactions but in a few cases, are merchants (14 growers), retailers (1), open market (2), direct exporting (4). Retailers and direct exporting may be considered as high valuing channels but

only concern a very few growers. It is worth noting that cluster tomatoes are relatively more concerned by those high valuing channels.

Table 24 : Different market channels used by the farmers of the survey sample

		Loose Classic	Cluster	Cocktail	Other	Total
main transaction	Merchant	9	1			10
	City hall	158	11	5	1	175
	Direct marketing	1				1
Total		**168**	**12**	**5**	**1**	**186**
additional transaction	Merchant	3	1			4
	Export		2			2
	City hall	7	1	1		9
	Retailers		1			1
	Open market	1				1
	Companies engaged in export		2			2
Total		**11**	**7**	**1**	**1**	**20**

Payment delay. Most growers (136) are paid with some delay while 51 declare cash payment. Although the number of observations is small (14 cases), cash payment seems much more frequent when selling to a merchant.

Table 25 : Payment delay by type of marketing channel

	forward	cash
Merchant	5	9
City hall	135	49

Export orientation. Although almost all the growers sell their product to a broker in the local market, 60% of them are aware that their product is exported in proportions that average 50% of what they sell. The top destination countries mentionned are Russian Federation, Germany, Bulgaria, Romania, and Azerbaijan.

Label. Four growers own a private label that they use to sell their products on the local market for more than 75% of their total production.

Prices. Growers have been asked about prices obtained per type of tomato and per month. Statistics herebelow are based on 113 growers that have given such information. Of course, such statistics have to be interpreted very carefully since i) periods of selling may be quite different between growers and prices are highly fluctuating within a year (see City Hall average prices per month for year 2010 and decade 2000-2009); ii) the number of observations for minor marketing channels and types of tomatoes (like cocktail and cherry) is too low to draw some conclusions; iii) City Hall prices include tax and broker commission and must then be reduced by 15% to be compared to prices obtained by growers. However, we may infer from the table below that cluster tomatoes benefit from higher prices than loose tomato. Moreover, it is worth noting that top prices obtained during fall 2010 (and fall 2009) are exceptional and may explain some grower future preferences for production during the fall.

Table 26 : Average Tomato Sales Price to Diffrent Buyers (in Turkish Liras/kg)

Buyers	**Sales Price (TL/kg)** Type of tomato				
	Loose	Cluster	Cherry	Cocktail	Total
Merchant	0,59	1,38	-	-	0,70
Export	-	1,28			1,28
City hall	0,77	1,04	1,42	1,25	0,81
Retailers	-	2,20	-	-	2,20
Open market	0,85	-	-	-	0,85
Direct Marketing (directly to consumers)	2,30	-	-	-	2,30
traders or merchants engaged in export	-	1,38	-	-	1,38
The companies engaged in tomato export	-	2,10	-	-	2,10
Total	**0,77**	**1,24**	**1,42**	**1,25**	**0,83**

*1€ equals to 1,9894TL in 2010, average rate.

Figure 9 : City Hall loose tomato monthly prices over the last decade (Turkish Liras/kg)

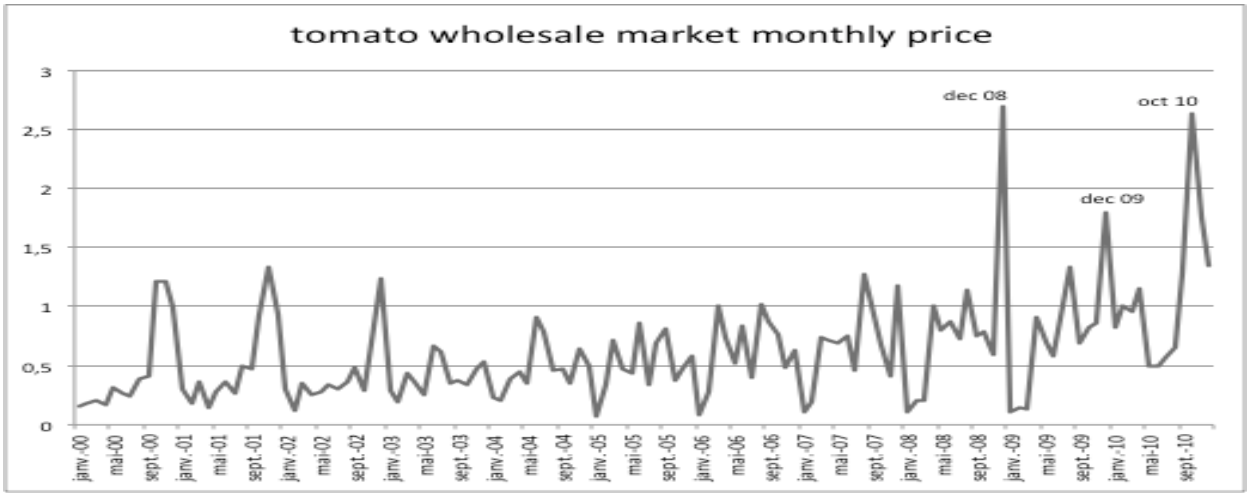
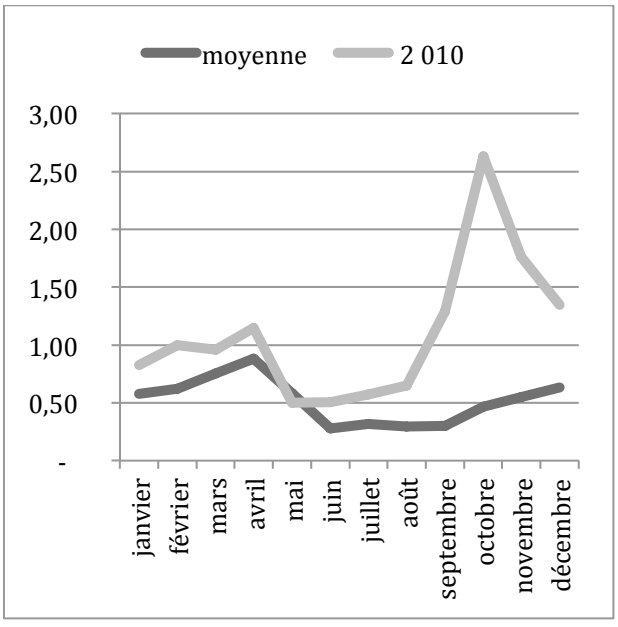


Figure 9 bis : City Hall loose tomato monthly prices (2010 vs average 2000-2009)



	Moy 2000-2009	2 010
janvier	0,58	0,83
février	0,62	1,00
mars	0,76	0,96
avril	0,88	1,15
mai	0,58	0,50
juin	0,28	0,50
juillet	0,32	0,57
août	0,29	0,65
septembre	0,30	1,29
octobre	0,47	2,63
novembre	0,55	1,76
décembre	0,63	1,35

Audit and residue control plan. Exporters and modern retailers in the domestic market progressively require their suppliers to be audited and/or to provide a plan of residue analysis. Only a minority of growers (39) are concerned by such requirements. Twenty-two of them have been audited, seven have been required a plan of residue control and ten have been requested both a plan of residue control and an audit. Among the latter are the eigth growers with Global Gap or Turkish Gap certificate. Those certified growers are large scale growers with high level of education.

GAP Training. Five of the eight certified growers have declared some training, oriented to owners (2), crop tecnicians (4), pesticides operators (3), quality managers (2), team manager (2) and workers (4). Eleven other growers not yet certified have been trained as well. Unlike certified growers, training for growers that are not yet certified is mostly oriented to owners.

Table 27 : Distribution of farms of the sample according to GAP certification

Category concerned by GAP training	GAP certified farms	Non certified farms
Owner	2	11
General crop	4	1
Pesticide operator	3	2
Quality manager	2	0
Team manager	2	0
Workers	4	1
Total of individuals that have been trained	**17**	**15**
Farms with training	5	11
Farms with no training	3	167
Total farms	**8**	**178**

Table 28 : Summary of Tomato Growers' Pest Management Features in Turkey

Practices	frequency		N/186 (%)	N includes sometimes	comments
Integrated Pest Management	Very strong	**Resistant varieties**	97%	181	
		Yellow traps	88%	164	
		Elimination of contaminated plants	87%	161	
		curtains for doors	87%	161	
	strong	**weeding**	76%	142	
		equipment cleaning	75%	139	
	medium	**wall spraying**	60%	111	
	weak	**blue traps**	34%	63	
		pheromons	24%	44	
		footbath	17%	32	
	Very weak	**Biological auxiliiairies**	3%	5	
Integrated Crop Management (ICM)	Very strong	**Bombus bees**	96%	179	
		Soil water in excess control	90%	167	
	weak	**rotation**	34%	64	
	Very weak	**Climate conditions automatisation**	4%	8	
Chemical Spraying Management	Very strong	**Delay before harvesting**	99%	185	
	strong	**treatment recording**	76%	142	of which 47 complete recording
		high monitoring frequency (>twice a week)	79%	147	
	medium	**own observations**	51%	94	of which ? 89 with history
		external support to treatment decision	41%	76	private or public (Agmin)
	weak	**private consultant**	19%	35	
		no head farmer participation in pest management	12%	23	employee or third party
		autonomy from input supplier in treatment decision	8%	15	
External control	weak	**audit**	17%	32	
	Very weak	**Residue control plan**	9%	17	
		GAP certification	4%	8	

Safety risk management

Grower plant protection decision environment

Sources of knowledge about plant protection. Growers' main sources of knowledge about plant protection and spraying are input suppliers (63% of the growers), other growers (38%), technicians of the Ministry of Agriculture (39%) and private consultants (40%). Information procured from cooperatives, auxiliary suppliers and medias concern only a minority of growers (respectively 13, 10 and 7%) while there is almost no grower procuring information from packings, certification bodies or universities/research institutes.

Cooperative membership which concerns 47% of the growers (87 growers) does not make difference in the sourcing of information except that cooperative members more often procure information from cooperative technicians (24% of the 87 cooperative members) than non members (4% of the 99 non cooperative members), which seems logical.

Private consultant affiliation which concerns 19% of the growers (35 growers) does not make difference either except that affiliated are more numerous (69% of the 35 affiliated) to procure information from private consultants than non affiliated (34% of the 151 non affiliated).

It is worth noting that dependency from pesticides dealers is strong (63%) and does not decrease for cooperative members or private consultant affiliated. Prescription which has turned mandatory since 2010 should impact the sources of knowledge and increase the rate of growers procuring information from MARA tecnicians or licensed private consultants.

Table 29 : Sources of Knowledge/Information about Plant Protection

	N	N/186 (%)	coop membership		private consultant affiliation	
			Yes (%)	No (%)	Yes (%)	No (%)
Input suppliers	117	63	61	65	63	63
Other growers	70	38	38	37	34	38
AgMinistry (MARA) technician	72	39	41	36	34	40
Private colsultant / technician	75	40	44	37	69	34
Coop technician	25	13	24	4	17	13
Auxiliary suppliers	18	10	9	10	14	9
Media (journals, radios...)	13	7	9	5	9	7
Research Institutes / University	0	-				
Packing technician	1	1				
Control and Certification Bodies	1	1				

Private consultancy. Private consultancy concerns 35 growers (19% of the total of growers). It is mostly directed to large scale growers (33% of the growers with more than 0.75 ha of greenhouse are affiliated compared to 6/7% of the growers with less than 0.5ha. Cooperative membership does not make difference regarding private consultancy affiliation : 15 of the 35 affiliated are cooperative members, which is roughtly the proportion of cooperative members vs non members (87 vs 99). A reason for it is that cooperatives have mostly a function of input provision and not a function of tecnical assistance.

The price for consultancy may be a barrier for small scale growers. Fees paid by farmers range from 200 TL (**€101)** to 18000 TL (**€9048)** with average of 3029 TL (**€1523)** annually. Fees first depend of the surface of greenhouse. Per unit of greenhouse surface, this cost is much higher for small-scale

growers (less than 0.5ha: minimum cost is 750€/ha) than for medium scale (0.5–1ha; minimum fee is 150€/ha). This difference demonstrates that the fee has a fixed component which disadvantages small surfaces. Fees also depend on the level of crop intensification since for large scale growers (more than 1 ha), the minimum fee per ha is 250€/ha, that is 50% higher than the minimum for medium-scale growers.

Table 30 : Cost of consultancy by size (€/ha)

Greenhouse size (ha)	N	N with consultancy	%	Mean cost/ha	Minim cost/ha	Maximum cost/ha	Std. Deviation
< 0,25	30	2	7	1130	750	1510	530
0,25-0,50	71	4	6	1020	500	1680	550
0,50-0,75	37	6	16	710	140	1260	370
0,75-1,0	15	5	33	750	160	1380	550
>1,0	33	11	33	1550	250	4140	1170
Total	186	28	15	1120	140	4140	870

*7 growers do not pay any fee for the consultancy because of some trade relations on input supply.

Information about IPM government subsidies. Almost one out of two growers (86 growers) have heard about subsidies provided by MARA to help implement alternative methods of control, in particular auxiliaries (66 growers), nets (44 growers), pheromons (31 growers), traps (12 growers). Although one grower out of three has heard of subsidies about auxiliaries, only a minority did already implement biological auxiliaries in its greenhouse.

Safety pressure as perceived by farmers. Major pest threatened by growers are by far Tuta absoluta (score of 7,9) and White flies (score of 6,5). They are followed to a lesser grade (less than 5) by spider mites and cut worms. Tarnished plant bugs, aphids and thrips are not perceived as very threatening. With a score of between 5 and 5,35, most important diseases (mildew, rüşt, oidium and botrytis) are not perceived as threatening as Tuta absoluta or White flies. Diseases like alternaria, anthracnosis, cladosporiosis, mycosphaerella, fusariosis and bacteoriosis are perceived as less dangerous (score between 4 and 3).

Table 31 : Score of Pest Pressure as perceived by growers

0 : absent ; 10 : very high	N	Mean
***Tuta absoluta*/leaf miner**	**186**	**7,92**
White files/*Aleurodes*	**186**	**6,51**
Spider Mites	**186**	**4,83**
Cut worms	**186**	**4,30**
Tarnished plant bugs	186	3,29
Aphids	186	3,18
Thrips spp.	186	2,73

Table 32 : Score of Disease Pressure as perceived by growers

0 : absent ; 10 : very high	N	Mean
Mildew	186	5,35
Rust	186	5,16
Oidium/powdery mildew	186	5,06
Botrytis/Grey mould	186	5,01
Alternaria spp.	186	3,93
Anthracnosis	186	3,65
Cladosporiosis	186	3,63
Mycosphaerella	186	3,55
Fusariosis	186	3,38
Bacteriosis	186	2,94
Nematod	186	2,39

Chemical control practices

Growers first control pest and diseases by applying pesticides. Growers declaring not using pesticides for controling pest and diseases are a minority : 19% of the growers do not spray pesticides against pest, 26% do not spray against diseases, 18% do not spray at all. Pest and diseases with higher number of growers using pesticides to control them are White flies (66% of the growers), Mites (63%) and

Mildew (62%). For all other pests and diseases, growers are less than 50% to use pesticides. This is the case in particular for Tuta absoluta, a pest that has emerged recently and which is the most threatened: only 24% of the growers declare using pesticides against Tuta.

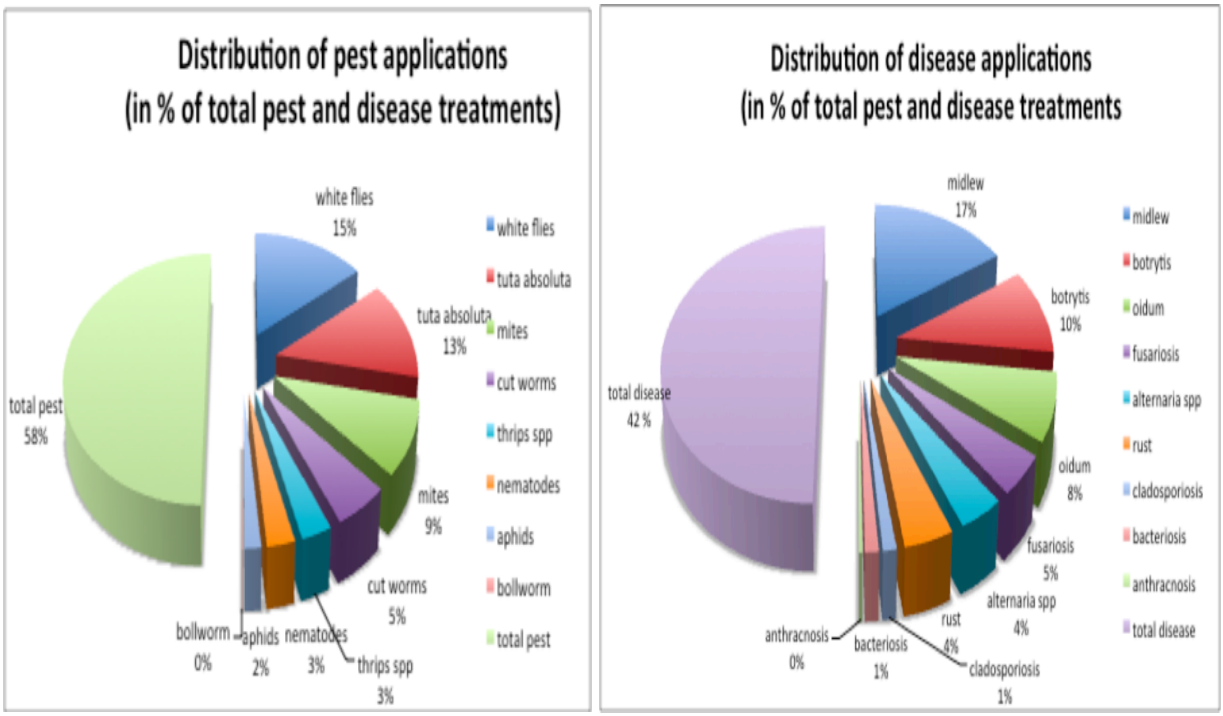
The average number of spraying per grower using pesticides is almost 25. Average numbers for pest and diseases spraying are respectively 16 and 10. The target with higher average number of spraying is by far White flies with 9,6 applications/per grower (using pesticides to control White flies). Most other targets have between 4 and 6 applications.

Table 33 : Growers pesticides spraying statistics

	Distribution of growers (%)			Spraying statistics for growers using pesticides		
	no spraying (%)	Spraying (%)	all	Mean	Min	Max
Tuta	76	24	100	5,6	1	30
Mites	37	63	100	5,7	1	35
Whites flies	34	66	100	9,6	1	60
Cut Worms	62	38	100	4,3	1	35
Botrytis	58	42	100	5,2	1	20
Mildew	38	62	100	3,6	1	35
Oidium	64	36	100	4,8	1	20
Rust	78	22	100	4,4	1	20
Total pests	19	81	100	16	1	106
Total diseases	26	74	100	10	1	40
All targets	18	82	100	24,7	1	143

Pest have more applications than diseases (respectively 58 and 42% of the total number of applications). White flies and tuta absoluta rank first and second among the pests in number of applications (respectively 15% and 13% of the total including pest and diseases) while mildew and botrytis rank first and second among diseases (respectively 17 and 10% of the total number of applications). Adding those four pest and diseases, we obtained more than 50% of the total number of spraying.

Figure 10 : Distribution of pest and disease applications



Molecules and comercial products used as pesticides.

For main pests, most growers are using Mospillan to control White flies, Agremec to control mites and Voliam Targo, Prokloin, Altacor and Decis to control Tutta. Main comercial products that are used when growers are concerned by diseases, are Ridomil for Mildew, Switch and Signum for Botrytis, Topas and Signum for Oidium.

Compliance with delay before harvesting. All growers except two declare comply with the regulatory delay before harvesting when applying pesticides.

Compliance with dosis standard. Information on pesticide usage has been expertised by the department of Plant Protection of the University of Izmir. Compliance with the dosis standard defined by MARA is critical for all the couples pest-pesticide or disease pesticide that show up in red colour.

Table 34 : Use of pesticides per type of pest

Pest	Commercial	Active Ingredients	% of	Dosis	Dosis
Tuta absoluta	Agremec	Abamectin EC18g/l		25	50,00
	Decis	Deltamethrin EC 25g/l	11	100	70,56
	Altacor	Chlorantraniliprole	14	12	15,07
	Prokloin	Emamectin benzoate SG5%	19	30	33,24
	Voliam Targo	Chlorantraniliprole	20	80	70,20
White flies	Mospillan	Acetamiprid SP20%	52	30	46,47
	Agremec	Abamectin EC18g/l		25	27,22
	Decis	Deltamethrin EC 25g/l		100	76,77
Mites	Agremec	Abamectin EC18g/l	75	25	39,73
	Decis	Deltamethrin EC 25g/l		100	50,00
	Voliam Targo	Chlorantraniliprole		80	80,00
Cut worms	Decis	Deltamethrin EC 25g/l		50	68,33
	Prokloin	Emamectin benzoate SG5%	49	30	31,49
Thrips spp.	Decis	Deltamethrin EC 25g/l		50	62,50
Aphids	Mospillan	Acetamiprid SP20%		30	34,17
	Agremec	Abamectin EC18g/l		25	25,00
	Decis	Deltamethrin EC 25g/l		50	85,00
Bollworm	Voliam Targo	Chlorantraniliprole		80	80,00

% of use of a pesticide for a given target

red color when overdose

Table 35: Use of pesticides per type of disease

Diseases	Commercial	Active Ingredients	% of	Dosis	Dosis
Mildew	Ridomil	Metalaxyl-M+Mancozeb	28	250	191,97
	Topas	Penconazole EC100g/l		50	100,00
Alternaria spp.	Ridomil	Metalaxyl-M+Mancozeb		250	256,67
	Topas	Penconazole EC100g/l		50	37,50
Anthracnosis	Switch	Cyprodinil		60	87,50
	Ridomil	Metalaxyl-M+Mancozeb		250	250,00
Cladosporiosis	Signum	Pyraclostrobin+Boscalid WG6.7		60	66,67
	Topas	Penconazole EC100g/l		50	50,00
Fusariosis	Switch	Cyprodinil		60	60,00
Botrytis/Grey mould	Switch	Cyprodinil+ Fludioxonil	27	60	53,90
	Signum	Pyraclostrobin+Boscalid WG6.7	20	60	141,96
	Mythos	Pyrimethonil SC 300g/l		125	117,01
Oidium/powdery mildew	Signum	Pyraclostrobin+Boscalid WG6.7	17	60	93,79
	Topas	Penconazole EC100g/l	27	50	55,20
	Mythos	Pyrimethonil SC 300g/l		125	60,00
	Shavit 25 EC	Triadimenol EC 250g/l		40	82,50
Rust	Switch	Cyprodinil		60	55,86
	Signum	Pyraclostrobin+Boscalid WG6.7		60	117,59
	Topas	Penconazole EC100g/l		50	60,00
	Mythos	Pyrimethonil SC 300g/l		125	106,25
	Shavit 25 EC	Triadimenol EC 250g/l		40	40,00

% of use of a pesticide for a given target

red color when overdose

Couples (target pesticide) with average dosis in excess. Couples exceeding the standard dosis by more than 50% are

- regarding pest: Tuta-Agremec, White Flies-Mospillan, Mites-Agremec, Aphids-Decis,
- regarding disease: Mildew-Topas, Botrytis-Signum, Oidium-Signum, Oidium-Shavit and Rust-Signum.

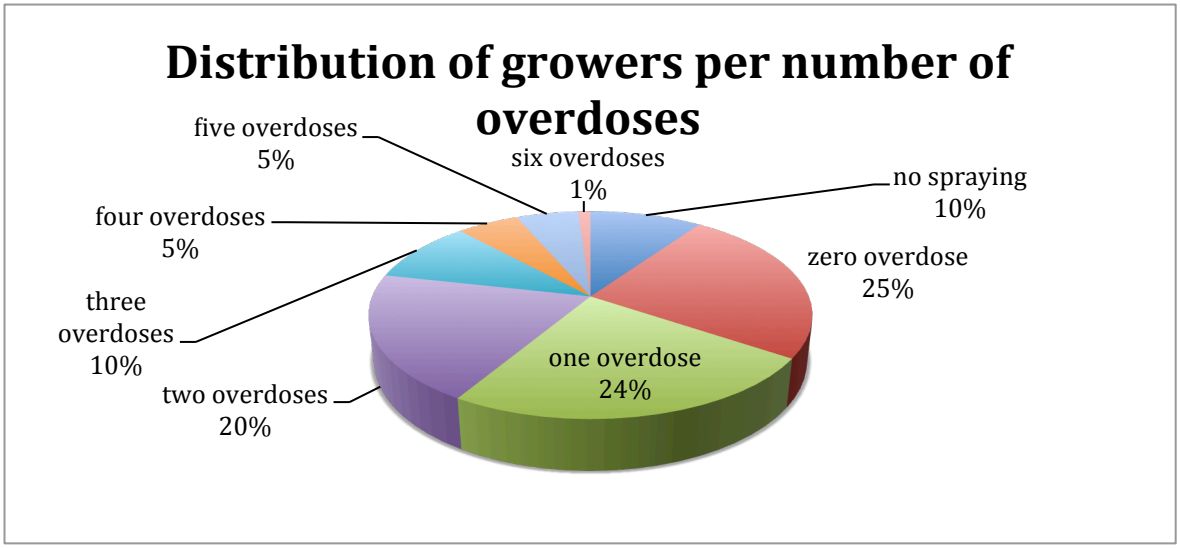
Within these couples, those with highest number of growers no complying with the standard are Mites-Agremec (53 growers with overdose), White Flies-Mospillan (40 growers with overdose) and Botrytis-Signum (15 growers with overdose) (see next table).

Table 36 : Number of spraying growers per pest-disease/pesticide and statistics on dosis applied with reference to the standard dosis

Pest	Pesticide	Dose	Nb qui	Nb	Moyenne	Minimum	Maximum
Tutta	Alcator	12	10	7	14	12,5	25
	Prokloin	30	6	0			
	Voliam targo	80	8	1	100	100	100
	Decis	100	7	0			
Mites	Agremec	25	83	53	47	30	125
White	Mospillan	30	76	40	63	35	130
Cut worms	Prokloin	30	24	3	50	40	60
Mildew	Ridomil	250	39	0			
Botrytis	Switch	60	21	2	64	63	65
	Signum	60	16	15	143	80	160
Oidium	Signum	60	11	5	110	100	125
	Topas	50	14	2	105	60	150

Number of overdoses per grower. Following statistics have been elaborated on the base of the 12 pesticides most commonly used (those with a percentage in the column "% of use"). We may rank spraying growers who are the vast majority (90%) according to the number of overdoses declared along the 12 couples (target-pesticides) above mentionned. Four groups of equivalent size may be distinguished: growers with total compliance (25%), growers with only one overdose (24%), growers with two overdoses (20%) and growers with more than two overdoses (21%).

Figure 11 : Distribution of growers per number of overdoses



Among the 122 growers with overdose, 72 only have overdose for pest, 5 only have overdose for disease and 45 have overdoses both for pest and disease.

Table 37 : Growers distribution according to the number of overdoses comparing pest and disease

over_pest	over_disease				Total
	0	1	2	3	
0	64	3	2	0	69
1	42	10	1	1	54
2	25	12	4	5	46
3	5	5	2	1	13
4	0	3	0	0	3
5	0	1	0	0	1
Total	136	34	9	7	186

Pest and Disease Monitoring Pratices

Questions about pest and disease monitoring are related to the following: i) who is doing monitoring ? ii) how frequently ? iii) who contributes to the treatment decision making process ? iv) what about spraying traceability (registering) ?

Person in charge of monitoring. Pest and disease monitoring is mostly done by the head farmer himself (71% of the growers) or the farmer and an employee (1%). Input suppliers (15%) or private consultants (2%) may help making the monitoring. In the remaining cases (11%), the head farmer delegates monitoring to an employee (8%) or to an outside person (3%).

Table 38 : 2Persons in charge of Pest/Disease Monitoring

Responsible in charge of monitoring	N	%
Farmer	133	71.5
Farmer and employee	2	1,0
Farmer, employee and input supplier	28	15.1
Farmer, employee and public or private consultant	4	2.1
Employee	14	7.6
External	5	2.7
Total	**186**	**100.0**

Monitoring frequency (Q60). A vast majority of growers (79%) declares doing high frequency monitoring, either every day (72%) or several times a week (7%). Only 21% have low frequency monitoring (once a week).

Factors of influence of the treatment decision making (Q79). Growers were asked to score on a 1-5 Likert scale (from never effective, to strong effective) the influence of each of the listed factors. Factors of influence or modalities of the decision making that have been listed and submitted to the grower were the following: preventive and automatic way, observations during the process of production, knowledge of pest history, economic criteria, advices of input supplier, of MARA farm tecnician, of private consultant, of cooperative, of certification body, of packing. Statistics have been elaborated by regrouping on the one hand 3+4+5 (moderate effective, rather effective and strong effective) and on the other hand 1+2 (never effective and low effective), qualifying the first set of "high influence" and the second set of "low influence". Another statistic is the average weight of each of these factors. Such a weight ranges between 1 (never effective) and 5 (strongly effective).

Table 39 : Factors influencing the treatment decision making

In a preventive and automatic way	60	22,3%
According to observations during the process of production	94	50,5%
According to my knowledge of pest and disease history	89	27,8%
According to economic criteria	34	18,3%
According to the advices of input suppliers	171	91,9%
According to the advices of the farm consultant in AgMin	77	41,4%
According to the advices of the cooperative.	25	13,4%
According to the advices of some private assistance	69	37,1%
According to the advices of the control and certification	5	2,7%
According to the advice of the packing technicians	_	0,0%

A Chi2 table has been made to identify proximities between the different factors of influence. To regroupings make sense:

- Field observations and knowledge of pest history are close to each other, meaning that a grower's decision is based on some expertise or experience of its own production. We qualify growers with high score for one of these two dimensions as "autonomous" and those with low score as "non autonomous".
- Advices from a MARA tecnician, a private consultant or a cooperative tecnician are close to each other as well and may be interpreted as assistance for decision. We label such influence on treatment decision as "public or private advice".

Four groups may be created based on these two criteria:

1. autonomous decision with influence of public or private consultant
2. non autonomous decision with influence of public or private consultant
3. autonomous decision with no influence of public or private consultant
4. non autonomous decision with no influence of public or private consultant

Table 40 : Growers distribution in the four groups of influence of the treatment decision making

		public/private consultancy		No public/private consultancy		total
		autonomous	non autonomous	autonomous	non autonomous	
A	N (%)	34	42	43	67	186
B	N (%)	50	36	54	46	186

A and B are two modalities of regrouping: B includes moderate effective in high influence, A does not

İnput suppliers is a major source of influence in the decision making process but it is little discriminating since 92% declare being influenced moderately or strongly. Of interest is the small group of growers (8%) who declared not taking into account suppliers' advices. We will see that this group features high level of ipm implementation.

Sources of weak influence are certification bodies and packing technicians. This is logical since growers already certified or in the process of certification are still a very thin minority. More surprising is the absent of influence of packing technicians. It is true that there is not yet much vertical integration in the tomato chain. Emerging integration in the export chain or in the supplying of modern retailers like Kipa should lead buyers to intervene in the treatment decision making process.

Preventive and automatic use. Only a minority of growers (39 growers) declares deciding treatments in a preventive and automatic way (score 4 or 5). Those growers are mostly of the type "autonomous", especially making their decision with no or little influence of public or private consultancy.

Table 41 : Preventive use of chemical control according to different modes of decision-making

Preventive use of chemical control	Mode of decision-making				All
	No external advice and non autonomous	No external advice and autonomous	External advice and non autonomous	External advice and autonomous	
0	47	16	56	28	147
1	3	19	3	14	39
All	50	35	59	42	186

Treatment recording (Q75-76). Only 24% of the growers do not make any recording. Most growers (76%) are now recording data on pesticide application in their farm. For most of them (48%), recording is still elementary with data limiting to date, name of the comercial product and dosis recommended. However, a significant proportion (28%) is completing with data such as active ingredient and/or delay before harvesting. It is noteworthy that 5 growers (3%) are using computer for recording.

Table 42 : Treatment recording among the farmers of the sample

	N	%
No recording	44	23.7
Simplified recording	90	48.4
Complete recording	47	25.2
Complete recording and computer	5	2.7
Total	**186**	**100.0**

Alternative control practices

We qualify as alternative control methods for pest management, practices that are usually labeled as IPM (Integrated Pest Management) and ICM (Integrated Crop Management). IPM practices include the use of resistant varieties, the use of traps (yellow sticky traps, blue traps, pheromons), the use of biological auxiliaries or natural enemies, hygienic precautions (equipment cleaning, wall spraying), equipment installation (curtains or insect nets, footbaths), mechanical methods (elimination of contaminated plants, weeding in and outside the greenhouse). ICM practices include practices that are oriented towards better agronomical conditions and only indirectly related to pest management. It is the case for instance of bombus bees for pollinization, crop rotation, climate conditions automatization, soil humidity control.

IPM practices (Q 56): Different levels of use may be discriminated. Practices that are generalized or almost generalized are the use of resistant varieties, yellow traps and insect nets (curtains) and the elimination of the first contaminated plants. Practices that have been adopted by a majority of growers but are not yet generalized (60 to 75% diffusion) are equipment cleaning, weeding and greenhouse walls washing and spraying. Practices with minor diffusion (less than one third of the growers) are the use of blue traps, pheromons and the use of footbaths at the entrance of the greenhouse. Practices that concern only an elite of growers are the use of biological auxiliaries.

Figure : Basic and elite safety risk management practices in Turkey

Photos by Murat Yercan

Heating System

Yellow sticky traps

insect nets

Bombus bees

Foot baths at the entrance of the greenhouse

Macrolophus (biological auxiliaries)

Table 43 : Score of Integrated Pest Management Practices

	1+2	3	4+5	% 4+5	% 3+4+5	Mean Score 1-5
Resistant varieties	5	5	176	95	97	4,66
Yellow sticky traps	22	8	156	84	88	4,30
Blue traps*	123		63	34	34	
Pheromons*	142	-	44	24	24	
Elimination of the first contaminated plants	25	15	146	78	87	4,18
Curtain for doors	25	13	148	80	87	4,15
Weeding in and outside the greenhouse	44	17	125	67	76	3,68
Harvest and cropping equipment cleaning	47	15	124	67	75	3,63
Greenhouse walls washing and spraying with insecticide	75	22	89	48	60	3,02
Existence of footbaths at each entrance of the greenhouse	154	-	32	17	17	1,77
Use of biological auxiliaries	179	-	7	4	4	1,15

1) Never 2)Seldom 3)Sometimes 4) Mostly 5) All the time

** : questions about blue traps and pheromons were asked in a binary mode (yes or no)*

Practices in line with pest pressure (see Q1). Main practices in line with pest pressure are weeding, elimination of the first contaminated plants and insect nets (following the tuta emergence in 2010, many growers have instaled insect net in the following season). Other practices like walls washing, equipment cleaning are more of the precaution style, to prevent from any infection, and should exist even though there is no pest pressure. **Traps and biological auxiliaries** are also in line with pest pressure and must be characterized by main pest target. While yellow traps are mostly used for white flies and blue traps for thrips, pheromons (and delta and blue ligth traps that are just emerging) aim at capturing Tuta. The use of biological auxiliaries is contrasted as well. While Eretmocerus (used by five growers) only aim at controlling white flies, Nesidicoris Tenuis (used by six growers) are polyvalent and help for controlling tuta, white flies, mites, etc. Most of the seven growers using biological auxiliaries are using both.

ICM practices. A vast majority of growers use bombus bees (179) and monitor water in soil to avoid water in excess (167). By contrast, only a minority of growers have automatic climatic conditions in their greenhouse. Rotation which is important in terms of agronomic conditions, as long as soiless culture is not introduced, is not a common practice (only 64 growers).

Table44 : Score of Integrated Crop Management practices

1) Never 2)Seldom 3)Sometimes 4) Mostly 5) All the time	1+2	3	4+5
Bombus bees	7	4	175
Water in excess control in soil	19	14	153
Rotation	122	17	47
Automat climatic conditions	178	1	7

1.E. GROWER SURVEY ANALYSİS OF IPM ADOPTİON

Alternative control and monitoring practices

Alternative control practices : variable definition

A **classical variable** to measure the level of ipm is the number of relevant practices adopted by the grower, each practice being affected by the same weight (1 if present, 0 if absent). Such a dichtoomy may be established in two different ways for practice measured on the 1-5 Likert scale : presence if 4+5 (modality A) or presence if 3+4+5 (modality B). We label this number "score IPM". For a given grower, the score may vary between 0 and 11 in the context of our survey with the eleven IPM variables identified through questionnary (Q56 and 62).

We propose to build a **typology of IPM adoption** with three levels of adoption: high, intermediate, low. First we identify discriminant practices by calculating the average IPM score of the group having or not having adopted such practices. By comparing such a score with the average IPM score of our sample (5,97 for modality A), we then differentiate two types of discriminant practices: "positive" practices when the average score of the group of adoption is one point higher than the average score of our sample and "negative" practices when the average score of the group of non adoption is one point (or one point and a half) lower than the average score of our sample.

Table 45 : IPM scores and differences from the average IPM score of the sample

1) Never 2)Seldom 3)Sometimes 4) Mostly 5) All the time	1+2+3	Score differ	4+5	Score differ	1+2	Score differ	3+4 +5	Score differ
Rezistant varieties	10	-0,37	176	0,01	5	-1,27	181	0,07
Yellow sticky traps	30	-1,74	156	0,33	22	-2,24	164	0,3
Blue traps	123	-0,44	63	0,86	12	-0,44	63	0,86
Pheromons	142	-0,34	**44**	**1,1**	14	-0,34	**44**	**1,1**
Elimination of the first contaminated plants	40	-1,97	146	0,54	25	-2,17	161	0,33
Curtain for doors	38	-1,71	148	0,44	25	-1,65	161	0,25
Weeding in and outside the greenhouse	61	-1,23	125	0,6	44	-1,22	142	0,38
Harvest and cropping equipment cleaning	62	-1,42	124	0,71	47	-1,54	139	0,52
Greenhouse walls washing and spraying	97	-0,83	89	0,9	75	-0,94	111	0,63
Existence of footbaths at each entrance	154	-0,3	**32**	**1,13**	14	-0,33	**39**	**1,13**
Use of biological auxiliaries	179	-0,11	**7**	**2,74**	17	-0,11	**7**	**2,74**

Positive practices are pheromons, footbaths and biological auxiliaries while negative practices are in the **first selection** (modality A, difference of one point and a half), yellow traps, elimination of contaminated plants and curtains for doors and in the **second selection** (modality B, difference of one point), in addition to the three previous practices, resistant varieties, weeding and equipment cleaning.

In selection S1, we define three levels of adoption as following:

- high level includes growers with at least one positive practice and no negative practice
- low level includes growers with no positive practice and at least one negative practice (means non adoption of such negative practice)

- intermediate level includes the rest of the sample, that is growers with at least one positive practice and at least one negative practice (group 2) and growers with no positive practice and no negative practice (group 3).

Table 46 : Levels of adoption in selection S1

Groupes Ipm Sélection 1	N	score11 (4+5)			
		Mean	Std	Min	Max
1 (high)	40	7,9	1,3	6	11
2	26	5,5	1,4	2	8
3	70	6,2	1,0	4	8
4 (low)	50	4,2	1,6	1	6
All	186	6.0	1.8	1	11

In selection S2, we define three levels of adoption as following:

- high level includes growers with at least one positive practice and no more than one negative practice
- low level includes growers with no positive practice and at least two negative practices
- intermediate level include the rest of the growers.

Table 47 : Levels of adoption in selection S2

Groupes Ipm Sélection 2	N	score11 (4+5)			
		Mean	Std	Min	Max
1 (high)	43	7,9	1,2	6	11
2	23	5,5	1,3	2	7
3	75	6,3	0,9	5	8
4 (low)	45	3,9	1,5	1	6
All	186	6.0	1.8	1	11

In tables 46 and 47, we can see from the mean scores and standard deviations of the three levels of adoption (high, intermediate 2+3 and low) that our typology is relevant. Moreover, we can see that there is not much difference in the sharing of the groups between S1 and S2: only a shift of three growers with high level of IPM adoption (from 40 to 43) and a shift of five growers with low level of IPM adoption (from 50 to 45), similar score statistics betwee the corresponding groups of the two selections. As a result, we will carry on our typology analysis by only using the first selection (S1).

In conclusion, we will use as IPM variables, the IPM score (classical variable) and the level of IPM as defined by our typology (alternative variable).

Monitoring practices : variable definition.

Monitoring practices that have been described previously are farm head involvement in pest monitoring, monitoring frequency, pesticide application recording and modality of decision making (degree of autonomy and dependence from external advice in the decision of pesticide application). The first practice has been put aside since 90% of the growers of our sample are involved in pest monitoring. Correlations between the other three practices have been tested with a Chi2 test. Chi 2 tests show that there is no strong correlation between monitoring variables (see annexe). As a result, the three monitoring variables (monitoring frequency, pesticide application recording and modality of treatment decision making) may be considered as independent and will be further implemented in the analysis of the influence of structure variables on behavior (IPM and monitoring).

IPM (alternative control and monitoring) practices : variable definition.
Chi 2 tests have been performed between the three levels of ipm adoption and the three variables of monitoring practices. No correlation has been found (see annexe). Accordingly, we will use both IPM and monitoring practices in our analyis of the structural determinants of IPM/monitoring practices adoption.

Determinants of IPM adoption

As a first analysis of the determinants of IPM adoption, for all groups of growers with specific behavior as regards to alternative control (three groups defined by the level of IPM-low, intermediate, high) or to monitoring practices (three groups defined by the mode of treatment recording, three groups defined by the monitoring frequency and four groups defined by the mode of decision for pesticide application), we have elaborated statistics about average characteristics of growers (age, education, experience, off-farm activity, other labor, coop membership, pest and disease pressure perception) and average characteristics of corresponding farming systems (farm, greenhouse, tomato production and marketing, third party control). By comparing characteristics across groups, it is possible to make hypothesis about what makes a difference between groups of IPM or groups of monitoring practices. Hereafter, we present what looks like as relevant characteristics of these groups of growers. Findings will have to be consolidated through an econometric analysis.

Groups of **IPM practices** are three: group high, group intermediate and group low.

- **Group "high"** regroups growers with higher education, rather young with lower farming experience, more independent (less cooperative membership), managing large scale farms and greenhouses (respectively 3,7 ha and 1,0 ha on average), resulting in high incomes (four times larger than the other two groups). Growers of this group are much involved in the management of the farm (lower percentage of off-fam activity), use relatively modern technology (higher percentage of single long period production, higher proportion of cluster/cocktail tomatoes, higher proportion of soilless culture), are less threatened by pest and disease pressure, obtain higher yields and start to diversify their marketing by selling to buyers requiring farm auditing and some residue control, by selling directly without passing through City Hall or by obtaining cash payment.
- **Group "low"** features growers with smaller greenhouse size (less than 0,5 ha on average), higher proportion of plastic greenhouse, more crop diversification, less intensive tomato cropping system (higher proportion of double production), higher proportion of off-farm activity, resulting in lower tomato yield and smaller farm income. While tomato marketing is traditional (selling to brokers in City Hall), they have still a high proportion of growers with no grading on the farm.
- **Group "intermediate"** has characteristics that are mostly intermediate between those of group high and those of group low. This is the case In particular of greenhouse area, tomato specialisation, level of intensification (measured by the percentage of single long period production), tomato yield, percentage of grading and total income.

Table 48 : Groups of IPM practices

	Level of IPM	High	Intermediate	Low
Farmer	Young Age	+		
	Education	+		
	Experience	-		
	Coop member	-		
Size/Capital	Farm size	+		
	Greenhouse size	+		-
	% of glass	+		-
Productivity	Off farm activity	-		+
	Specialisation	+		-
	Technology	+		-
Risk adverse	Pest perception	-		-
Marketing	better valuing	+		-
Performance	Yield	+		-
	Income	+		-

Groups of **treatment recording**. They are quite similar to those of IPM level. The group of "full recording" has characteristics similar to the group of high IPM level while the group of "no recording" has characteristics similar to the group of low IPM level. Such proximity is not surprising as long as those three groups of recording significantly differ by the score of IPM. IPM scores for groups "full recording", "simple recording" and "no recording" are respectively 6.7, 6.0 and 5.1 while those scores for groups high, intermediate and low level of IPM are 7.9, 6.0 and 4.2 (in the case of selection 1). However there are some differences, in particular concerning the group "full recording" which differs from the group high IPM by the following: growers are younger, yields are not higher than those of group "simple recording", cash payment is less frequent and prices obtained are lower.

Groups of **monitoring frequency**. Monitoring frequencies that had been distinguished are "once a week or more", "two to four times a week" and "every day". Nothing very interesting shows up when comparing the characteristics of the three groups. The intermediate group "monitoring two to four times a week" sometimes differs from the two others but the two others have most of the time similar characteristics. No conclusion can thus be drawn from this type of monitoring practice.

Groups of **treatment decision making**. Four groups have been derived from our analysis of the factors influencing the pesticide application decision making process: with or without the support of external advice (not including input suppliers who are most of the time influencing) and with or without autonomy, growers being qualified of "autonomous" when deciding pesticide application when the decision is based on field observations and/or knowledge of the history of pest management in the farm. Unlike groups of recording there is no clear correlation between IPM score and decision making behavior (respectively 6.2, 6.4, 5.4 and 5.8). Group specific characteristics are the following:

- Group **"external advice + autonomy"** differentiates from the other three groups by younger growers, less off-farm activity, largest farm and greenhouse area (respectively 3,3 has and 0,8 ha), higher tomato system intensification (percentage of single long period calendar), higher awareness of disease pressure and more original marketing (higher percentage of non standard tomato, higher percentage of non traditional channel) . **Together with the group "no external advice + autonomy"**, it shares similar characteristics of higher total income (two or three times higher than

groups with no autonomy) and higher yields, providing us with the hypothesis of a higher performance in terms of income and yield for growers having autonomy.

- Group **"no external advice + autonomy"** regroups growers rather young (not so younger than the previous ones but still), with higher education, high proportion of off-farm activity, less intensive tomato systems (lower single long period production, lower proportion of heating systems) but more specialized on greenhouse activity, less threatened by pest pressure and more willing to value the product by grading on the farm. **Together with the group "no external advice + no autonomy"**, they share the lowest farm size.
- Group **"no external advice + no autonomy"** features beside the lowest farm size, the lowest greenhouse size and the highest proportion of plastic greenhouse (signal of a lack of capital), the lowest yields, the less marketing diversification (lowest percentage of non standard tomato, lower proportion of buyer auditing) and the lowest total income.
- Group **"external advice + no autonomy"** regroups growers with lower experience, higher cooperative membership, and intermediate characteristics of structure and performance (farm and greenhouse size, yield, total income).

Table 49 : Distribution of the growers of the sample in four groups of influence of the treatment decision-making

		external advice		no external advice	
		autonomous	non autonomous	autonomous	non autonomous
Farmer	Young Age	+		+	
	Education			+	
	Experience		-		
	Coop member		+		
Size/Capital	Farm size	+		-	-
	Greenhouse size	+			-
	% of glass				-
Productivity	Off farm activity	-		+	
	Specialisation			+	
	Technology	+		-	
Risk adverse	Pest perception	+		-	
Marketing	better valuing	+			-
Performance	Yield	+		+	-
	Income	+		+	-

Table 50 : Distribution of the growers of the sample according to IPM types and treatment recording

		Score IPM 11	IPM Type			Treatment recording		
			Low	Med	High	No	Simple	Full
	N / Mean		50	96	40	44	90	47
Farmer characteristics								
• age	42,5		42,5	43,0	41.0	43.3	44.6	38.0
• Education (% high	25		20,0	17,7	47,5	15,9	21,1	42,5
• Experience (% less than 15	37		30,0	35,4	47,5	29,5	32,2	55,3
• Off-farm activity (%)	24,7	5,67	33	20	23	23	32	14
• amount_labor	5,4		4.4	4.6	9.3	5,0	4.6	7.3
• Coop membership (%)	46,8	5,82	53	50	29	50	54	31
Farm characteristics								
• total area (da)	24,3		18.2	14.8	54.6	19.4	19.3	36.9
• greenhouse area (da)	7,1		4.8	6.3	13.0	6.3	5.6	10.4
• spe tomato (% area greenhous	88		84	88	94	87	87	91
• spe greenhouse (%area total)	54		48	59	50	55	55	53
• income_pdt_ttl (k€)	103		47	59	315	61	53	226
• tomato income/total inc(%)	79		73	80	83	76	81	78
• sharecropping (% total area)	5		2	7	3	7	2	6
• land renting (% total area)	7,3		7	6	12	2	7	11
Greenhouse characteristics								
• plastic greenhouse area (%	55		64	49	54	66	52	50
• Heating system (%)	93	5,98	91	93	94	93	90	96
• roof_sprinkler (%)	13	7,12	5	14	26	11	10	21
• Soiless (%)	3	8,60	0	0	14	0	0	10
Tomato production								
• tomato variety (% loose)	90		94	93	80	89	98	79
• intensification (% double)	27	5,4	40	26	12	43	23	19
• tomato yield (loose, kg/m2)	11,3		10,3	10,9	11,9	9,8	11,3	11,4
Tomato marketing								
• Sorting by the grower (%)	81	6,12	72	82	91	84	76	87
• City Hall (% total first T)			92	97	90	98	96	89
• payment (% cash)	27	6,00	26	23	43	27	29	25
• Price (loose tomato)	0,39		0,39	0,39	0,39	0,41	0,40	0,33
Natural conditions								
• disease pressure perception	2,44		2.45	2.63	1.91	2.48	2.72	1.92
• pest pressure perception	2,67		2.52	2.99	2.06	2.80	2.81	2.31
Third party control								
• audit_externe %	17	7,09	5	15	43	7	9	40
• plan_control_residus %	9	7,12	9	3	26	2	10	14

Table 51 : Distribution of the growers of the sample according to monitoring frequency and treatment decision-making

		Monitoring frequency			Making treatment decision			
		everyday	2-4 a week	once a week	No external advice		External advice	
					No autonom	Autonomy	No autonomy	Autonomy
	N / Mean	134	13	39	50	35	42	28
Farmer characteristics								
• age	42,5	43.2	42.2	40.2	44.2	41.8	43.4	39.6
• Education (% high	25	22	8	39	26	29	22	24
• Experience % less than 15	37	35	31	44	44	40	27	38
• Off-farm activity (%)	24,7	21	39	33	26	37	25	12
• amount_labor	5,4	5.2	5.9	6.0	4.4	5.7	5.6	6.2
• Coop membership (%)	46,8	49	46	41	42	49	53	43
Farm characteristics								
• total area (da)	24,3	23.0	38,4	23.8	18.7	17.1	27.2	32.6
• greenhouse area (da)	7,1	7.1	6.9	7.1	5.2	7.2	7.9	8.2
• spe tomato (% area greenhous	88	86	100	91	88	90	88	87
• spe greenhouse (%area total)	54	57	35	53	55	62	52	49
• income_pdt_ttl (k€)	103	108	67	101	43	151	92	151
• tomato income/total inc(%)	79	76	90	85	81	80	76	79
• sharecropping (% total area)	5	5	7	4	4	9	1	7
• land renting (% total area)	7,3	8	11	5	6	10	7	7
Greenhouse characteristics								
• plastic greenhouse area (%)	55	51	62	67	64	51	59	40
• Heating system (%)	93	91	100	95	96	86	95	91
• roof_sprinkler (%)	13	16	0	10	12	11	20	7
• Soiless (%)	3	2	0	5	0	3	2	7
Tomato production								
• tomato variety (% loose)	90	90	92	89	96	91	91	81
• intensification (% double)	27	28	15	26	26	34	29	19
• tomato yield (loose, kg/m2)	11,3	10.8	10,5	11,7	10,0	11,7	10,9	11,7
Tomato marketing								
• Sorting by the grower (%)	81	80	62	90	76	89	81	79
• City Hall (% total marketing)		93	92	100	96	97	95	88
• payment cash (%)	27	19	39	51	32	29	25	24
• Price (loose tomato, €/kg)	0,39	0,37	0,39	0,43	0,39	0,37	0,40	0,37
Natural conditions								
• disease pressure perception	2,44	2.40	2.69	2.51	2.40	2.37	2.36	2.67
• pest pressure perception	2,67	2.75	2.23	2.54	2.70	2.29	2.75	2.83
Third party control								
• audit_externe (%)	17	16	15	21	6	23	20	21
• plan_control_residus (%)	9	7	15	15	6	17	9	7

2. SAFETY RISK MANAGEMENT IN MOROCCO

2.A. MOTIVATIONS: SCOPES AND AIMS OF THE STUDY

This part of the report expands on safety control issues in the Moroccan tomato chain at the export and domestic market level. A general picture will be given based on interviews and secondary data. We will then focus on growers' adoption of integrated pest management and GAP certificates (GlobalGAP, TESCO's Nurture, Organic farming) and their determinants. To that purpose, a survey has been conducted in the main districts of the region Souss-Massa-Drâa (Agadir), which is the lead region of production of greenhouse tomato in Morocco.

Tomato to be consumed in fresh has been selected as the reference crop for the case study. Four main arguments justify such a choice. Tomato is one of the main crops in the Moroccan FFV industry (25% of vegetable production), the share of exports is significant (36% of early production is exported, mainly to UE), tomato has been concerned by the development of pesticide safety risk management and tomato has characteristics and stakes that allow for comparison with Turkey, the other country under survey in task 5.4.

Our survey of 86 growers in the Souss-Massa region aims at giving a precise and clear picture of the level of development of the conventional and alternative practices of pest and disease management in Morocco. Face to face interviews based on a closed questionnaire with farm owners and managers have been realised during 2011. Growers have been asked about their structural characteristics and their behaviour as regards to pest management: pest and disease monitoring, pesticide application decision making, recording, chemical control and alternative methods like preventive practices and biological control.

This part of the report is organized as follows. In a first section, we give some information on the fresh tomato industry in Morocco (production, marketing, distribution and consumption) and on pesticide safety regulations (organisations and laws, traceability, good agricultural practices) with a focus on public/private control both at the export and domestic level. In sections two and three, we present the methodology and the findings of our face-to-face survey in the Souss-Massa region. In section two, we describe the sample with some statistics on farmers, farms, greenhouses, tomato production and marketing, cooperative membership and vertical relationships. We then identify the various forms of safety risk management by focusing on pest pressure as perceived by farmers, information and monitoring practices, chemical control practices, alternative control practices and third party control. In section three, we propose indicators of integrated and chemical pest management in order to establish a typology of practices. We then identify some structural factors influencing the adoption of IPM and GAP certificates.

2.B. FRESH MARKET-ORIENTED TOMATO INDUSTRY

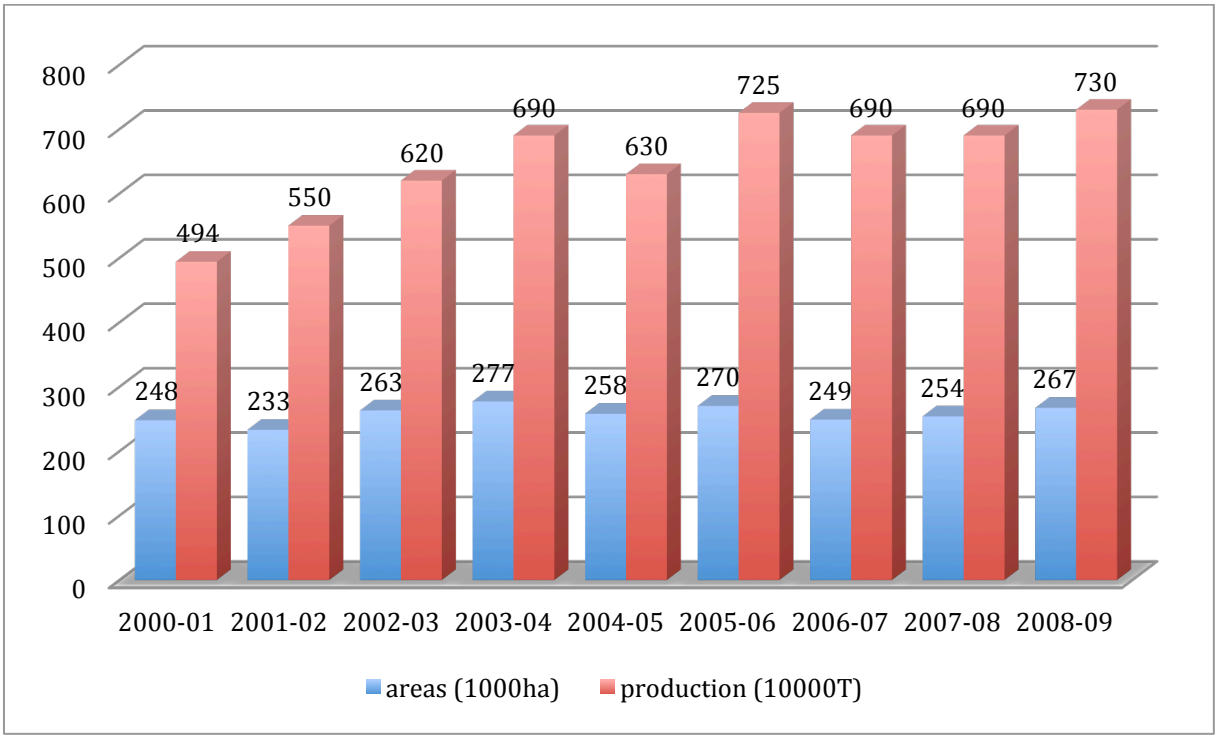
Tomato production in Morocco

The agricultural sector is one of the main pillars of the Moroccan economy, with a contribution to GDP of about 20%. The sector employs 45% of the working population and represents 17% of the global Moroccan exports (Crédit Agricole du Maroc, 2009 Statistics[13]). In rural areas, about three quarters of the working population derive their income from farming (Ministère de l'Agriculture, 2011[14]).

Horticultural production.

The horticultural sector occupies 16% of the country Utilised Agricultural Area (UAA), with a surface of about 1,300,000 ha, among which 1,060,000 ha of fruit groves and 260,000 ha of vegetables. The global average production is of about 10 million tons, among which 3 millions tons of fruits and more than 7 millions tons of vegetables (Crédit Agricole du Maroc, 2009 Statistics[15]). In 2008-09, the global surfaces dedicated to vegetables reaches 267,000 ha (+7.5 % between 2001 and 2009), corresponding to a production of about 7.3 million tons (+48% between 2001 and 2009). Half of this production is concentrated on three productions: potatoes (22%), tomatoes (17 %) and onions (11 %).

Figure 1. Evolution of fruits and vegetables area and production.

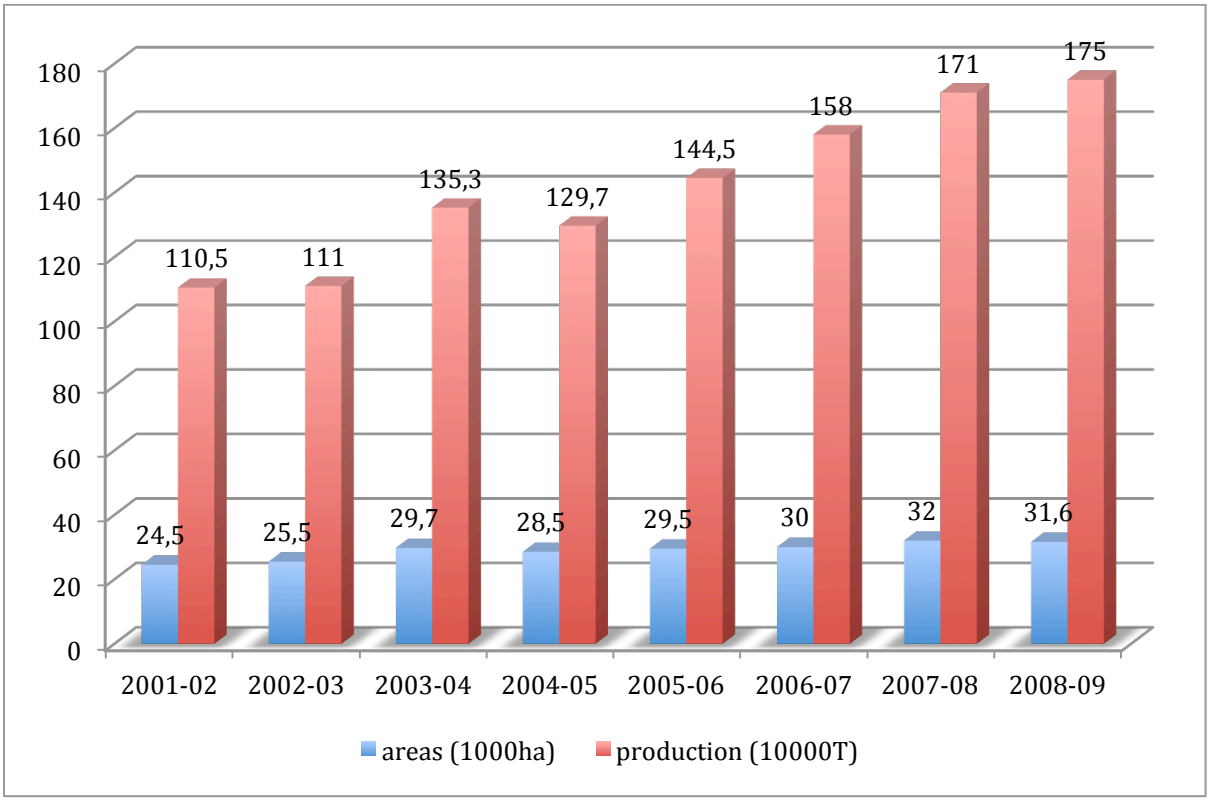


Source: Conseil Général du Développement Agricole (2011).

[13] http://www.fellah-trade.com/fr/info-filiere/chiffres-cles-maroc/introduction
[14] http://www.agriculture.gov.ma/sites/default/files/MA-AGRI%20EN%20CHIFFRES-VF.pdf
[15] http://www.fellah-trade.com/fr/info-filiere/chiffres-cles-maroc/introduction

Within vegetables, early crops knew the strongest growth since 2001, to reach 31,600 ha during the 2008-2009 campaign (+29% over the period).

Figure 2. Evolution of early vegetables area and production.



Source: Conseil Général du Développement Agricole (2011).

Tomato production.

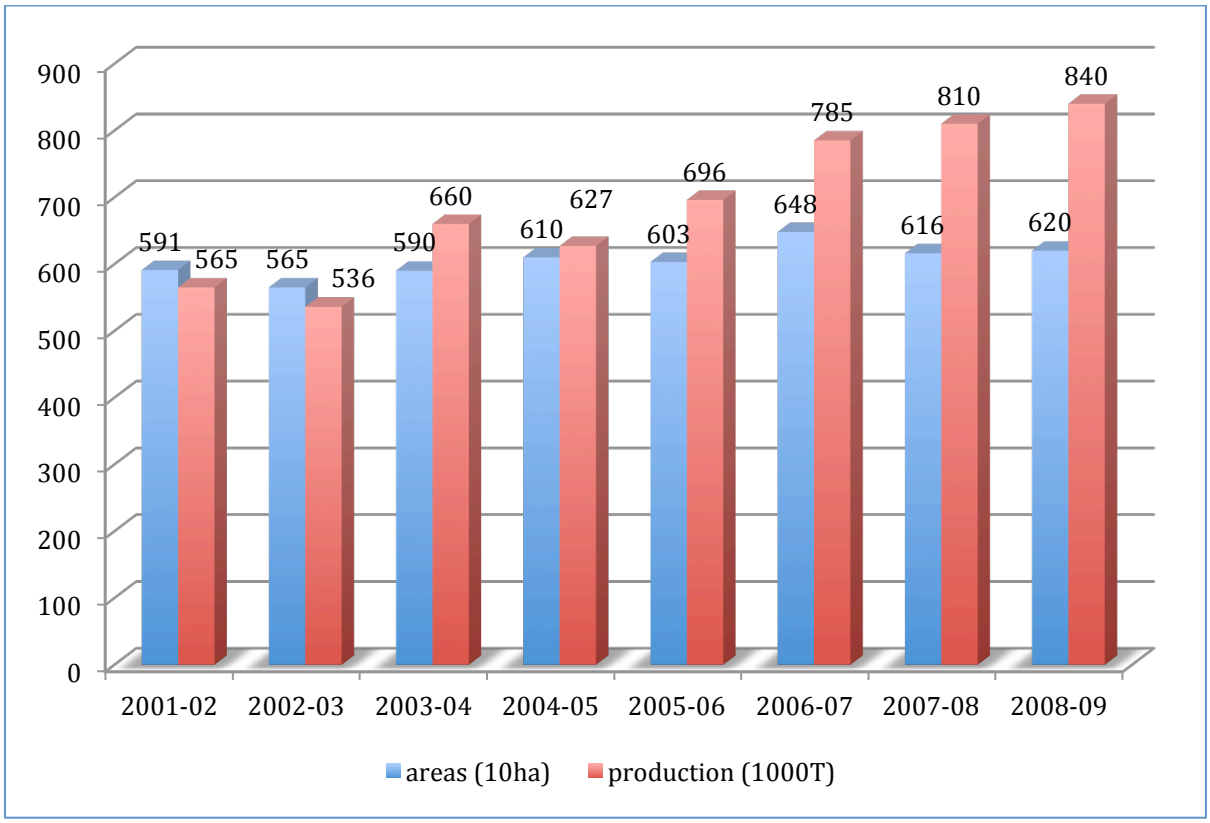
Tomato is one of the three most cultivated vegetables in Morocco, along with potatoes and onions. It occupies a farming area of about 20,000 ha (2003-2007 average). With an average production of 1.25 millions tons between 2005 and 2010, it represents 25% of the total fresh vegetables production. On a national base, tomato production increased nearly 1.5 times between 1996 and 2010, from 0.88 millions tons to 1.28 millions tons (FAOSTAT). This growth is due, for the main part, to the very strong growth of the production of early tomato, which grew from 560,000 tons in 2001 to about 850,000 tons in 2009, whereas the UAA under production little increased, from 5,900 to 6,200 ha (a 5% increase, against about 50% for tonnage).

Greenhouse and tomato localisation.

Fresh produce localisation.

As many Mediterranean countries, Morocco produces a large variety of fruits and vegetables. These productions are distributed through all the regions, but are more particularly concentrated on the coastal zones and the Atlas foothills. However, one region is widely dominant: the Souss-Massa (Agadir) (See map 1). This preeminent situation results at first from the strong development of the protected crop production since the 1970s.

Figure 3. Evolution of tomato area and production.



Source: Conseil Général du Développement Agricole (2011).

Tomato production localisation.

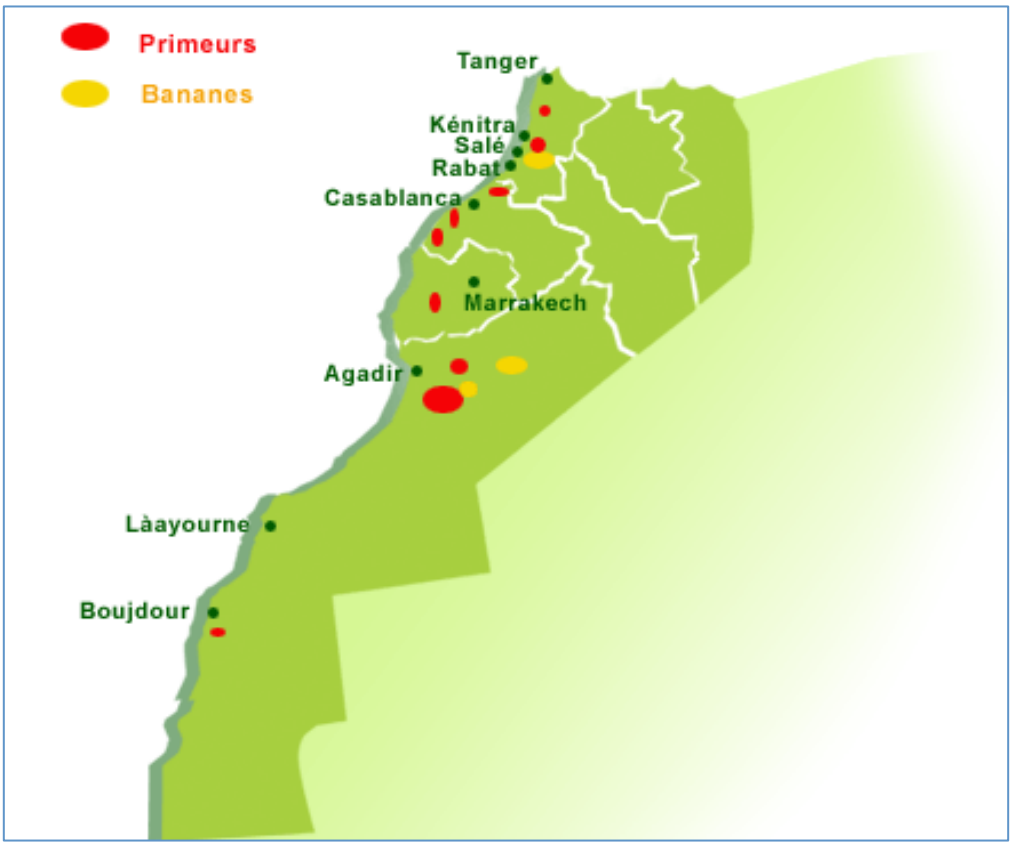
Summer tomato is produced everywhere cultivated over the Moroccan countryside. However, the most intensive crops, which are widely dominant, are much localised: early tomato is produced essentially along the coast and, massively, in the region of Souss-Massa (60%); industrial tomato is rather cultivated in the regions of Gharb (Kénitra, 15%) and Loukos (Larache, 15%). The rest (approximately 10 %) is produced in the regions of Doukkala-Abda and Haouz, in the South of Casablanca, as well as in Sahara.

Greenhouse vegetable localisation.

Protected vegetables farming cover approximately 16,500 ha (against 250 ha in 1980), distributed essentially along the coastal zones. The region of Souss-Massa concentrates about 75%. The crops are diverse (banana, strawberry, eggplant, cucumber), but the dominant product remains tomato, with approximately 4,000 ha (El Fadl and Chtaina, 2010); strawberry follows (2,400 ha), then French bean (2,300 ha), melon (1,300 ha) and zucchini (1,100 ha). In terms of production, tomato represents about 60% of the whole tonnage, followed by strawberry (10%), French bean (8%), pepper (7%) and melon (4%).

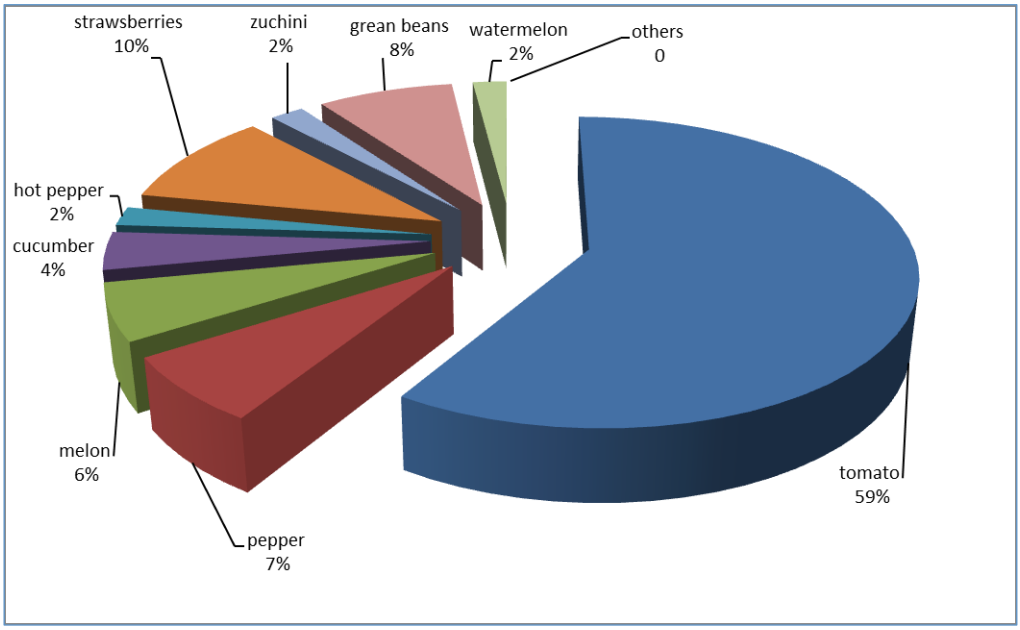
The increase of tomato areas under plastic cover has been continuous, following the contingent restrictions imposed in the agreement of Associations Morocco- European Union: from 5,500 ha in 1995/96 to 15,150 ha in 2005/06 (Choukr-Allah, 2007).

Map 1. Moroccan fresh produce localisation.



Source: APEFEL[16].

Figure 4. Production percentages of several crops grown under plastic cover (2005/2006).



Source: Choukr-Allah (2007).

[16] http://www.apefel.com/apefel-secteur-fruits-legumes-regions-production.html

The leadership of Agadir.

Agriculture is the main economic activity of the region of Souss-Massa and it is characterised by a high diversity of crops: cereals, vegetables, fruits, particularly citrus fruits. Some significant figures illustrate this importance (Europalliance Consulting, 2010). At the national level, Souss-Massa is the first producing region for citrus fruits and vegetables. It is also the first region in production of bananas under greenhouses. It represents:

- 32% of the national agricultural added value.
- 44% of Morocco agricultural export value.
- In vegetables, 21% of country production and 80% of exports.
- In citrus fruits, 48% of country production and 62 % of exports.

The trend of evolution in surfaces dedicated to vegetables in Souss-Massa shows a constant progress, owed partially to the massive arrival of foreign investors, in particular Spanish and French. And so, the dedicated area grew from around 15,000 ha in 2001 to more than 24,000 ha in 2007 (El Fadl and Chtaina, 2010). In this evolution, the protected early crops represent approximately 1.75 times the area of seasonal production. The increase observed in the early production area is due, there still largely, to the crops under plastic cover or greenhouses, which cover more than 9,000 ha in 2007 (Cerezo-Monje et al., 2011).

Around 30% of tomato producers are small-scale farmers who cultivate less than 5 ha. Their production area represents only about 10-15% of the total production area for early tomatoes. The majority of the producers cultivate an area between 5 and 20 ha. Farms belonging to this group cultivate around 50% of the total tomato area. Only 10-15% of the farms are larger than 20 ha, but they represent around 40% of the early tomato area (Chemnitz and Grethe, 2005).

Table 1. Evolution of area and production in the Souss-Massa-Drâa region.

	2007-08		**2008-09**		**2009-10**	
	Area (ha)	Prod. (T)	Area (ha)	Prod. (T)	Area (ha)	Prod. (T)
Early production	15,615	1,227,433	13,750	1,170,601	15,300	1,095,375
Incl. greenhouses	9,335	1,052,970	8,339	1,016,401	8,622	928,783
Incl. tomato	4,411	683,448	4,299	709,331	4,768	639,671
Incl. field crop	6,280	174,463	5,411	154,200	6,678	166,592
Incl. tomato	180	9,846	231	12,620	151	4,515
Seasonal production (no tomato)	8,749	297,485	7,945	254,416	8,728	308,280
Total vegetables	24,364	1,524,918	21,695	1,425,017	24,028	1,403,665

Source: Office de Mise en valeur du Souss-Massa, from Cerezo-Monje et al. (2011).

Greenhouse technology.

Greenhouse production in Morocco appeared in the end of 1960s with the first experimental trials on tomato and pepper in the region of Agadir. The 1976 Morocco-EEC agreement, while introducing a limited window (in November-April) for the export of tomatoes on the EEC market, constrained the Moroccan producers to adapt to these requirements, in particular by developing early crop production. The presence of greenhouses became significant from the beginning of 1980s. 500 ha are reached in 1982 (Bekkaoui, 1993).

Greenhouse types and characteristics.

The basic greenhouse used for vegetable crops is a structure of 3 to 3.4 m high, 9 m wide and 56 m long, covering about 500 m2. This hemi-cylindrical "Quonset" type, with structural elements in aluminium, is well adapted to small farmers. One variant (Delta 9) has 2 lengthwise sheets of plastic covering the house with a central overlap for ventilation. The other (Sucodam) has hemispheric overlapping plastic strips with ventilation achieved by separating the strips. The remainder is made of Eucalyptus wood or galvanised steel (Canary Island types). This cheaper method is increasing in popularity particularly in the Souss-Massa valley where it represents 53.7 % of vegetable crop greenhouses according to Choukr-Allah (2007). The big advantage of this type of greenhouse, whose height achieves 5 m, lies in the importance of their volume, what allows to reduce the thermal variations, and thus to have a more favourable night-temperature. Some producers also turned to shelters-greenhouses with more sophisticated metallic structure (6 m height). This type of greenhouses allows yields which can go to 250 tons per ha.

Crop management.

Only some small producers still use non-grafted tomato, for a production intended essentially for the local market. Others are sourcing from nurseries specialised in transplanted plantations. In terms of water management, drip irrigation is today generalised in all the farms. Concerning phytosanitary treatments, greenhouse producers are abandoning mobile atomizers, replaced by fixed installations. Treatments are activated from the head-station and conveyed via a permanent piping inside tunnels/greenhouses equipped with mobile lances (Guennouni, 2010). Conversely, soilless cultivation is little developed, on a few hundreds of ha and for certain high-end products, as very specific tomatoes.

IPM practices.

Altogether, integrated pest management is well endorsed by Moroccan producers, in particular because of the very strong orientation towards the European market. However, in their study on tomato production in Morocco, El Fadl and Chtaina (2010) point several limits in the development of IPM:

- An insufficient farmers' academic level, for pests and diseases scouting, risk monitoring and chemical treatment decision, the respect of intervention thresholds, as well as the choice of pesticides and their preparation.
- A lack of specialised agricultural advisers, who can follow-up the evolution of the diseases and the dynamics of pests in farms, allowing the implementation of a regional warning system.
- A limited producers' budget for the purchase of traps and other tools used in IPM.
- Little supervision of farmers in pests' knowledge.

Markets for Moroccan tomatoes

Tomato local marketing.

The Fresh Fruit and Vegetables (FFV) are constituents of the Mediterranean diet. In Morocco, they are the object of an important consumption, which reach on average 50 kg of fruits and 90 kg vegetables per capita and per year. Even if some other Mediterranean countries are larger consumers (like Turkey with 100 kg of fruits and 230 kg of vegetables), in comparison with countries from Latin America and Asia, the Moroccan consumption of FFV can be considered as a very high average, especially for developing countries.

In 2009, if we do not take into account industrial tomato, Moroccan tomato production reached 1.1 MT. On this volume, approximately 28% were exported and 72% were consumed on local consumption markets.

The local market supplying is ensured trough three different ways:

1. During the autumn/winter period, the domestic market supply is primarily based on production dedicated to export. This off-season production corresponds to the amount of products dedicated to export and which do not comply with the requirements of export markets, or which exceed their demand.
2. From May to September, the local market is supplied by seasonal tomato production mainly cultivated on open fields. It comes from various areas of Morocco, primarily from traditional zones where tomato is cultivated (Souss-Massa, Loukos, etc.).
3. Lastly, a share of industrial tomato is also consumed on fresh tomato market.

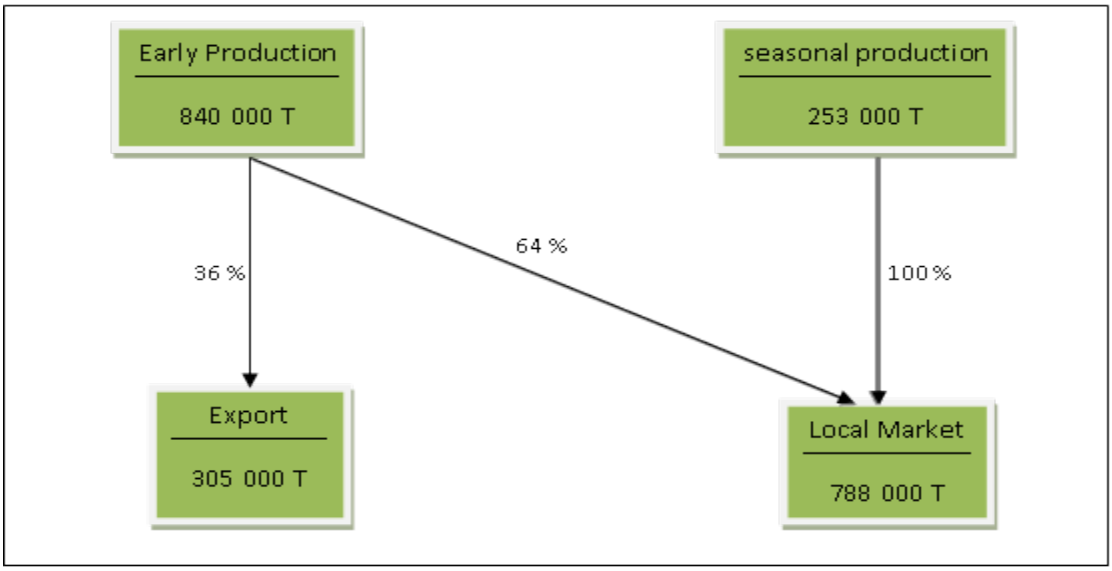
The retail trade.

Three types of actors take place in distributional channels of the FFV: supermarkets, traditional trade and the wholesale marketing.

Until now, the retail trade of FFV is mainly realised through the intermediary of small shopkeepers installed in stores or in "souks" and the Moroccan commercial structure still remains largely traditional since the country counts less than 400 stores whose surface exceeds 300 m2 and 48 hypermarkets (surface upper than 2 500 m2), including 8 Cash and Carry (Gain report, 2011)[17].Supermarkets are globally concentrated in the zone of Casablanca-Rabat, which benefits from modern infrastructures and a purchasing power higher on average than the remainder of the country. However, since 2003, we observe a development of modern stores in cities considered as less important (Kenitra, Khourigba) or with a more limited purchasing power (Agadir, Fes, Meknes, Tangier, Tetouan).

[17] http://gain.fas.usda.gov/Recent%20GAIN%20Publications/Retail%20Foods_Rabat_Morocco_12-21-2011.pdf

Figure 5. The markets of fresh consumption tomato in 2009.



Source: Authors' work based on Conseil Général du Développement Agricole (2011).

The traditional retail.

The traditional retail sector is still strongly anchored in Moroccan habits that have, quasi daily, to carry out their food purchases from the merchants installed in both souks and markets. Thus, the traditional trade continues to play an important role thanks to its proximity and usefulness either in the large cities or in the rural areas where 45% of the population is still living. Two main characteristics contribute to this situation. At first the fact that, as for Turkey, the Moroccan consumer remains guided firstly by price, what does not favour the large-scale food retailing in its strategy of quality differentiation. Then the institutional context, which obliges any FFV to transit by wholesale markets, what even there penalise retail chains in their integration of the supply chain.

The central role of wholesale markets.

The organisation of the domestic market rests mainly based on wholesale markets located in urban areas and managed by cities. In Morocco the national regulation requires that any FFV should go through this institution, where it undergoes a 7% levy on the total value of products (or according to its origin for imported goods). However the regulation is currently argued by Moroccan government. These institutions are criticised insofar as their operation and their organisation do not lend themselves to the modernization requirements for the distribution of FFV in Morocco. The structures appear out of day (very limited storage capacities in cold, absence of conditioning stations) and their operation is more and more questioned, especially in Casablanca, the biggest wholesale market. The development of modern retail, with higher qualitative and quantitative requirements, should appreciably modify the organisation of this market in medium-term. As an illustration of these maladjustments, it seems that less than 25% of the annual Moroccan production of any fruit and vegetable should go through wholesale markets (the remainder includes rural consumption, post-harvesting losses and marketing out of wholesale market).

Intermediaries between production and marketing of FFV, wholesale markets take up today a dominating range in Morocco. Two types of wholesale markets exist: those located in consumption areas (in particular Casablanca) and those located in production areas (in particular Agadir). One can distinguish several types of actors within wholesale markets, according to whether they operate in production or in consumption area, and according to whether they operate with the sale or the purchase sides (Codron et al., 2006).

Table 2. Main operators on Moroccan FFV wholesale markets.

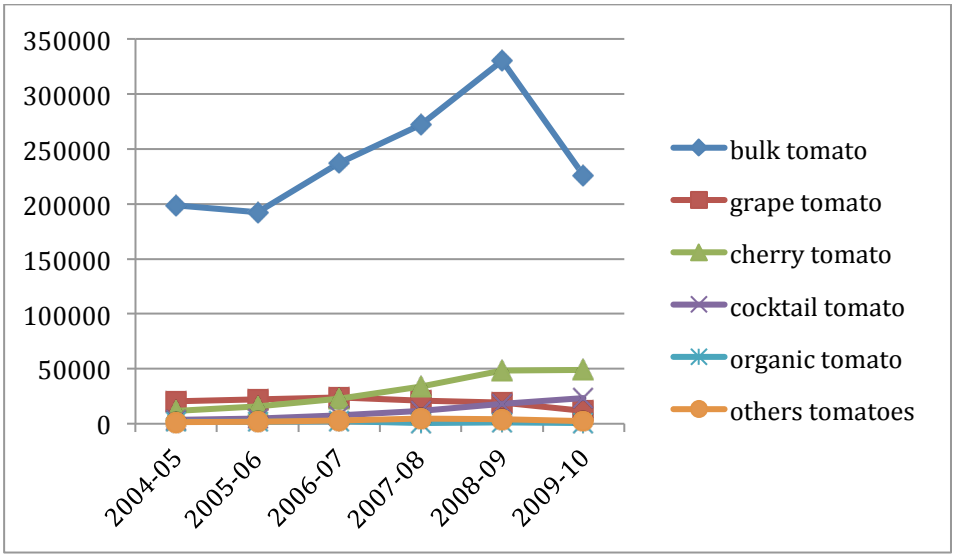
Sellers	Buyers
Wholesale markets in production areas	
- Local producers who sell their own production comprising only one product or several products in the same way of standards (for example various market-gardening products); - Brokers who sell products for large producers; - "Product specialised" market wholesalers, generally shippers, who sell part of the products on local wholesale market and send the other part, towards wholesale markets located in consumption areas, to other wholesalers. After harvesting, these wholesalers make own purchases at the farm level or of a conditioning station. They can have called upon pickers who collect goods on farms.	- Product specialised wholesalers who are also shippers and who buy from producers; - "Urban" wholesalers or their representatives who directly buy on wholesale markets in production areas (without having any relationships with shippers) and undertake to convey goods to wholesale markets in consumption areas where they carry on their activity; - Dedicated wholesalers who buy a whole range of products from the "single product" wholesalers or directly from producers, and who constitute sets corresponding to their customers' preliminary orders; Local retailers. The FFV department manager buys directly on wholesale markets
Wholesale markets in consumption areas	
- Product specialised wholesalers who receive the products shipped from production areas. In Casablanca, they are located on a part of the wholesale market (Agadir market); - Product specialised wholesalers who buy from the previous ones and sell at the squares level to retailers or to other specialised wholesalers that deliver to customers retailers; - Dedicated wholesalers installed in a store located on the wholesale market. They buy from market wholesalers who receive products shipped from production areas. Then, after carrying out the functions of sorting and assortment, they dispatch batches towards various customers. They deliver to their customers more or less complete sets; - Importers who directly receive imported fruits. Storage is done in a cold room. The customers are wholesalers.	- Product specialised wholesalers located at the squares level and who buy on the Agadir market; - Dedicated wholesalers who buy at the squares level retailers, carrying out more or less complete sets to retailers; - Local retailers. The FFV department manager buys directly on wholesale markets.

Tomato export markets.

Export volumes and destination countries.

Moroccan tomatoes exports knew an increasing trend between 2004 and 2009, from 236,000 to 421,000 tons (El Fadl and Chtaina, 2010). This increase is essentially due to the progress of conventional tomato, which increases from 200,000 tons to 330,000 tons, between 2004-2005 and 2008-2009. The effort of diversification of the exporters could be observed by the significant breakthrough of the cherry tomato, the exports of which grew from 11,000 ton in 2004-2005 to almost 50,000 tons in 2009-2010. The cocktail tomato presented a similar trend, while the cluster tomato showed certain stagnation in the export.

Figure 6. Export volumes of tomato, per category (tons).



Source: Authors' work based on El Fadl and Chtaina (2010).

Concerning tomato export destinations, Morocco exports the largest part (approximately 90 %) towards the EU and the rest towards countries as Russia and the countries of the Middle East.

Association Agreement with the European Union.

With the restriction imposed by the European market on the agriculture product, Morocco has signed several agreements with the European Commission. The last negotiation was completed in 2012 and reinforces Morocco preferential access to European markets for several agricultural products. The greatest preference is for tomatoes. The current Moroccan quota is 210,000 tons. The agreement plans immediately, that is from its coming into force, a 20,000 ton increase and of 32,000 in four years. On the other hand, it does not modify the customs duty.

The minimum entry price for Morocco is considerably lower than for other countries. Resulting from a good negotiation that Morocco concluded with the EU in 2003, a general framework of tariff contingency is applied to tomatoes imported from Morocco for the period from October to April with a preferential entry price of 46.1 Euros/kg and an *ad valorem* duty of 0 %. Above this contingency, the regime for MFN is applied.

Within the framework of this tariff quota, if the entrance fee is equal or higher than 461 €/t, which is the conventional entrance fee fixed for Moroccan tomatoes at their entry on the EU markets, specific rights mentioned in the list of the concessions of the EU to WTO disappear. If the price is 2, 4, 6 or 8% lower than the conventional entrance fee, the customs specific duty is equal to 2, 4, 6 or 8% of this agreed entrance fee. If the entrance fee is lower of more than 8% than the conventional entrance fee, the WTO customs specific duty is applied.

Non-tariff trade barriers on the European market.

At the regulatory level concerning the FFV sector, the safety question is mainly related to the use of healthy-plant products along growing process and harvesting and the presence of pesticides residues within marketed products. Before their marketing, the fruit and vegetables must respect the MRLs authorised. The law defines these MRLs. On the other side, since January 1, 2005 an obligation of traceability, which forces operators to be informed of the whole trajectory of products from the parcel where was cultivated, has been added. Parallel to this regulatory framework and since the beginning of the 1990s, there is a multiplication of private standards impelled by customers and particularly hypermarkets, standards which are generally much more constraining than national regulations.

With this kind of quality standards increasingly constraining, especially safety standards, the access to the export market becomes more selective and tends to only concern companies that are able to comply with. In this case, some of these companies have international strategies and establish in France to better control the transit of their products. But, the majority of exporters market their products by the intermediary of French importers, who are then, due to responsibility rules, at the core of safety control devices. The strategies of these importers as regards to the safety control are thus a crucial factor for the valorisation of Moroccan IPM export tomato.

2.C. FRESH PRODUCTS SAFETY REGULATİON İN MOROCCO.

Food safety public institutions.

Safety public institutions in charge of the fresh produce sector have been relatively weak until the mid 2000s in Morocco. Main activity was focused on establishing lists of pesticides that could be used for protecting fresh produce crops while farmers' control and provision of incentives for implementing IPM practices were almost inexistent. Theoretically, several ministerial departments (from the Ministry of Agriculture, Health, Interior, Industry and Trade) are mandated to exert control activities in the area of personnel hygiene, product weights and fraudulent practices, equipment and plant certification, product quality, and instrument calibration. However, to avoid duplication and coordination problems, three organisations are mainly in charge of sanitary control of fresh fruits and vegetables: EACCE, LOARC and ONSSA.

EACCE. Since 1932, the Moroccan *Etablissement Autonome de Contrôle et de Coordination des Exportations* (EACCE) is a key actor for safety control of all Moroccan exported FFV[18]. EACCE is in charge of legal information about international markets, like changing MRLs regulation or forbidden molecules or commercial quality standards.EACCE focuses in particular on the evolution of standards and regulations within the EU and makes diffusion of any change to growers-exporters and exporters. At the international level, EACCE has a delegation in Geneva and participates in the discussion of international standards within the United Nations Economic Commission for Europe (CEEONU).

ONSSA. The *Office National de Sécurité Sanitaire des Produits Alimentaires* (ONSSA) is an independent agency under the supervision of the Ministry of Agriculture[19]. ONSSA was created in 2009 by the Law 25-08. It is in charge of regulating, implementing, and controlling the conformity of products with the local regulations, including standards, labeling, and packaging. Its organisation is based on 11 Regional delegations and 6 analysis laboratories. ONSSA is also in charge of the control of imported products, through the DCQ (Direction du Contrôle de la Qualité). ONSSA is in charge of monitoring the sanitary situation of crops: for instance, in 2010, 1,585 phytosanitary shifts and 1,988 diagnoses have been achieved by ONSSA inspectors. ONSSA also proceeds to the control and certification of seeds and plants, as well as to the control of agricultural inputs (fertilizers and pesticides). In 2010, 952 controls of pesticides were realised, of which 21 were not compliant. Samples are analysed at the accredited Official Laboratory for Chemical Analysis and Research (LOARC)[20].

Located in Casablanca, **LOARC** is in charge of the control for agricultural and food products, fertilisers and pesticides to be sold on the national market. It contributes to research programs to promote agriculture and stock breeding, to develop food standards and to control unfair and fraudulent practices. LOARC holds several accreditations and national and international approvals: it was first approved in 1992 by the International Olive Oil Council for the analysis of olive oil and oil cake, and was accredited in 1999 by the French Committee of Accreditation (COFRAC).

Legislation history.

The Law 13/83 published on October 5, 1984 is the first law for food quality control and fraud repression in Morocco. This law defines the procedures that inspectors should follow to investigate fraudulent products. In particular, it describes sampling procedures and procedures to identify and prevent sales of unsafe products. Then, on March 5, 2009, ONSSA has been established by the Law 25-08. The law stipulates the basic principles and concepts for food safety, and requires all the food chain stakeholders to fully comply with standards in order to ensure food safety through the whole food value chain. This will effectively means holding producers and processors accountable for mandatory measures that include farms registration, livestock identification, traceability, self control, hygiene good practices guides, and the recall of non-compliant products. This law also specifies mandatory measures of informing consumers through product labelling. Moreover, it states that any food product must have a label mentioning all product characteristics. In 2011, the Moroccan Counsel of Government has adopted a decree which enforces the traceability of food products from the producer to the final consumer. The decree will hold producers accountable for compliance with the general food safety requirements of all marketed products.

[18] http://web2.eacce.org.ma
[19] http://www.onssa.gov.ma/onssa/index.php
[20] http://www.loarc.org

Regulation at the production level.
The recent Food Safety Law, Act No 28-07, includes requirements for growers, and ONSSA plans to introduce inspections of producers accordingly. In the last years, ONSSA (and DPVCTRF until 2009) has provided regular training to growers. In 2010, the regional ONSSA office in Agadir has performed 128 training missions and 10 meetings with producer groups to promote the good plant protection practices and the introduction of record keeping for pesticide applications. ONSSA has also promoted biological control in the production of tomatoes and peppers, which has been widely introduced by growers in Agadir (DG-SANCO 2011-6027). Since 2002, DPVCTRF then ONSSA have been involved in the calibration and checking of spraying equipment for growers, which is a requirement from private standards to which growers are certified. The legal requirements for traceability and record keeping of Act No 28-07 will apply from September 2011. They had already been promoted by EACCE for the approval of pack-houses.

IPM promotion.
To our knowledge, there is no monetary incentive to promote IPM practices at the farmer level. However, ONSSA is mandated to provide farmers with technical assistance and advice to better manage pest hazards and implement good agricultural practices. To that purpose, ONSSA organises in particular, training sessions oriented to farmers and technicians.

A public/private control of exports.

Border fresh produce rejection for safety issues.
Private and public actors of the Morocco fresh produce export chain have been long aware that safety is a key challenge for competitiveness on export markets, in particular EU markets. As a result, they have organised into efficient structures of safety control, in particular EACCE and LOARC. The degree of rejection of Moroccan products at the borders of customer countries is very low. The EU RASSF (Rapid Alert System for Food and Feed) database has reported only 13 cases of rejection of Moroccan fresh produce for the last three years (01/01/2008 until 28/10/2011). No one of them concerns tomatoes[21].

Quality control procedure for compliance with international standards at the customs level.
EACCE is in charge of controlling residues on exported fruits and vegetables. EACCE owns 6 analysis laboratories, located in the main regions of production of Morocco. Two laboratories, in Casablanca and Agadir, are accredited according to ISO 17025 by the French Accreditation Body COFRAC. EACCE plans to achieve accreditation of the remaining laboratories in 2012. Accreditation provides control flexibility for Moroccan products at their entry in the European market, especially at the French border city of Perpignan.

EACCE makes its controls at the packing level and, in some litigious cases, at the field level. Controls are systematic. In 2009/2010, 1,498 samples of vegetables were taken. The group of pesticides to be analysed in a sample is decided by EACCE inspectors, depending on the last pesticides recorded by the producer. The produce is already exported, before the analytical result is known. The non compliance rate was 2% (DG-SANCO 2011-6027).

[21] http://ec.europa.eu/food/food/rapidalert/index_en.htm

Where non-compliance is identified, EACCE writes to the exporter concerned, blocks the export of consignments from the same plot of the farm. EACCE requests an explanation from the exporter, including data on traceability and records of pesticide applications. EACCE does not consider informing the EU importer.

Moroccan exporters' vertical organisation.
A survey carried out by Ubifrance in 2005, shows that Moroccan exporters have a diversity of legal status (limited liability companies, co-operatives, etc.) and property rights (cross shareholdings, strategic alliances between groups, etc.). Three main types of organisation may be identified, discriminating by the level of forward and backward integration (either ownership or contracting):

i) Export groups like Maraissa (Azura), Rosaflore (Idyl), Doche (Matysha) or Delassus which are fully vertically integrated, from production to export activities. Such groups are characterised by a mixed structure of both European and Moroccan capital. They dispose of platforms in Spain or in France and may perform a full control of their export activities.

ii) Export groups like Domaines Royaux, Soema (Avryl) or Armona which are only integrated backward into production, either through ownership or contracting. With no forward integration into import activities, they sell their products through French importers.

iii) Export groups like OCE and Salam which are not integrated, neither forward or backward.

It is worth mentioning that, from a legal point of view, export groups of the first type are the only one which bypasses importers to introduce products into the European Union. They are therefore the only ones to have a legal liability for safety compliance in the importing countries.

Global Gap standards.
Due to the strong export orientation of Moroccan production towards the EU, a vast majority of the production is nowadays Global Gap certified (more than 80% in our survey sample). The diffusion of certificates started in the early 2000s.

Regulation of the domestic market.

Plant protection products control.
Imports, manufacturing, storage, and marketing are subject to strict government control relative to plant protection products (Law 32-00 of February, 2002). Importers, producers, and distributors of pesticides need to be licensed by the government (Decree 2-99-106 of May, 1999) and each pesticide marketed has to be approved by ONSSA, whatever the crop is export-oriented or domestic-market oriented.

Fresh produce national products' control.
Annually, LOARC deals yearly with more than 20,000 samples of agricultural and processed food products. Quality and composition are checked in regards to their conformity with regulations and labelling. Their other activity is safety control, in particular by the search and the quantification of food additives and contaminants (heavy metals, pesticides residues, mycotoxins, HAPs, PCBs, etc.), and the detection of frauds and forgeries.

About 1,000 tests are carried out on fresh produce for pesticides (70% on citrus fruits and 30% on vegetables). The vast majority of these tests (95%) relates to residues, whereas 5% are oriented to pesticides formulations. Since 1994, LOARC has invested more than 5 million euros for the acquisition of equipment to cope with the changing legislation and regulation (Gazette Labo, 2007[22]).

Fresh produce imported products' control.

For clearing customs, importers are required to present a sanitary certificate for all animal food and fresh fruit and vegetables that they are importing. A local analysis made by an official laboratory may also be required, especially for new and unfamiliar imported products. ONSSA refers to *Codex* standards for tolerance levels.

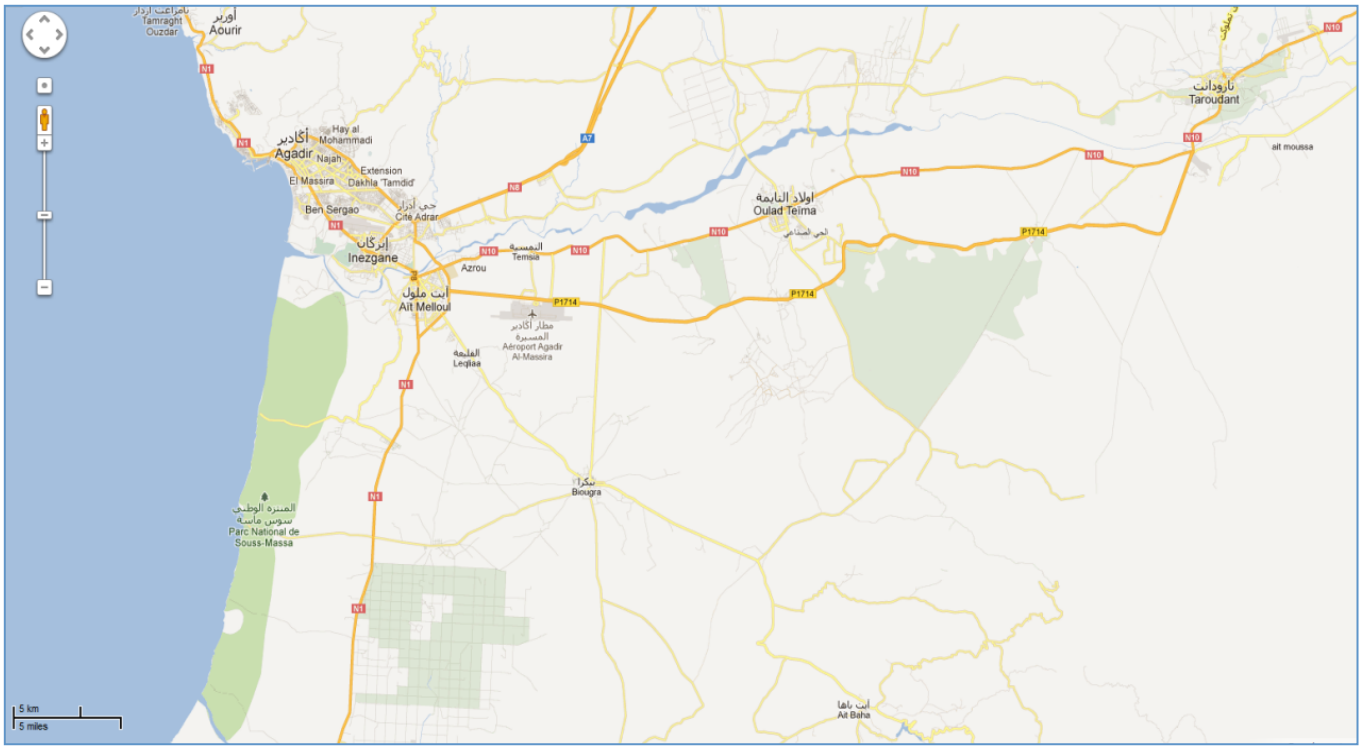
[22] http://www.gazettelabo.ma

2. D. GROWER SURVEY DESCRIPTIVE ANALYSIS

Methodology and data collection

Our analysis focuses on the Souss-Massa-Drâa province because it represents 60% of the total early fresh tomato production. In this region of South-West Morocco, tomato production is spread around the towns of Agadir, Aït Melloul, Biougra, Aït Baha and Taroudant (See Map 2).
We interviewed a total of 86 farm owners or managers by snowball sampling. A 16 pages questionnaire was used for face-to-face interviews with growers. It was based on information gathered by the French team during a one-week exploratory mission in Morocco made of field visits and interviews of key informants on FFV safety/IPM issues in the fresh produce sector. The survey itself was conducted by Eng. Imane Benanni, a graduate in agricultural economics from ENA Meknes.

Map 2. Main towns of the Souss-Massa-Drâa region.



©2012 Google Map.

The survey itself took place in three steps:
Step 1. Exploratory interviews: Conversations were led in Agadir and the Moroccan capital Rabat with various actors and institutional bodies in the sector of FFV production and export, in particular:

- GAP and organic farming certifying firms: IMC, Integra Maroc, Ecocert ;
- Farm inputs distributors: Univert Horticole, Agrimatco, Ezzohor, Planet Horticole, Casem, Horticom ;
- Professionnal associations: COMADER and APEFEL (*Association Marocaine des Producteurs Exportateurs de Fruits et Légumes*), the main trade organisation for FFV;

- Public agencies and governmental departments: MAPM, DRA-SMD, ORMVA-SM, EACCE: Agadir agency, Technical Direction, Department of technical and commercial Regulations, Department of external relations and communication.

Step 2. Test of the questionnaire: Tests were realised in summer 2010. The 2010 SIFEL (Fruit and Vegetable International Fair) of Agadir allowed to meet several participants in the FFV chain, to discuss points to be handled in the survey. Besides, two tests were realised on site with farmers. The questionnaire is in French because preliminary findings show that greenhouse owners and managers generally achieved secondary education. The enumerator was nevertheless able to translate questions in Arabic in case of necessity.

Step 3. Field work: Face-to-face interviews were realised by Eng. Imane Bennani with 86 producers between December 11th, 2010 and November 16th, 2011. After a first series of 25 interviews, the questionnaire was simplified, certain questions turning out to be difficult or sensitive for the interviewees. For example, we initially planned a comprehensive covering of pesticides treatments (for each application: active ingredients, commercial product name, dose, date of treatment, targets). The manager and the owner generally not being in charge of treatments, this question was simplified (total number of pesticides applications by target during the season). Also, some questions on production costs and employees were eliminated. A second series of 63 farm visits was then realised.

Sample.
Contrary to packing stations, there is no directory or official census of tomato producers in Souss-Massa, and therefore no way to stratify the sample. According to our conversations with local nursery firms, we can estimate at 300 the total number of tomato producers during the 2009/2010 campaign. Chemnitz's estimation was 600 for the whole Morocco in 2006 (Chemnitz, 2007). The list of growers was constituted by snowball sampling, a first list of address and phone number being supplied by experts working in the FFV in the region, then other names were added by interviewees.

Face-to-face interviews.
The interviews lasted between 45 and 75 minutes. Most of the managers should have the agreement of the owner before answering the questionnaire. Only 17 contacted farms refused to answer. The managers generally gave much more details than the owners, these ones remaining careful in their answers. Some interviewees asked for a confidentiality of the name of the farm.

Aims of grower survey.
The aim of the grower survey is to i) characterize the current average state of pest management practices, highlighting on the one hand, chemical control and on the other hand alternative practices of control such as IPM or ICM; ii) evaluate the diversity of such practices and the key factors of such a diversity.
Main proxies of pest management practices included in the questionnaire are:

- Chemical control: sources of knowledge on the use of pesticides, sources of influence in the treatment decision making process, treatment recording;
- Alternative pest control (IPM): footbath, curtains, weeding, equipment cleaning, wall spraying, yellow and blue traps, pheromones, biological auxiliaries;
- Integrated crop management (ICM): climate control automatization, soil water in excess control, rotation;
- Environment: public and private consulting, third party control, certification;

Main proxies of the determinants of pest management patterns included in the questionnaire are:

- Farm characteristics: size, land tenure, crop diversification, labour structure;
- Greenhouse characteristics: size, covering material;
- Farmer characteristics: age, education, sources of income, cooperative membership, vertical relationships;
- Tomato production : type, yield, production costs;
- Tomato marketing: marketing channel, exports, prices.

Farming systems

Farm characteristics

Farm Size: Sous-Massa farms are of larger size than Turkish farms in the Antalya survey, with an average Utilised Agricultural Area (UAA) of 69 ha (Table 3). The biggest making 500 ha. The area under greenhouse is very important too, with on average 55 ha under greenhouse, what represents ¾ of the total area. The area with tomato is on average 40 ha and represents more than 50 % of the total UAA.

Table 3. Distribution of tomato farms size.

	N	Mean	Std	Min	Max
Total UAA (ha)	86	69.82	91.84	1.00	460.00
Greenhouse area (ha)	86	53.95	79.05	0.80	460.00
Tomato area (ha)	86	40.64	63.7	0.80	380.00
Greenhouse area in % of UAA	86	74.78	24.3	4.76	100.00
Tomato area in % of UAA	86	57.04	28.33	3.00	100.00

Land tenure: 70% of the growers own at least a part of their holding. On average, 54% of the acreage is in full property.

Labour: In terms of labour, we notice that most of farms (80 on 86) rely on waged (non family) labour, with seasonal and/or permanent employees (Table 4). On average, growers employ 39 employees, with a strong dispersal according to the size of farms. This workforce represents 87% of total labour in the sample. The family workforce is not thus the main contributor to farm labour. Less than a farm on two declares to use such a workforce (40 on 86). When it is the case, the farm mobilizes on average about three members of the family.

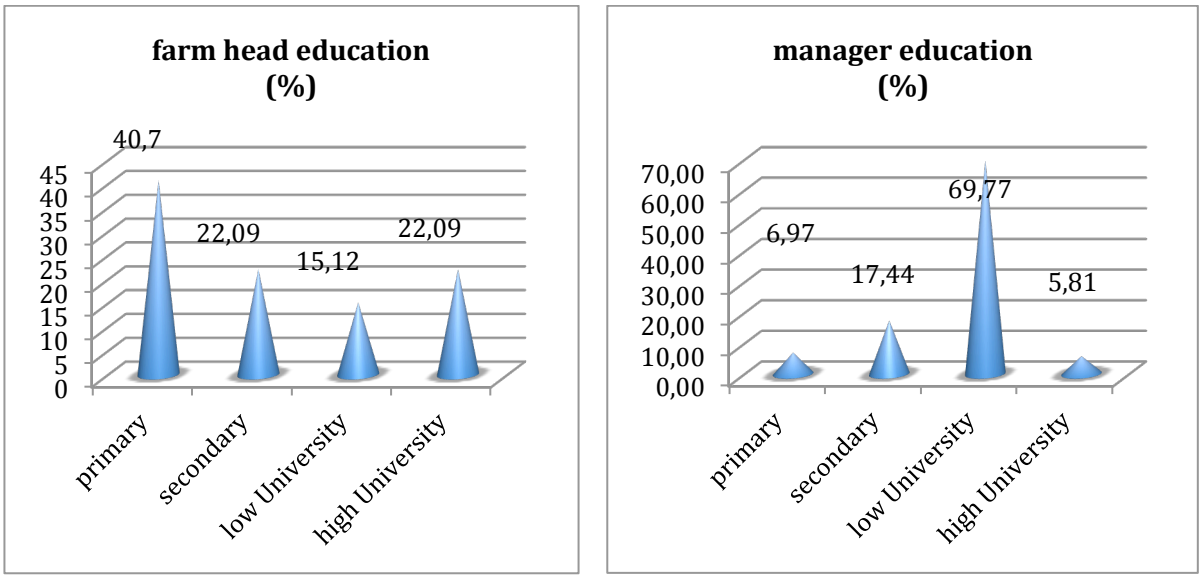
Table 4. Distribution of farm labour.

	N	Mean	Std	Min	Max
Family labour	86	1.52	3.38	0	25
Family labour (if different than 0)	40	3.28	4.36	1	15
Waged labour	86	39.07	65.17	0	400
Waged labour (if different than 0)	80	42.00	66.67	1	400
Total labour	86	40.59	64.94	0	400
Weight of waged labour (% total labour)	86	86.97	24.87	0	100
Weight of waged labour (%) (If different than 0)	80	91.32	15.74	16.67	100

Farmer characteristics

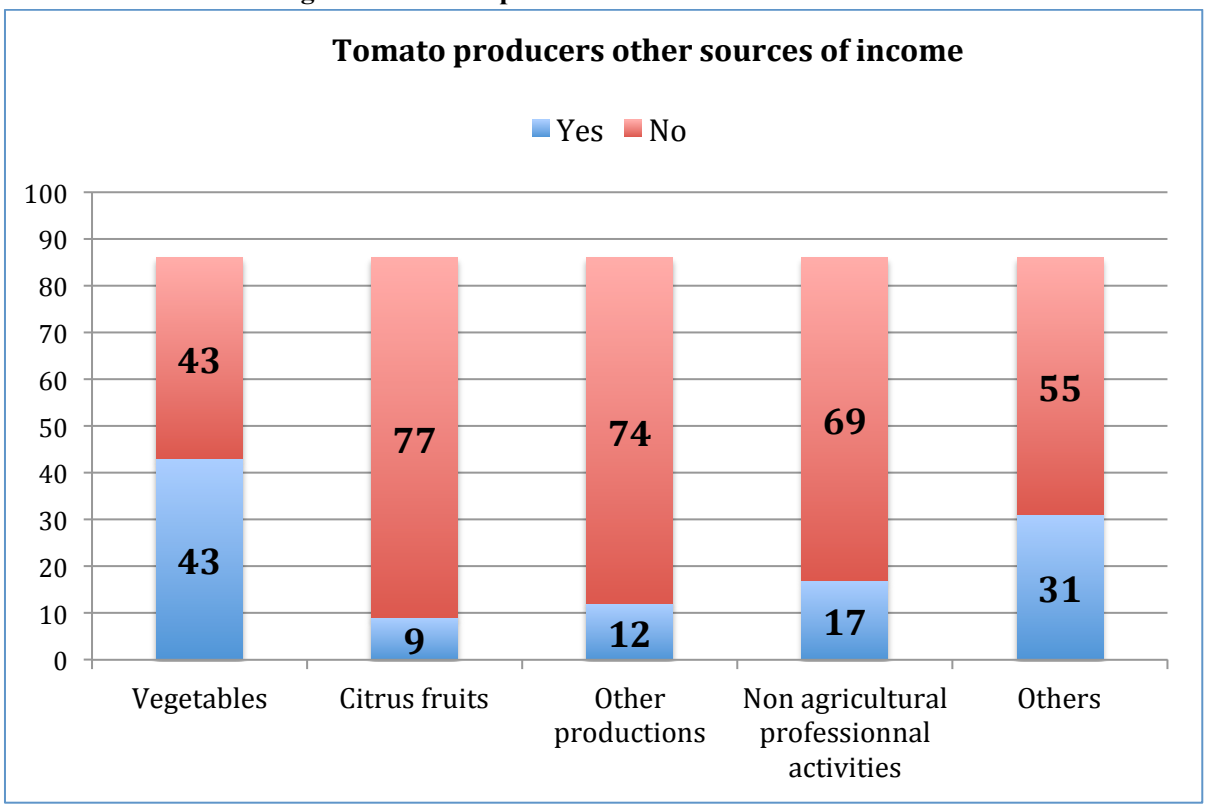
Age and education. In the Moroccan survey, we identify not only the characteristics of the owner (farm head), but also those of the farm manager that lead the workforce (when he is different from the owner). We notice that managers are younger and better trained than owners. The owner is on average 51 years old against 35 for the manager. Heads' level of agricultural training are well enough distributed, while about 70% of managers have an upper level, most of the time a two years university degree (*Brevet de technicien supérieur*).

Figure 7. Education level of farm head and manager.



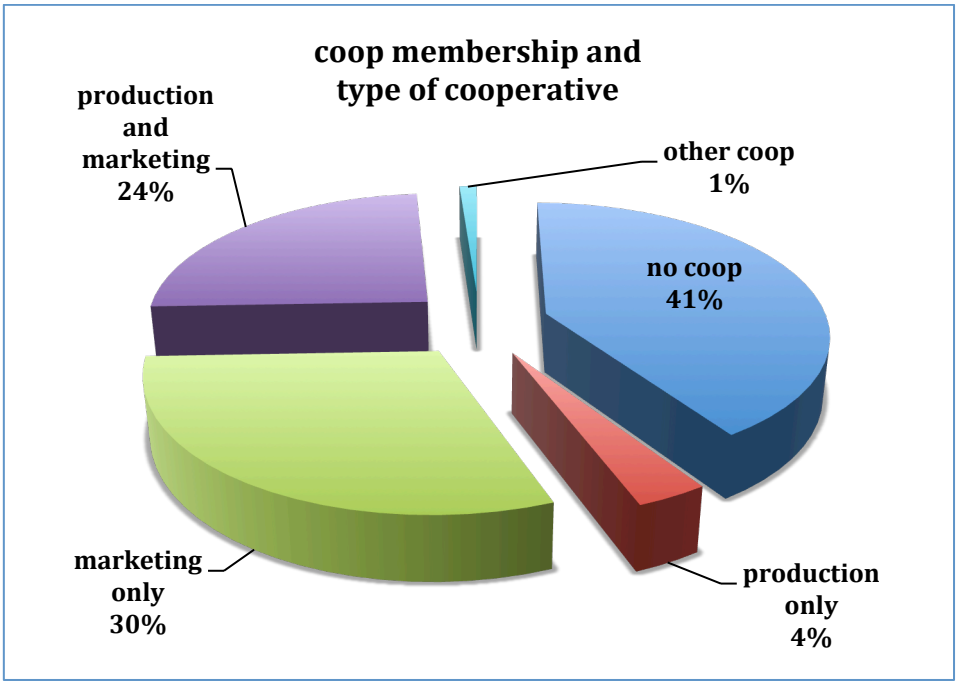
Sources of income: If we consider farm managers, we notice that only one-third have a secondary activity outside the farm. Near a tomato farm head on two has another revenue stream: income supplements are essentially vegetables growing and non agricultural professional activities. Only 9 on 86 also grow citrus trees.

Figure 8. Tomato producers other sources of income.



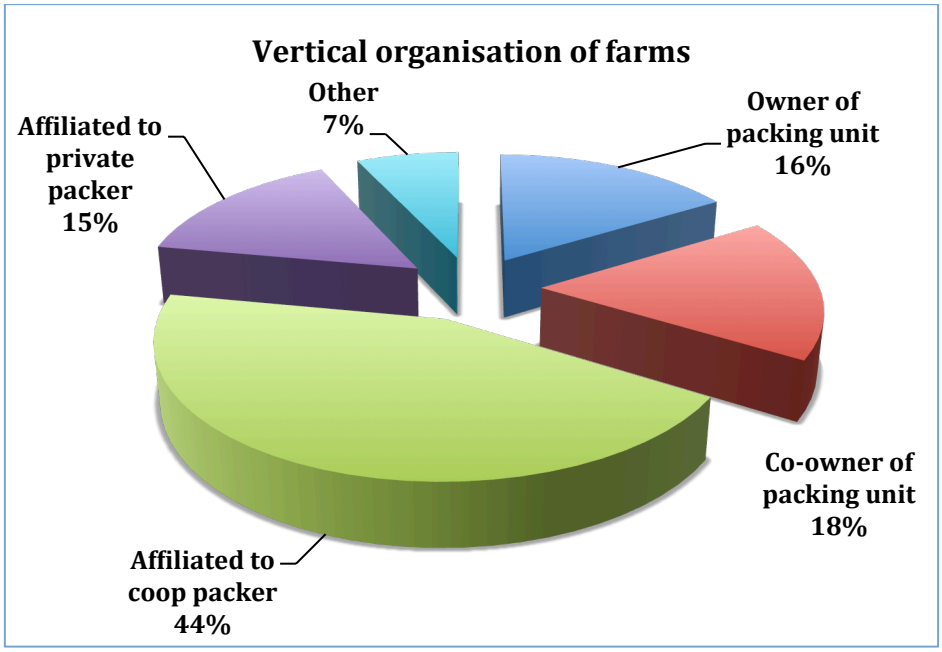
Cooperative membership: 59% of growers adhere to an agricultural cooperative (Figure 8). When this is the case, they generally adhere to a marketing coop or to a coop that simultaneously handle production and marketing activities. In terms of their implication in the cooperative leadership, about 37% of farm heads in our sample declare to be a member of the bureau (president, treasurer, etc.), essentially when the cooperative is marketing-oriented.

Figure 8. Cooperative membership.



Vertical linkages. Most of farm heads are affiliated (60%) or hold in property (37%) a packing station for fresh fruits and vegetables (Figure 9). In the first case, the affiliation is generally to a cooperative in which the farmer has no stake. In the second case, it could be a private station or a coop (the grower share the ownership of the station with other FFV producers).

Figure 9. Vertical organisation of tomato farms.



Greenhouse characteristics

Plastic is the dominant coverage for greenhouses in the area. As expected, there is no glasshouse, thanks to the cool Souss-Massa climate. All 86 farms do use multi-chapel Canary type greenhouses, with 8 also using Delta type (See picture 1). Wood (78) and iron made construction (42) are mostly preferred in the area. Less than 10% of farms use soilless culture.

Tomato production

Most of the farms produce loose classic (round) tomato (97%), but only 21% produce cherry tomato and 27% cluster tomato. On average, round tomato represents 86.8% of the volumes produced (Table 5). Farms are generally large tomato producers, with an average of 40.6 ha of tomato (for an UAA of 69 ha). Loose classic tomato covers an average of 27.3 ha, for a production of 5,700 tons. This figure is very different from the Turkish case, where growers are mostly small scale producers, volumes per farm do not exceeding some dozens of tons. Cherry's area is a little superior to that of cluster (7.3 against 6.1 ha), but the production is on average lower (726 tons against 1,119) because of sharply lower yields. It is indeed a less intensive production.

Picture 1. Wood-made Canary type greenhouse in the Souss-Massa.

Source: El Fadl and Chtaina (2010).

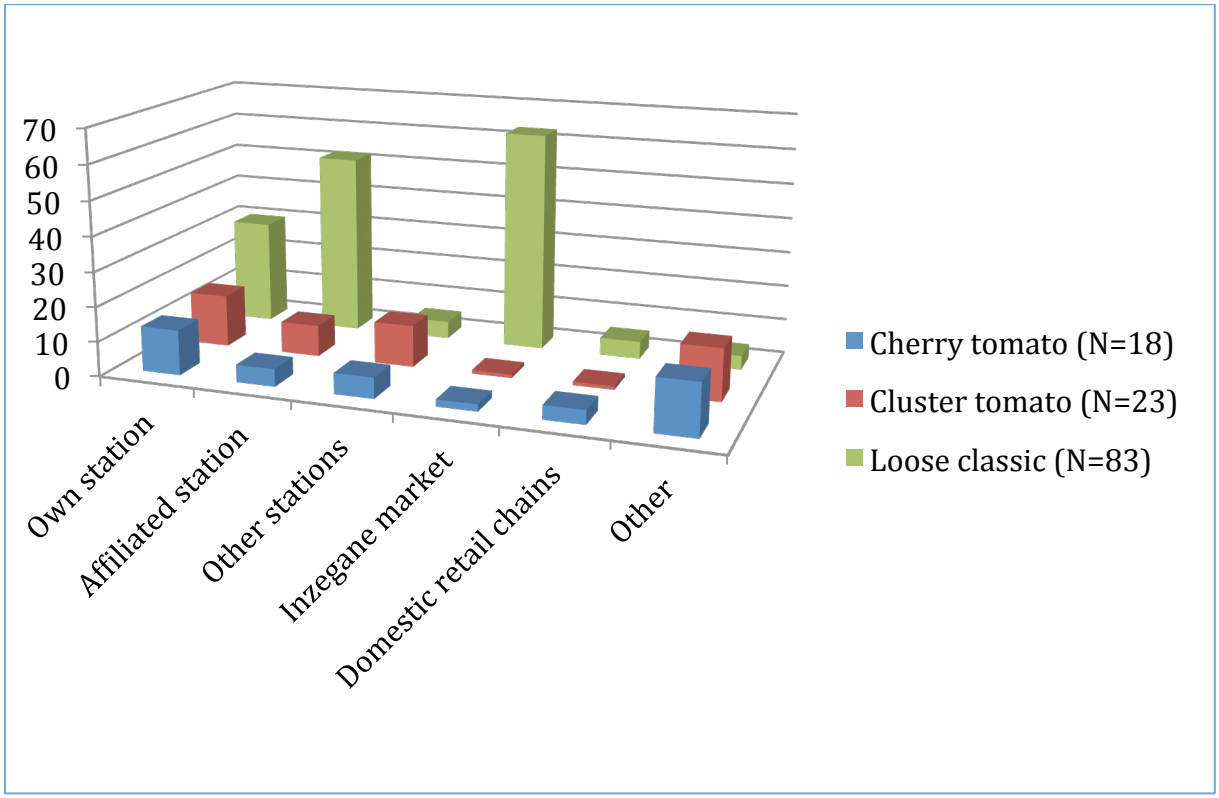
Table 5. Tomato area, tonnage and yield.

	Variable	N	Mean	Std	Minimum	Maximum
Loose classic	Area (ha)	86	27.31	37.79	-	220.00
	Production (tons)	86	5,712	8,622	-	52,800
	% of total production	86	86.80	23.91	-	100.00
Cluster	Area (ha)	86	6.08	18.07	-	120.00
	Production (tons)	86	1,119	3,644	-	26,400
Cherry	Area (ha)	86	7.26	31.15	-	230.00
	Production (tons)	86	726	3,111	-	22,080
Yield (tons/ha)	Loose classic	83	194.04	47.52	60.00	280.00
	Cherry	18	123.94	126.41	50.00	595.00
	Cluster	23	164.13	44.36	60.00	240.00

Tomato marketing

Marketing channels. For loose classic tomato, production is delivered to packing stations, whatever the station is own by growers (30 out of 83 producers) or affiliated to a coop or a private packer (52). These are the main export-orientated channels. The Inzegane market is the main market for tomato grade-outs that supply traditional fresh vegetables wholesalers and shop keepers (63 out of 83 growers). Other marketing channels are few used, including direct sales to domestic retail chains (only 5 producers).

Figure 10. Marketing channels by tomato type.



Production and exports. The Souss-Massa tomato chain is strongly export-orientated. Thereafter, 70% of loose classic tomato producers export some of their production. Given their large size, these 58 farms export on average 5,771 tons of loose classic tomato, while 2,154 tons of grade-out go to the domestic market. The exporters represent 94% of the total production in the sample (459,628 tons on 491,270). All cherry tomato producers and all but one cluster growers are exporting some of their production. Grade-outs are very important for cluster tomato (41% of exporters' production, against 27% for round tomato and 18% for cherry).

Table 6. Production, exports and grade-outs.

	Volumes (tons)	N	Mean	Std	Min	Max	Total
Loose classic tomato	Production	83	5,919	8,708	90	52,800	491,270
	Production (exporters only)	58	7,925	9,720	90	52,800	459,628
	Exports	58	5,771	6,586	40	31,680	334,694
	Grade-outs	58	2,154	3,517	0	21,120	124,934
Cluster tomato	Production	23	4,186	6,156	120	26,400	96,276
	Exports	22	2,595	3,687	72	16,800	57,094
	Grade-outs	22	1,773	2,737	40	9,600	39,003
Cherry tomato	Production	18	3,470	6,190	50	22,080	62,458
	Exports	18	2,837	5,349	50	20,900	51,057
	Grade-outs	18	633	1,290	0	5,489	11,401

Export markets. The top destination is by far the EU, with France as the favourite country: all but two producers of loose classic tomato export to France. Besides, almost half of them export towards Russia. Half of the cherry producers export towards United Kingdom. Only one third of the producers (29) declare to know the name of the end-customer and also one third (31) declares that its production is sold under the private brand of a distributor.

Figure 11. Main exports markets for loose classic tomato.

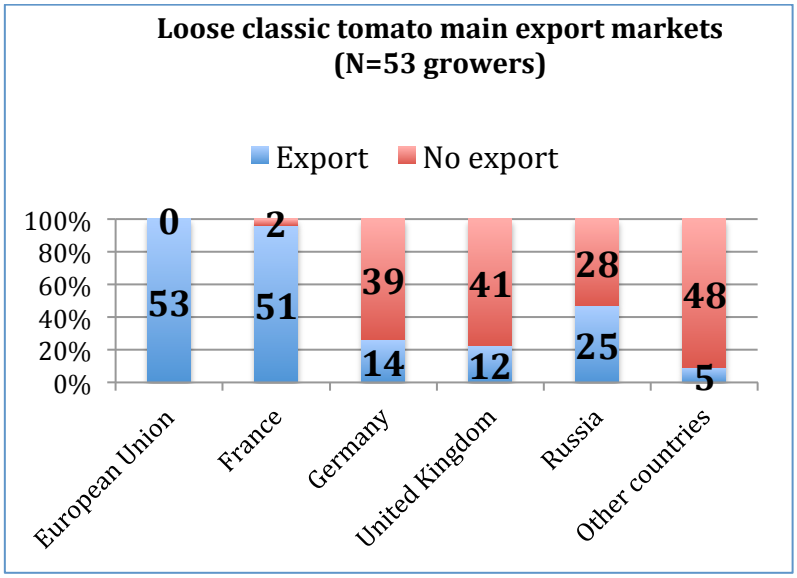


Figure 12. Main exports markets for cluster tomato.

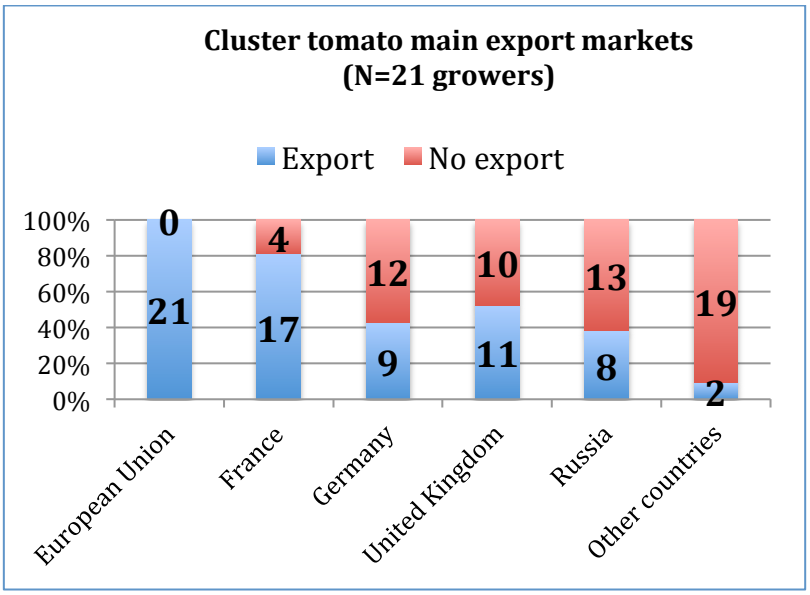
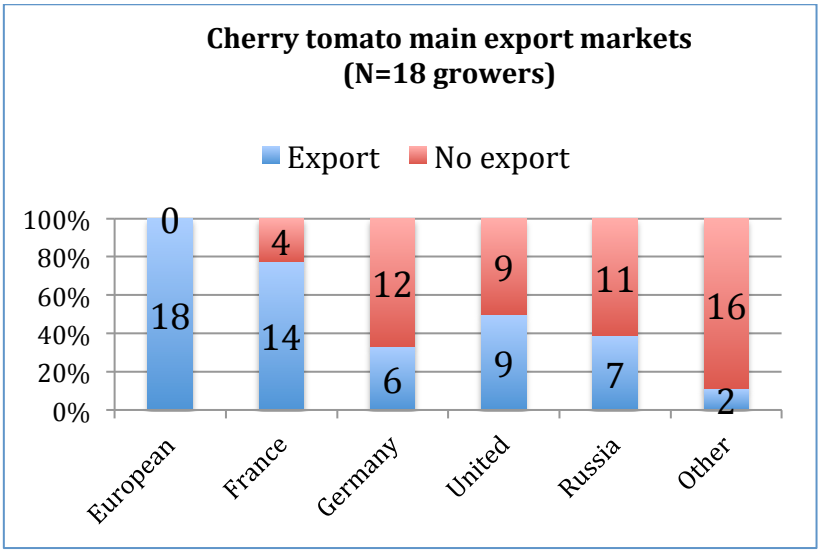


Figure 13. Main exports markets for cherry tomato.



Safety risk management

Tomato pest risk

We asked producers to self-evaluate the risk from main tomato devastating invertebrates and diseases, on a ten-point scale (0: absent; 10: very high risk).

Major pest feared by Souss-Massa growers are Tuta absoluta, the tomato leaf miner (score of 5.7) and white flies (score of 4.1). These average scores are lower than in Turkey (7.9 for Tuta and 6.5 for white flies). They are followed to a lesser extent by spider mites and cut worms.

No disease has a score higher than 5. Mildew is the most important, followed by botrytis, bacteriosis and oidium (powdery mildew). Diseases like tomato pith necrosis, alternaria, anthracnosis, cladosporiosis and fusariosis are perceived as less dangerous (lower than 2). Again, scores are overall lower than in the Antalya survey.

Table 7. Pest risk perceived by growers.

0: absent ; 10: very high

	Mean	Std
Tuta absoluta/leaf miner	5.65	2.60
White files/Aleurodes	4.08	2.30
Cut worms	2.91	2.74
Spider Mites	2.13	1.91
Cotton bollworm	1.02	1.82

Table 8. Disease risk perceived by growers.

0: absent ; 10: very high

	Mean	Std
Mildew	4.63	2.86
Botrytis/Grey mould	3.77	2.08
Bacteriosis	2.59	2.31
Oidium/powdery mildew	1.92	2.16
Cladosporiosis	1.51	2.16
Tomato pith necrosis	1.07	1.58
Alternaria spp.	0.91	1.53
Fusariosis	0.62	1.26
Anthracnosis	0.30	0.97

From the specie-centred risk evaluation, we built a synthetic indicator for all tomato pests, and another for all diseases, which indicate the degree of local risk perceived by the decision maker. The indicator is the non-weighted average of all items. These synthetic scores are low on average, 1.74/10 for diseases and 2.64/10 for devastating invertebrates. Let us note that they are not directly comparable with the scores of the Antalya survey, because the same species are not always present in both regions.

Chemical control practices

Factors influencing spraying. Growers were asked to rank factors that are important in their decision to spray pest protection products. Potential factors that have been listed and enumerated were the following: pesticides application in a preventive and automatic way, observations during the process of production, knowledge of pest history, economic threshold, and advices of input supplier, private consultant, or cooperative technicians.

The very large majority of growers quote preventive treatments, but also pesticides applications based on scouting and the history of pest and disease (Table 9). We guess that the explanation for what would at first glance be considered as contradictory strategies is that producers have different practices according to targeted species. For example, they control mildew in a preventive and automatic way, using calendar spraying, and simultaneously scout for bugs. These sources of influence in the decision making are little discriminating, since they are quoted by more than 90% of growers.

Sources of weak influence are the use of economic thresholds (spray only when pest population is above a certain threshold) and external advices. Contrary to the Turkish case, it is difficult to discriminate between farms on chemical control practices, identifying "autonomous" versus "assisted" producers, since few Souss-Massa producers declare to need advice. The use of advices from input suppliers is the most discriminating item.

Table 9. Factors quoted as influencing pesticides spraying decision making.

	N/86	%
In a preventive and automatic way	85	98.8
According to observations during production	85	98.8
According to my knowledge of pest and disease history	80	93.0
According to economic thresholds	5	5.8
According to the advices of input suppliers	22	25.6
According to the advices of the cooperative	13	15.1
According to the advices of some private assistance	2	2.3

Chemical spraying recording

Only one grower does not make any recording of chemical spraying. For the 85 others, recording is comprehensive as they all declare recording the date of application, name of the commercial product and doses applied. Most of them also record the length of the application (95%), the names of the applications supervisor (95%) and the farm worker in charge of spraying (99%). Event non-certified producers record pesticides applications. For the mode of recording, about two-thirds record on paper only, the remainder recording on computer, without giving up the paper version.

Table 10. Pesticides applications recording.

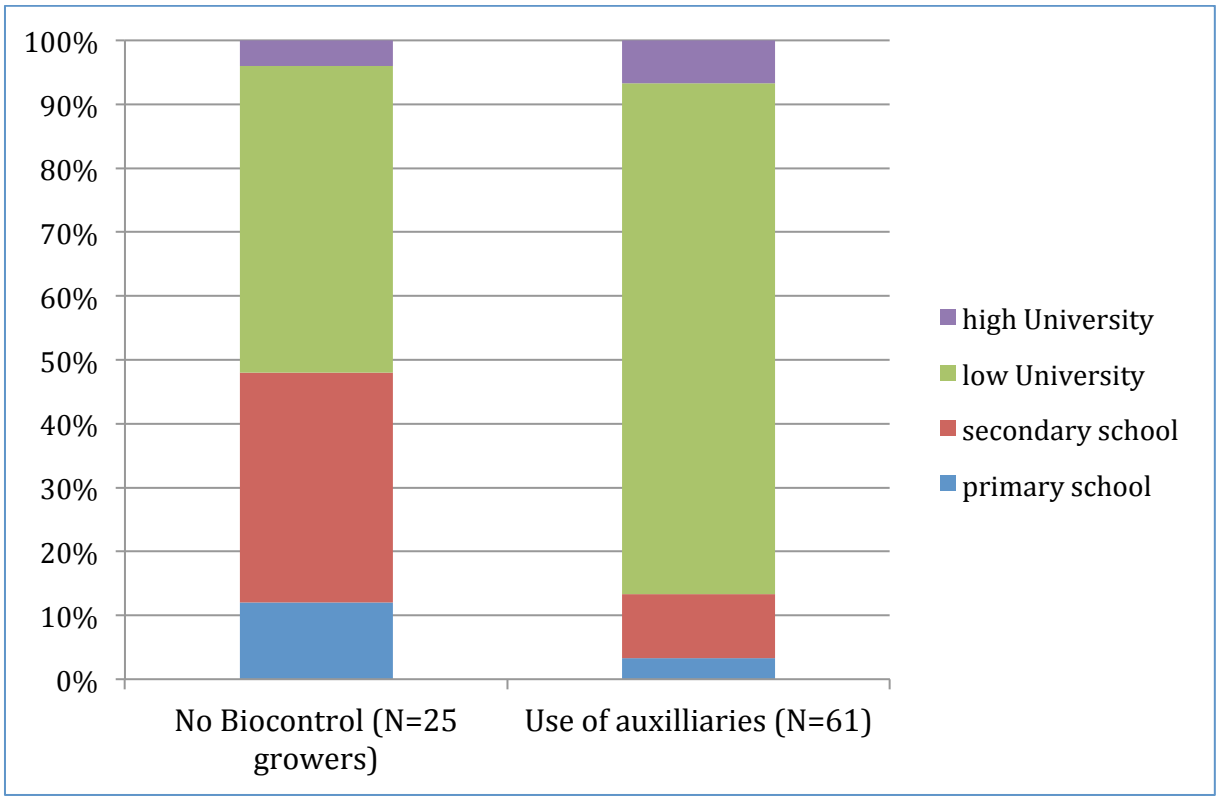
	N	%
No recording	1	23.70
Paper only	55	63.95
Computer only	2	2.33
Computer and paper	28	32.56
Total	86	100.00

Alternative pest control practices

We qualify as alternative control methods for pest management, practices that are usually labelled as IPM and ICM (Integrated Crop Management). IPM practices include the use of resistant vegetables varieties, insect traps (yellow sticky traps, blue traps, pheromones), the use of biological auxiliaries or natural enemies, hygienic precautions (equipment cleaning, wall spraying), equipment installation (curtains or insect nets, footbaths), mechanical methods (elimination of contaminated plants, weeding in and outside the greenhouse). ICM include practices that are oriented towards better agronomical conditions and only indirectly related to pest management. Table 11 summarize surveyed growers' pest management features.

IPM practices: Different levels of use may be discriminating. In Morocco, practices that are generalised or almost generalised are the use of yellow traps and insect nets (curtains), the elimination of the first contaminated plants, equipment cleaning, weeding and greenhouse walls washing and spraying, the use pheromones. Footbaths are also strongly diffused in the sample (86% of growers). Practices with less diffusion are the use of blue traps (63%) and biological auxiliaries (71%). In contrast with the Turkish case, these last two practices are nevertheless adopted by the majority of growers. Farm managers working in greenhouses using auxiliaries have a higher educational background than others (Figure 14).

Figure 14. Farm manager education and the use of biocontrol.



ICM practices. A majority of growers monitor water in soil to avoid water in excess (63%).

Audit and residues control plan. Exporters and modern retailers in the domestic market progressively require their FFV suppliers to be audited and/or to provide a plan of pesticides residues analysis. Contrary to the Turkish case, where only a minority of Antalya growers are concerned by internal audit (39 on 186 in the survey), a large proportion of Moroccan farms have such requirements. On 86 producers, 71 are audited (83%) and 84 have been required a plan to control residues (98%). Only 29% of farms have an employee specialised in quality control. This percentage is higher for farms certified under GlobalGAP option 1 (individual certification by opposition to collective certification). Residues control samples are essentially done on the basis of tomato tonnages. The control of residues is infrequently defined by growers themselves (16% of farms); generally, tomato producers are included in plans defined by stations and buyers.

Table 11. Summary of Tomato Growers' Pest Management Features in Morocco.

Practices	Frequency	Practice	N/86 (%)
IPM	Very strong	Yellow traps	100%
		Elimination of contaminated plants	100%
		Curtains for doors	100%
		Weeding	100%
		Equipment cleaning	99%
		Wall spraying	97%
		Pheromones	97%
	Strong	Footbaths	86%
	Fair	Biological auxiliaries	71%
		Blue traps	63%
ICM	Fair	Soil water in excess control	63%
Chemical Spraying Management	Very strong	Treatment recording	100%
		External support to treatment decision	100%
	Strong	Autonomy from input supplier in treatment decision	87%
External control	Very strong	Pesticides residues control plan	98%
	Strong	Audit	83%
		GlobalGAP certification	83%
	Fair	GG certificate for more than five years	53%
		GG certification option 2	40%
	Weak	Internal pesticides residues control plan	16%
	Very weak	TESCO's Nurture certification	9%
		Organic farming certification	3%

Good Agricultural Practices certification. Most of the farms surveyed are either already GlobalGAP certified (67 on 86) or under the process of being certified (11). The difference between tomato growers is the year of adoption, which spreads out between 2003 and 2011, bringing to light early-adopters and followers (Figure 16). A few farms combine GlobalGAP and TESCO's "Nurture" certification. Let us note that four producers gave up their certification during the period studied. Finally, only four farms on 86 have never been certified and are not in the course of certification.

Figure 15. Good Agricultural Practices certification.

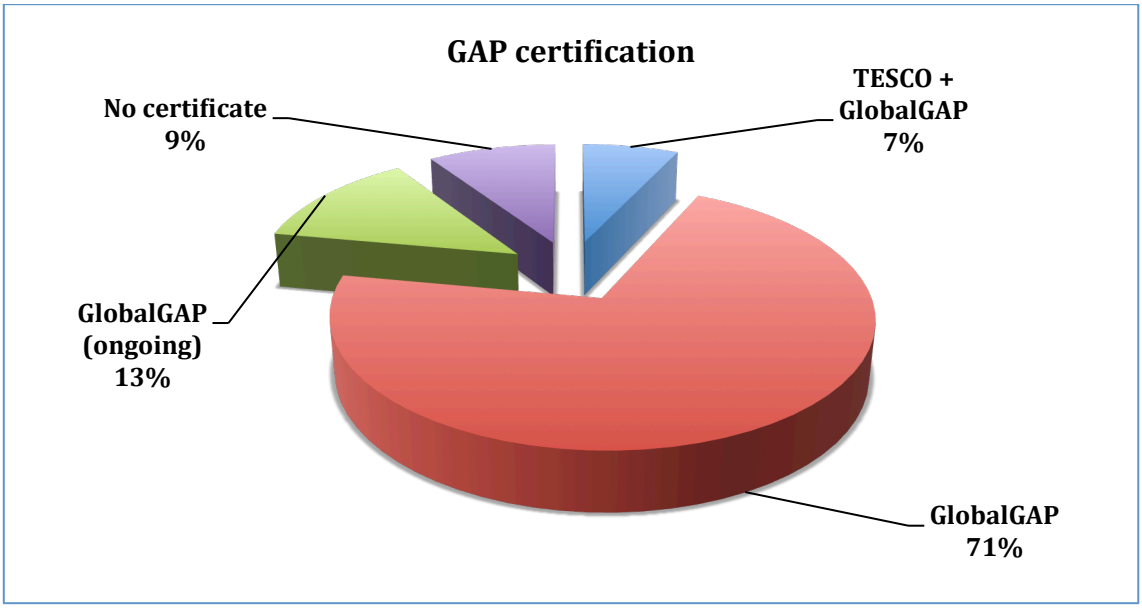
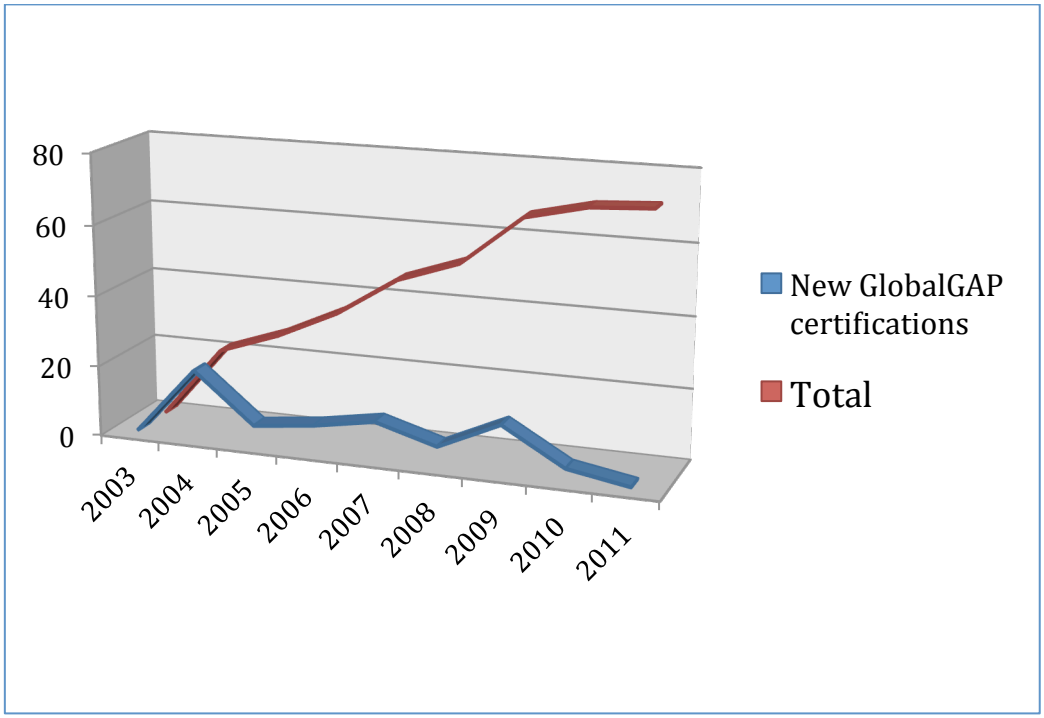
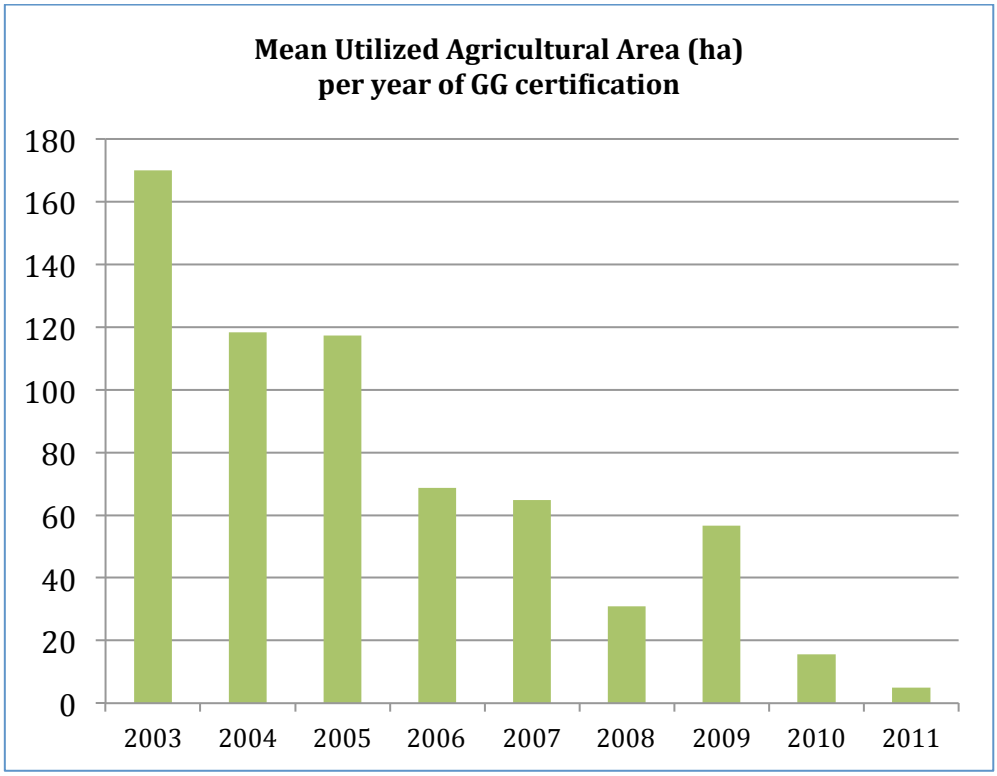


Figure 16. Dynamics of GlobalGAP certification in the 2000s.



The certified GlobalGAP greenhouses are not necessarily bigger than the uncertified ones, but we notice that early-adopters are larger than late-adopters (Figure 17).

Figure 17. Size and of GlobalGAP certification.



2.E. GROWER SURVEY ANALYSIS OF IPM AND GAP ADOPTION

Five typologies based on tomato producers' **patterns of pest management** are made to analyse the characteristics of farms with different levels of IPM and GAP (Table 12). Souss-Massa farms belonging to groups 1 are the most advanced in the use of alternative practices and the management of pesticide safety risk. For example, in the typology based on the use of biocontrol, farms belonging to group 1 do use auxiliaries, whereas farms of group 2 have not adopted this alternative way of managing insects.

Table 12. Typology of farms based on their pest management features.

	Group 1	Group 2	Group 3
Biological auxiliaries	Yes	No	/
Blues traps	Yes	No	/
Decision-making based on input dealer	No	Yes	/
Computer pesticides recording	Yes	No	/
GlobalGAP certification	Early adopters (2003-2006)	Followers (2007-2011)	Non adopters

A summary of cross-sectional data is presented in Table 13. Note that these preliminary findings should be completed by rigorous statistical tests.

Table 13. Characteristics of growers from Group 1.

		Biological auxilliaries	Blue traps	GlobalGAP (early adopters)
Farmer	**Age**	+	+	+
	Education	+	+	+
	Other income	+	+	+
	Coop member	-	+	
Size/Capital	**Land in property**	+	-	
	Workforce	+	+	+
	Farm acreage	+	+	+
	Greenhouse acreage	+	+	+
Productivity	**% Greenhouse**	-	-	+
	Specialization	-	-	+
	Yield	-	+	-
Risk assess.	**Pest presure**	+	+	+
	Disease pressure	+	+	+

Farmers that have adopted **biological auxiliaries** head much larger farms, whatever it is assessed by total labour (50 workers against 17), farm size (89 ha against 23) or area under greenhouse (67 ha against 18). Data suggest that they are a little older and better educated, have more frequently other sources of income than tomato (72% against 52%). There is a higher probability that their farm is externally audited (Table 14).

We find the same characteristics for farms with **blue traps** targeting Tuta absoluta, although the difference with other farms is less important for area (77 ha against 52) and greenhouse size (59 against 40). Total labour is more than two-times the amount of other farms (48 workers against 22).

In terms of chemical spraying management, farms with **computer-assisted traceability** are also larger, for example their average area under greenhouse is 99 ha, against 54 for farms that only record pesticides data on paper (Table 15). Finally, the majority of farmers who do not base their decision on **the advice of inputs dealers** head larger farms: on average 83 ha including 64 ha of greenhouse, against 37 ha and 30 ha of greenhouse for other farmers.

Early adopters of **GlobalGAP certification** are a little older and have more frequently other sources of income (Table 16). Their farms are much larger: 108 ha on average, against 49 ha for "followers" and 30 ha for non-adopters. The farms are also the most specialised in tomato grew under protected cultivation, with 83% of area under greenhouse and 65% of UAA in tomato.

Table 17 shows another typology of farms, based on their **degree of vertical integration** within the tomato supply chain. The owners of packing units are the most integrated farms. They are by far the largest operators, with more than twice the average labour (94 workers against 41) and farm area (156 ha against 70). In terms of size, co-owners of packing units come second. Cooperative membership is logically more frequent in these farms (all but one) and in farms affiliated to a cooperative packer.

Table 14. Integrated Pest Management practices.

	Auxiliaries (No)	Auxiliaries (Yes)	Blue traps (No)	Blue traps (Yes)	All
N	**25**	**61**	**24**	**62**	**86**
Farmer characteristics					
Age of farm head	46.3	53.5	48.8	52.3	51.3
Education	3.4	3.9	3.6	3.8	3.8
Other sources of income (%)	52	72	46	74	66
Total labour	16.6	50.4	22.4	47.6	40.6
Coop membership (%)	64	57	54	61	59
Farm characteristics					
Total farm area (ha)	23.4	88.8	51.7	76.8	69.8
Greenhouse area (ha)	18.3	68.6	40.4	59.2	53.9
Area under full property (%)	51.5	55.6	67.3	49.5	54.5
Tomato (% of UAA)	52.9	58.7	55.8	57.5	57.0
Greenhouse (% of UAA)	77.4	73.7	76.6	74.1	74. 8
Loose classic tomato (% of tomato area)	52	45	52	46	47
Tomato production					
Loose classic tomato yield (kg/m2)	19.4	18.4	18.5	18.8	18.7
Third party control					
External audit (%)	0	28	13	23	20
Control plan for pesticide residues (%)	96	98	100	97	98
Risk assessment					
Disease pressure	1.4	1.9	1.5	1.8	1.7
Pest pressure	2.3	2.8	2.6	2.7	2.6

Table 15. Chemical spraying management.

	Advice of input dealer (Yes)	Advice of input dealer (No)	Computer recording (Yes)	Computer recording (No)	All
N	**25**	**61**	**30**	**56**	**86**
Farmer characteristics					
Age of farm head	49.6	52.0	52.6	50.7	51.3
Education	3.4	3.88	3.97	3.6	3.7
Other sources of income (%)	60	69	73	63	66
Total labour	26.3	46.5	57.7	31.4	40.6
Coop membership (%)	60	59	50	64	59
Farm characteristics					
Total farm area (ha)	37.0	83.2	98.8	54.3	69.8
Greenhouse area (ha)	29.8	63.8	86.7	36.4	53.9
Area under full property (%)	45.3	58.2	48.9	57.4	54.5
Tomato (% of UAA)	57.0	57.1	64.2	53.2	57.0
Greenhouse (% of UAA)	79.5	72.8	81.7	71.0	74. 8
Loose classic tomato (% of tomato area)	54	44	48	47	47
Tomato production					
Loose classic tomato yield (kg/m2)	20.0	18.2	17.7	19.3	18.7
Third party control					
External audit (%)	4	26	30	14	20
Control plan for pesticide residues (%)	96	98	100	96	98
Risk assessment					
Disease pressure	1.3	1.9	2.0	1.6	1.7
Pest pressure	2.4	2.8	3.2	2.4	2.6

Table 16. GlobalGAP certification.

	GG Early adopters (2003-2006)	GG Followers (2007-2011)	Non - adopters	All
N	**35**	**36**	**15**	**86**
Farmer characteristics				
Age of farm head	54.1	50.5	47.3	51.3
Education	3.9	3.7	3.4	3.7
Other sources of income (%)	74	64	53	66
Total labour	61.9	24.9	28.6	40.6
Coop membership (%)	63	53	67	59
Farm characteristics				
Total farm area (ha)	108.3	48.8	30.4	69.8
Greenhouse area (ha)	94.9	27.2	22.5	53.9
Area under full property (%)	53.4	56.5	52.1	54.5
Tomato (% of UAA)	65.6	54.5	43.2	57.0
Greenhouse (% of UAA)	82.8	69.6	68.4	74.8
Loose classic tomato (% of tomato area)	46	50	43	47
Tomato production				
Loose classic tomato yield (kg/m2)	18.5	18.6	19.7	18.7
Third party control				
External audit (%)	23	22	7	20
Control plan for pesticide residues (%)	100	100	87	98
Risk assessment				
Disease pressure	2.0	1.5	1.6	1.7
Pest pressure	3.0	2.4	2.4	2.6

Table 17. Vertical integration of tomato farms.

	Affiliated to private packer	Affiliated to cooperative packer	Owner of packing unit	Co-owner of packing unit	All
N	**13**	**38**	**14**	**15**	**86**
Farmer characteristics					
Age of farm head	48.4	50.3	51.9	56.9	51.3
Education	3.8	3.6	3.9	4.1	3.7
Other source of income (%)	62	55	86	87	66
Total labour	29.4	17.3	93.6	43.9	40.6
Coop membership (%)	31	79	7	93	59
Farm characteristics					
Total farm area (ha)	36.2	26.2	155.9	117.6	69.8
Greenhouse area (ha)	31.6	17.8	131.1	77.3	53.9
Area under full property (%)	26.6	64.4	37.0	61.1	54.5
Tomato (% of UAA)	67.2	55.6	59.8	54.7	57.0
Greenhouse (% of UAA)	79.3	70.1	79.9	75.3	74.8
Loose classic tomato (% of tomato area)	57	50	40	45	47
Tomato production					
Loose classic tomato yield (kg/m2)	18.2	18.3	19.4	20.3	187
Third party control					
External audit (%)	8	24	36	7	20
Control plan for pesticide residues (%)	92	97	100	100	98
Natural conditions					
Disease pressure	1.2	1.7	1.9	1.9	1.7
Pest pressure	2.4	2.6	2.8	2.7	2.6

3. ANNEXES

EXPERT MEETİNG AT THE EGE UNİVERSİTY (OCT 4, 2010)

Main topic: Managing the market risks with special target on safety risk management at fresh fruits and vegetables production level

Were attending the meeting:

Emin Yildirim, Turkish MinAgri, Department of Crop Protection;

Ufuk Uysal, Turkish MinAgri, Department of Crop Protection ;

Nurhayat Bayturan, Private Consultant ;

Yuksel Tuzel, Pr. at Ege Univ., Fac. of Agriculture, Dpt. of Horticulture ;

Tulin Kilic, Research Institute on Crop Protection in Izmir ; Onder Volkan Bayraktar, Student at Ege Univ., Fac. Agriculture, Dpt. of Ag Economics and Rural Studies ;

Murat Yercan, Pr. at Ege Univ., Fac. Agriculture, Dpt. of Ag Economics and Rural Studies ;

Dicle Hicyilmaz, Ege Univ., Fac. Agriculture, Dpt. of Ag Economics and Rural Studies ;

Hacer Kocaoglu, Turkish MinAgri Regional Service, Dpt. of Crop Protection;

Ekin Taskin, Aeagean Exporters' Association ;

Oner Tatli, Food Safety Control Lab., Izmir Region ;

Ahamadah Wakweya, Student at Ege Univ., Fac. Agriculture, Dpt. of Ag Economics and Rural Studies;

Hakan Adanalioglu, Post doctoral fellow at Ege Univ., Fac. Agriculture, Dpt. of Ag Economics and Rural Studies;

Sylvain Rousset, Research fellow in Ag Economics at CEMAGREF ;

Jean-Marie Codron, Senior Researcher in Ag economics at INRA Montpellier ;

Selma Tozanli, Prof. of Ag Economics at CIHEAM-IAMM Montpellier.

EXPERT MEETİNG AT THE IAV-CHA AGADİR (OCT 25, 2010)

Main topic: Managing the market risks with special target on safety risk management at fresh fruits and vegetables production level

Were attending the meeting:

Akka Aït El Mekki, Pr. at ENA-Meknes, Dpt. of Ag Economics

Imane Bennani, Master Student at ENA-Meknes

Lahcen Kenny, Pr at IAV – CHA, Dpt of Horticulture

Zouhair Bouhsina, engineer in Ag economics at INRA Montpellier

Sylvain Rousset, Research fellow in Ag Economics at IRSTEA ;

Jean-Marie Codron, Senior Researcher in Ag economics at INRA Montpellier ;

Other key informants that have been met during the exploratory mission (Oct 24-30) were:

Lahcen Laaouane, Principal authorizing officer at EACCE (Southern Region),

Lahcen Abaha, regional director of ONSSA (Souss Massa Drâa)

Hicham Hafid, auditor at Integra Belgique

Imad Jawhari, commercial sub-director of CASEM HORTEC (input dealer)

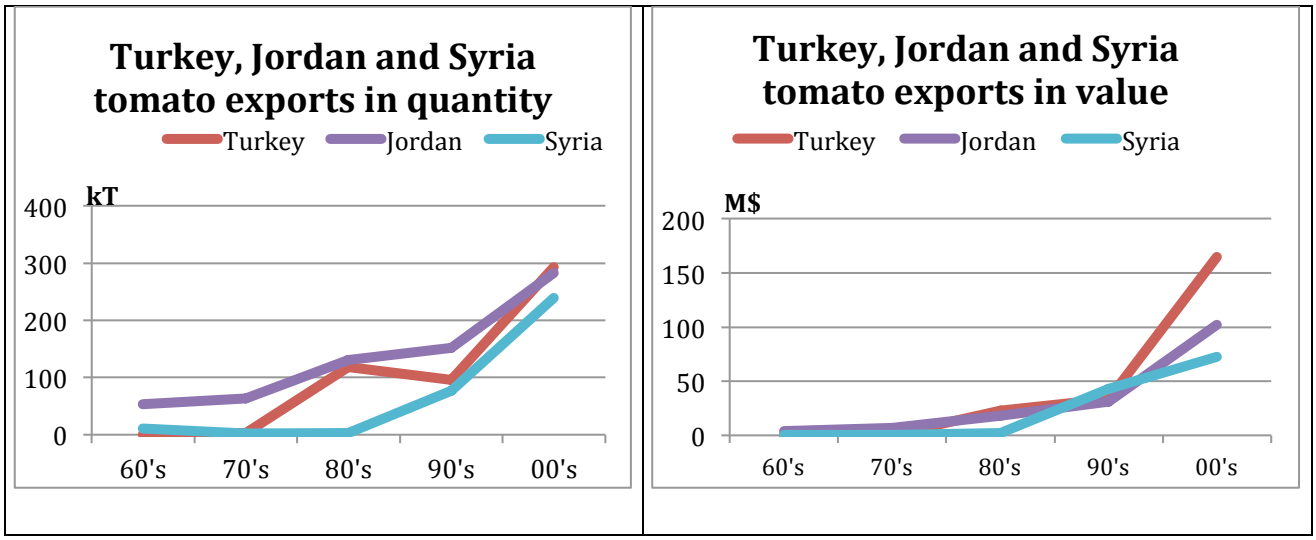
DATA ON THE TOMATO INDUSTRY

Table 1 : Tomato production of the top 10 tomato growing countries as well as South and East Mediterranean countries and the Netherlands for the last 50 years *(000 metric tons)*

Country	1960s		1970s		1980s		1990s		2000s	
	Volume	Rank	Volume	Rank	Volume	Rank	Volume	Rank	Volume	Rank
China	4 213	2	4 355	3	6 269	3	12 798	1	32 726	1
USA	5 414	1	6 894	1	7 979	1	11 218	2	12 785	2
USSR	3 584	3	5 774	2	7 311	2	7 058	3	-	-
Turkey	1 284	6	2 466	5	4 445	5	7 004	4	9 787	3
India	528	14	847	13	2 382	9	5 634	6	9 092	4
Egypt	1 221	7	1 893	7	3 460	6	5 143	7	7 955	5
Italy	3 137	4	3 525	4	5 257	4	5 799	5	6 633	6
Iran	134	31	241	28	1 010	14	2 472	10	4 556	7
Spain	1 306	5	2 140	6	2 424	7	3 135	9	4 155	8
Brazil	609	9	1 326	9	1 848	10	2 595	9	3 553	9
Bulgaria	732	8	783	14	821	15	479	29	390	37
Mexico	566	12	1 194	9	1 798	11	2 143	11	2 844	10
Morocco	250	24	373	22	500	23	898	19	1 149	16
Tunisia	111	35	234	29	388	28	593	24	997	19
Syria	147	30	373	23	686	19	457	20	992	20
Algeria	105	36	166	36	358	30	703	28	783	22
Netherlands	292	22	370	24	505	22	573	27	659	29
Israel	115	33	212	30	319	33	442	31	427	39
Jordan	182	27	134	38	216	37	356	32	499	34
Lebanon	47	50	69	49	153	41	271	38	269	46
World total	**30 957**		**41 322**		**62 162**		**85 660**		**129 037**	

Note : simple averages are calculated for the decades

Source : Authors' work based on FAO statistics, www.fao.org



QUESTIONNAIRE FARMER SURVEY IN TURKEY

I) SURVEY DATA

Name of the surveyor K1 ……..	Number of the survey …….	Date : K2 …/…../…	Municipality K3 …….	Village & town K4 …….

Name of the company: K5 …….	Address of the farm : K6 ……	Name of the interviewee: K7 ……	Position 1)Owner 2)General or Crop manager 3)Quality manager 4)Other ……
			K8

Q27. Age	K9 …….	**Q28.**Sex 1)Male 2)Female	K10 …….	**Q29.**Education year	K11 …….

Type of tomato 1) Loose classic 2) Cluster 3) Cherry 4) Cocktail 5) Other……	Do you have certificate? 1)Yes 2)No
K12 …….	K13 …….

II) COMPANY/FARM AND FARMER IDENTIFICATION/GENERAL DATA

II.1. Farm ownership and organization

Q1. Date of creation of the company	.....	Q1.1.how long greenhouse producing?	.....year	Q1.2.how long greenhouse tomato producing?	.....year

Q2. Company Legal status 1)Individual farmer 2) Non trading company 3) Limited Company 4)Co.Inc. 5) Cooperative 6) Other.....	…..

Q3. Number of owners	.....	Q4. Share of the capital of the main owner	.....%	Q5. Number of farms held by the company	.....

Q7. Total agricultural area of the company (decars)	Q8. Total Greenhouse area (decars)	Number of plastic greenhouses	Plastic greenhouse area (decars)	Number of glassgreenhouses	Glass greenhouse area (decars)	Soilless greenhouse area (decars)
.....	.....	....	....	...	...	.....

Q9. (*) total tomato area (decars)	The number of greenhouse with tomato	The area of greenhouse with tomato (decars)	The number of plastic greenhouses with tomato	The area of plastic greenhouses with tomato (decars)	The number of glass greenhouses with tomato	The area of glass greenhouses with tomato (decars)	The area of soilless greenhouse with tomato (decars)
.....	....	....	...	...	...	...	...

*2009-2010 production season...

Q10. Land tenure

TOTAL FARM LAND			TOTAL LAND WİTH TOMATO		
Own land (decars)	Renting (decars)	Share cropping (decars)	Own land (decars)	Renting (decars)	Share cropping (decars)
.....	.....	.....			

Q11. Is the farmer a member of a coop? 1) Yes 2)No	....
Q12. If yes, what kind of coop? 1) Village/Rural Development coop 2) Marketing coop 3) Credit coop. 4)Other……..	....
Q35. Does the owner belong to the board of an agricultural cooperative ?1) Yes 2)No	….
Q36. If yes, in which type of cooperative ? 1) Village/Rural Development coop 2) Marketing coop 3) Credit coop. 4)Other……	….

The type of cooperative	Services 1)marketing 2)input supply 3)processing and packing4)consultancy 5)credit 6)others.....
Village/Rural Development coop	……
Marketing coop	……
Credit coop.	……
Others……	…….

II.2.Last campaign (2009/2010) production

Q13. Tomato productions

GREENHOUSES			OPEN FIELD		
	Production (tons)	Yield (kg/decar)		Production (tons)	Yield (kg/decar)
Total tomato production	……	……	Total tomato production	……	……
Loose classic	……	……	Loose classic	……	……
Cluster	……	……	Cluster	……	……
Cherry	……	……	Cherry	……	……
Cocktail	……	……	Cocktail	……	……
Other (.....)	……	……	Other (.....)	……	……
Other (.....)	……	……	Other (.....)	……	……

Q14. Other Vegatebles Production

GREENHOUSES		OPEN FIELD	
Melons (tons)	.....	Melons (tons)	.....
Green beans (tons)	.....	Green beans (tons)	.....
Zucchini (tons)	.....	Zucchini (tons)	.....
Peppers (tons)	.....	Peppers (tons)	.....
Eggplant (aubergine) (tons)	.....	Eggplant (aubergine) (tons)	.....

Garden peas (tons)	.....	Garden peas (tons)	.....
Gherkins (tons)	.....	Gherkins (tons)	.....
Other : ……	.....	Other : ……	.....
Other: ……(tons)	.....	Other: ……(tons)	.....
Other: ……(tons)	.....	Other: ……(tons)	.....
Other: ……(tons)	.....	Other: ……(tons)	.....

II.3.Tomato Marketing

Q15. Does the farm own a packing firm? 1) Yes 2)No	....
Q16. If no, is the farm affiliated to a packing firm? 1) Yes 2)No	....
Q16.1. If no affliated, why ?.....	....
Q17. If it is affiliated, what is the status of the packing firm? Private 2) Cooperative 3) Public	.....

Q18.For the season 2009/2010 (last campaign)

Type of tomato[1]	Buyers[2]	Quantity sold (kg)	Currency 1)TL 2)€ 3)$	Sales price	Type of selling[3]	Sales period[4]
……	……	……	…	……	……	……
……	……	……	…	……	……	……
……	……	……	…	……	……	……
……	……	……	…	……	……	……
……	……	……	…	……	……	……

……	……	……	…	……	……	……
……	……	……	…	……	……	……
……	……	……	…	……	……	……
……	……	……	…	……	……	……
……	……	……	…	……	……	……
……	……	……	…	……	……	……

[1] 1) loose classic 2)cluster 3) cherry 4) cocktail 5) other.....

[2] 1) Merchant 2) Export 3) City hall 4) Retailers 5)open market

6) Cooperative/association 7) Affialiated packing firm 8) Other packing firm 9)Others.....

[3] 1) cash 2)instalment

[4] 1)January 2)February 3)March 4)April 5)May 6)June 7)July 8)August 9)September 10)October 11)November 12)December

Do you sell tomato to the local market with your private brand? 1) Yes 2)No	....
If yes, what is the share of tomato sold with your private brand?	....%

Do you export tomato? 1) Yes 2)No	....
If yes, what is the quantity of tomato exported in 2009/2010?	.....tons

If yes, continue with Q23. If no, continue with Q20 and Q21.

Q23. what was the share of the different countries for each type of tomato ?

Type of tomato	EU COUNTRIES	NON-EU COUNTRIES

Loose classic	.....%	.....%
Cluster	.....%	.....%
Cherry	.....%	.....%
Cocktail	.....%	.....%
Others.....	.....%	.....%

THE SHARE OF EU COUNTRIES

Type of tomato	France	Germany	UK	Holland	Bulgaria	Other EU
Loose classic	.....%	.....%	.....%	.....%	.....%	.....%
Cluster	.....%	.....%	.....%	.....%	.....%	.....%
Cherry	.....%	.....%	.....%	.....%	.....%	.....%
Cocktail	.....%	.....%	.....%	.....%	.....%	.....%
Others.....	.....%	.....%	.....%	.....%	.....%	.....%

THE SHARE OF NON-EU COUNTRIES

Type of tomato	Russia	Ukrain	Other Commonwealth Countries*	Arab Countires	Others
Loose classic	.....%	.....%	.....%	.....%	.....%
Cluster	.....%	.....%	.....%	.....%	.....%
Cherry	.....%	.....%	.....%	.....%	.....%
Cocktail	.....%	.....%	.....%	.....%	.....%
Others.....	.....%	.....%	.....%	.....%	.....%

*Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan , Uzbekistan, Georgia, Belarus, Moldova, Armenia

Q20. If no, do you know how much volume of your tomatoes has been exported in	.....

2009/2010? 1) Yes 2)No	
Q21. If yes, the share of exported tomato during the last campaign (2009/2010)	…..%

Q24. Beyond the importer, do you know your final customers in the destination countries ? 1) Evet 2)Hayır	....
Q25. If yes, do you know if your tomatoes are sold with retailer private brand ?1) Evet 2)Hayır	....
Q25.1.If yes, which brand?	.....

II.4.Farmer Identification

Q30. How much time does the owner spend on his farm? 1) < 10 h/week 2) 10 - 20 h/week 3) 21 - 30 h/week 4) 31-40 h/week 5) above 40 h/week	.....
Q31. How much is the owner involved in daily management, like crop farming or pesticide spraying? 1)Weak 2) Regular 3) High	.....
Q32. Does the owner have other jobs?1)Yes 2)No	.....
Q33. If yes, spell out those jobs? 1)..... 2)..... 3)..... 4)..... 5).....6).....	.....

Q34.2. Income sources for crops

Vegetable&Field Crops	Fruits

Tomato	.....TL	Citrus	.....TL
Green beans (tons)	.....TL	Pomegranate	.....TL
Zucchini (tons)	.....TL	Peaches	.....TL
Peppers (tons)	.....TL	Plump	.....TL
Eggplant (aubergine) (tons)	.....TL	Grape	.....TL
Garden peas (tons)	.....TL	Cherry	.....TL
Gherkins (tons)	.....TL	Other (.....)	.....TL
Potato	.....TL	Other (.....)	.....TL
Wheat	.....TL	Other (.....)	.....TL
Barley	.....TL	Other (.....)	.....TL
Other (.....)	.....TL	Citrus	.....TL
Other (.....)	.....TL	Pomegranate	.....TL
Other (.....)	.....TL	Peaches	.....TL

Q34. Income sources of owner for 2009/2010	
Income from crops	.....TL
Income from animal production	.....TL
Wage from other farms	.....TL
Government subsidies	.....TL
Non-agricultural income	.....TL
Retirement and other pensions, other transfers	.....TL
Others (.....)	.....TL
Total Income	.....TL

II.5.General or crop manager identification

Do you have production manager in your farm? 1) Yes 2)No	....

Q37.Age	.....	Q38.Sex 1)Male 2)Female	.....	Education year	.....
Q39. Highest diploma in agricultural education for the production manager? 1)No agricultural education 2) Primary school 3) High school 4) Vocational school 5)Undergraduate level at the University 6) Agriculture Engineer 7)Graduate Level					.....

II.6.Human Resources

Q40. Permanent family labor	Number	Working Days	Daily working hours	Total wage (TL)
Farmer	……	……	……..	…….
Wife	……	……	……..	…….
Relative (M)	……	……	……..	…….
Relative (F)	……	……	……..	…….
Father	……	……	……..	…….
Mother	……	……	……..	…….
Kid (M)	……	……	……..	…….
Kid (F)	……	……	……..	…….
Other……. (M)	……	……	……..	…….
Other …… (F)	……	……	……..	…….

Q41. Permanent non-family labor	Number	Working Days	Daily working	Total wage

			hours	(TL)
Manager/crop manager	.....	.....	.....	.....
Crop protection manager	.....	.....	.....	.....
Quality manager	.....	.....	.....	.....
Logistic manager	.....	.....	.....	.....
Team manager	.....	.....	.....	.....
Workers (M)	.....	.....	.....	.....
Workers (F)	.....	.....	.....	.....

Q44. Domateste Çalışan Geçici/Mevsimlik İşgücü	Number	Working Days	Daily working hours	Total wage (TL)
Workers (M)	……	……	……..	.....
Workers (F)	……	……	……..	.....

III. SAFETY RISK MANAGEMENT IN GREENHOUSE TOMATO PRODUCTION

III.1.Greenhouse characteristics

Type of greenhouse cover? 1)Glass 2)Plastic	.....
Q45. What is the construction material used in the greenhouse frame? 1) Wood 2) Iron 3) Galvanized iron 4) Aluminium	.....glass greenhouse .....plastic greenhouse
Shape of greenhouse? 1)Single 2) Multi-chapel	.....
Q46. Heating? 1) Yes 2) No	.....
Q47. If yes, % with heating?	.....%
Q47.1. If yes, what is the source of heating material? 1)Wood 2)Coal 3)Fuel 4)Diezel 5)LPG 6)Gas 7)Jeotermal 8)Solar 9)Biogas 10)Elektricity	.....

11)Other.....	
Q47.2. If no, what kind of passive method used? 1)Fall and spring production method 2)inside isolation 3)glass material 4) Polietilen plastic 5)Double covered material 6)thermal curtain 7)low tunnel 8)mulching 9) Wind shelter 10) Roof sprinkler 11)Others.....	.....
Q50. Drip irrigation? 1) Yes 2) No	....

III.2.Disease prevention practices

Production periods? 1) Single production 2) Double production	....
Q51.If single production :	...../...../.....plantation date .....harvest number ...../...../.....start for harvest ...../...../.....end for harvest
Q52.1.If double production (Fall)	...../...../.....plantation date .....harvest number ...../...../.....start for harvest ...../...../.....end for harvest
Q52.2. If double production (Spring)	...../...../.....plantation date .....harvest number ...../...../.....start for harvest ...../...../.....end for harvest

Q53. Plantation dates are chosen according to ? 1) Never effective 2)low effective 3)moderate effective 4)rather effective 5) strong effective

1.Demand, Commitment with our customers	…….
2.Technical and farm management constraints	…….
3.Safety risk management	…….
4.Packing requirement	…….
5.Heating cost	…….
6.Other……	…….

Q55. Type of tomato	Density (n / decars)
Loose classic	.....
Cluster	.....
Cherry	.....
Cocktail	.....
.....	.....
.....	.....

Q56. Integrated pest management practices (IPM practices) 1) Never 2)Seldom 3)Sometimes 4) Mostly 5) All the time	
Harvest and cropping equipment cleaning	…….
Greenhouse walls washing and spraying with insecticide	…….
Existence of footbaths at each entrance of the greenhouse	…….
Water in excess control in soil	…….
Weeding in and outside the greenhouse	…….
Yellow sticky traps	…….
Elimination of the first contaminated plants	…….
Use of biological auxiliaries	…….

Rotation	…….
Curtain for doors	…….
Automat Climatic conditions	…….
Bombus bees	…….
Rezisted varieties	…….
Enough time between chemical treatments and harvest	…….
Other……	…….
Other ……	…….
Other ……	…….

III.3.Safety pressure

Q57. In the following two lists of tomato pest and diseases, please evaluate the pressure for each of them by giving a number between 0 (absent) and 10 (very high)	
1.Mites	……
2.White flies/Aleurodes	……
3.Cut worms	……
4.Aphids	……
5.Tarnished plant bugs	……
6.Thrips	……
7.Tuta absoluta/leaf miner	……
8.Other……..	……
9.Other……..	……
10.Other……..	……

Q58. Disease please evaluate the pressure for each of them by giving a number between 0 (absent) and 10 (very high)	
1.Alternaria	……
2.Anthracnosis	……
3.Bacteriosis	……
4.Botrytis/Grew mould	……
5.Cladosporiosis	……
6.Fusariosis	……
7.Mildiou/late blight	……
8.Mycosphaerella	……
9.Oïdium/powdery mildew	……
10.Rust	……
11.Nematod	……
12.Other……..	……
13.Other……..	……
14.Other……..	……

III.4.Pest monitoring

Q59. Is there some pest monitoring for tomato? 1) Yes 2)No	....
Q60. who is in charge of the monitoring? 1)Farmer ownself 2) General/crop manager 3)Farm technician 4) Team manager 5) Greenhouse Worker 6) Other farm employee 7) Packing technician 8) Outside intervention: ……..	.....

Frequency for pest monitoring? 1)Everyday 2)Once a week 3)2-4 a week 4) once in 2 week 5)Once in a month	.....

Are you affiliated to any agricultural consultant ? 1) Yes 2) No	.....
If yes, how much pay for this in a year?	.....TL
Are you receiving any goverment support for this consultancy? 1) Yes 2) No	.....
If yes, how much you received?	.....TL

Q62. Type of trap? 1) Yellow 2)Blue 3)Delta 4) Pheremon recipient 5)Diğer.....	.....

Type of trap	Target	Quantity / decars	Price per each (TL)
Yellow panel	.....	.....	.....
Blue panel	.....	.....	.....
Delta trap	.....	.....	.....
Pheromon recipient	.....	.....	.....
Other.....	.....	.....	.....
Other.....	.....	.....	.....

III.5.Use of biological auxiliaries

Q63. Use of biological auxiliaries 1) Yes 2) No	.....
Q64. If yes, first year of introduction?	.....

Q66. Auxiliary	Target	When (day and month)	Number of introductions during the 3 months time span before the start of harvest	Introduction to greenhouse according to : 1) economic damage threshold 2)Initial time for damage 3)Other…….. ……..
Eretmocerus mundus	……..	...../.....	…….	……..
Eretmocerus eremicus	……..	...../.....	…….	……..
Encarsia Formosa	……..	...../.....	…….	……..
Macrolophus caliginosus	……..	...../.....	…….	……..
Nesidicoris tenuis	……..	...../.....	…….	……..
Typhlodromips swirskii	……..	...../.....	…….	……..
Dicyphus hesrus	……..	...../.....	…….	……..
Aphidoletes	……..	...../.....	…….	……..
Trichogramma pretiosum	……..	...../.....	…….	……..
Podisus nigrispinus	……..	...../.....	…….	……..
Other……	……..	...../.....	…….	……..
Other……	……..	...../.....	…….	……..
Other……	……..	...../.....	…….	……..

Q67. Why do you use auxiliaries ? (selecting a number from 1 to 5)

1) Never effective 2)low effective 3)moderate effective 4)rather effective 5) strong effective

Economizing	……
More efficient than pesticides, no efficient alternative, technical dead-lock	……
Minimizing pesticides residues, avoid problems of delay between spraying and harvesting	……
Comply with customer requirements, keep one's customers/markets	……
Willing to improve agricultural practices	……
Other growers do it	……
Other……	……
Other……	……
Other……	……

Q68. Do your farm produce auxiliaries?1) Yes 2) No	.....
Q69. When you buy auxiliaries, do your seller provide you with technical assistance after auxiliary introduction? 1) Yes 2) No	.....
Q70. If Q69 is yes, how frequently does he do it on average during the campaign? 1 or more / week 2) 1 or 2 / month 3) more than 2 / month	…..

III.6.Chemical protection

Q71. Did you cancel any treatment with synthetic pesticides on your farm (or part of your farm) ? 1) Yes 2) No	.....
Q72. If yes, since what year?	.....
Q73. If yes, on what percentage of your greenhouse area?	.....%
Q73.1. Why do you not use pesticide in this parcel? 1)For my household 2) for customer demand 3)testing for the results with no pesticide 4) Others.....	.....
Q74. On those areas without any treatment with synthetic pesticides, did you cancel any treatment with organic or mineral products? 1) Yes 2) No	.....

Q75. Do you register pesticides spraying? 1) Yes 2) No	.....
Q76. If yes, how do you do it? 1) Sheet of paper 2) By entering data in computer	.....
Q77. More precisely, what do you register? 1) Date of intervention 2) Phenologic state of the plant 3) Name of the product 4) Dosis 5) Duration of the intervention 6)Other.....7)All	 .....

Q78. Table of pesticides applications

Kullanım Amacı 1) Mites 2) White flies 3)Tetranychus	Commercial name of the product	Number of spraying operations during the last campaign	Dosis 1)gr/100 lt 2)ml/100 lt	Area sprayed for 100 lt mixture (m^2)

4)Cut worms 5)Trips 6)Aphids 7) Tarnished plant bugs 8) Tuta absoluta 9) Alternaria 10) Anthracnosis 11) Bacteriosis 12) Botrytis/Grew mould 13) Cladosporiosis 14) Fusariosis 15)Mildiou 16) Mycosphaerella 17) Oïdium/powdery mildew 18) Rust 19)Other…….. 20)Other…….. 21)Other……..				
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III.7.Decision and assistance

Q79. How do you decide the use of a pesticide? (selecting a number from 1 to 5) 1) Never effective 2)low effective 3)moderate effective 4)rather effective 5) strong effective	
In a preventive and automatic way	……
According to my knowledge of pest and disease history	……

According to observations during the process of production	……
According to economic criteria	……
According to the advices of input suppliers	……
According to the advices of some private assistance	……
According to the advices of the coop.	……
According to the advices of the control and certification	……
According to the advices of the farm consultant in Agricultural Ministry	……
According to the advices of the packing technicians	……
Others……	……

Q80. When you buy pesticides, does your seller provide you with some technical assistance regarding the use of pesticides? 1) Never 2) Seldom 3) Somewhat 4)Rather 5) Always	.....
Q82. What are your sources of knowledge about plant protection? (selecting a number from 1 to 5) 1) Never effective 2)low effective 3)moderate effective 4)rather effective 5) strong effective	
Other growers	……..
Auxiliary suppliers	……..
Other input suppliers	……..
Coop or packing technician	……..
AgMinistry technician	……..
Private consultant /technician	……..
Research/University	……..
Media (journals, radios..)	……..
Other : ……	……..
Other : ……	……..

Q84. Have you heard of administrative actions for promotion of biological methods and auxiliaries for plant protection? 1) Yes 2) No	.....
Q85. If yes, which one did you heard? 1)Nets (70.00 TL/decar) 2) Pheromon recipient +Trap (30 TL/decar) 3) Auxiliaries (100 TL/decar) 4) Nets + Pheromon recipient +Trap (100 TL/decar) 5) Pheromon recipient + trap + auxiliaries (130 TL/decar) 6) Nets + auxiliaries (170 TL/decar) 7) Nets + pheromon recipient + auxiliaries (200 TL/decar)	….

Q86. If yes, how did you hear from such actions? 1)AgMinistry staff 2)Other growers 3)Input suppliers 4)Auxiliary suppliers 5)Coop/packing technician 6)Other technician 7)Private consultant	……

8)Research/University 9)Media (journals, radios..) 10)Other : ……..	

Which promotions have you received?

Promotions	1)yes 2)no	Promotion received for last campaign (TL)
Biological auxiliaries	……	…….
Bombus bee	……	…….
Fertilizer promotion	……	…….
Fuel promotion	……	…….
Soil analysis	……	…….
GAP promotion	……	…….
Organic agriculture	……	…….
Greenhouse insurance	……	…….
Other.....	……	…….
Other.....	……	…….
Total	……	…….

IV. CERTIFICATION AND QUALITY

IV.1.Existence of a certificate

Q87. Is you firm certified in last campaign? 1) Yes 2)No	.....
If yes, what kind of certification?	….

1)GlobalGap (EUREPGAP) 2)Turkish Global Gap 3)Tesco Nurture 4) LEAF 5)Organic 6) Other.....	
Q87.1.If yes, option? 1)Individual 2)Group	….
If yes, is tomato concerned by such certificate ? 1)Yes 2) No	….

Annual Cost of the Certificate	(TL/year)
GlobalGap (EUREPGAP)	.....
Turkish Global Gap	.....
Tesco Nurture	.....
LEAF	.....
Organic	.....
Other.....	.....
Other.....	.....

Q88. If your firm is certified, how many external audits were made during the campaign 2009-2010?	....times
Q89. Was your firm certified in the past for tomato ? 1) Yes 2)No	……

Q89.1. If yes,

Certifications	First year of certification	Year of possible abandon of the certificate
GlobalGap (EUREPGAP)	.....	.....
Turkish Global Gap	.....	.....
Tesco Nurture	.....	.....
LEAF	.....	.....

Organic	.....	.....
Other.....	.....	.....

Q90. If the certificate has been abandoned, reasons? (selecting a number from 1 to 5) 1) Never effective 2)low effective 3)moderate effective 4)rather effective 5) strong effective	
Certificate too costly	…...
Red tape, too much paper	…...
Less sales for export	…...
Not profitable	…...
No price differentation	…...
Other raison:…….	…...

IV.2.In house Control

Q91. Is there a grading system within your firm? 1) Yes 2)No	…..
Q92. Does your firm perform self-control to prepare external audits? 1) Yes 2)No	…..
Q93. If yes, who performs such control? 1)Farmer ownself 2)Firm employee 3) External/third party auditor	…..
Q94. Is there some pesticide residue plan of control within the firm? 1) Yes 2)No	…..
Q95. If yes, how was such a plan elaborated? 1) Self elaborated 2) Imposed by the packing firm, by the exporter 3) Imposed by final customers (supermarket…)	…..
Q96. Was the number of analysis fixed according to the following criteria? 1) Volume 2) Varieties 3)Cultivated area	…..

IV.3.Good practices training

Q97. How frequency applying good agricultural practices training? (selecting a number from 1 to 5) 1) Never 2)only one time 3)several time 4)mostly 5) regularly	
Worker training for handling chemical products, disinfectants, pesticides, biocides or other dangerous stuff	……..
Appropriate formation on safety and health issues for all employees	……..
Formation to first emergency actions on each farm (at least one person)	……..
Basic formation on hygiene	……..
Formation on traceability and record keeping	……..
Pesticides regulation	……..
Spraying equipment tuning/setting	……..
Pest and disease observation	……..
Other : …….	……..

Q98. Persons that have been trained	Numbers
Owner	.....
General/crop manager	.....
Pesticide operator	.....
Quality manager	.....
Team manager	.....
Workers	.....

V. PRODUCTION COSTS

V.2.Certification Costs *(if it is certified, !)*

Q100. When starting a certification procedure, how do you perceive the costs of implementation for complying with the certificate requirements? 1) Prohibitive 2) Fairly high 3) Moderate	.....

Q101. Which initial costs are according to you, the highest when starting a certificate ? (list the first three ones)		
……(1.)	……..(2.)	……(3.)

Q102. How do you perceive the recurrent costs of certification, when the certificate is already obtained? 1) Prohibitive 2) Fairly high 3) Moderate	.....

Q103. . Which recurrent costs are according to you, the highest when the certificate is already obtained? (list the first three ones)		
……(1.)	……(2.)	……(3.)

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