The structural characteristics, economic performance and prospects for the Italian cactus pear industry

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ABSTRACT

This paper summarizes the results of a recent agro-economic survey of the Italian Cactus pear industry to assess its structure and competitiveness. To this end, a search was conducted to monitoring the production economics and market for Cactus pears (*Opuntia ficus indica*) for ten years, carried out a rigorous analysis of a sample company local firms chosen as a case study – using analyses of technical and economic efficiency - to be able to define the structure and potential of the cactus pear industry. Cactus pear is a tropical and subtropical crop important in agricultural economies throughout arid and semiarid parts of the world. Multivariate analysis was applied to understanding the dynamics of the developmental processes involved, the opportunities and threats to the industry and various industry expert assessments were included, often used to construct territorial analysis models with a systemic approach. The analysis shows that cactus pear sector plays a strategic role in areas with a high 'ruralness' index where often the other fruits species don't find suitable conditions (especially for problem concerning water resources). In these contexts the cactus pear cultivation has become particularly diffuse raising employment and creating income for the primary sector and territory, encouraging the development of the local resources.

***Keywords*:** Economical indices, Multi-Sectoral Qualitative Analysis (MSQA), cactus pear and fruit supply chain.

INTRODUCTION

Cactus pear cultivation is not a particularly large sector within Italy's fruit sector, but is vital to the economies of certain areas and is an essential source of employment and income due to its exports to the European Union (EU) and non-EU countries (Griffith, 2004).

In Sicily, typical region belonging to the subtropical areas, where cactus pear accounts for over 96% of the total Italian harvest, official statistics (ISTAT) show a surface area of 8.3 thousand hectares producing about 87 thousand tons annually. The increasing interest in

cactus pear cultivation is because it's present in areas with a high 'ruralness' index (the three macro-typologies of areas identified are: intensive agriculture rural areas; intermediate rural areas; and rural areas with comprehensive development problems). These areas suffer of problems typical of more marginal areas in terms of development and lack of services to enterprises and the population, as well as scarcity of infrastructure, with a lower resident population density and different degree of specialization productive. Rural areas account for 93.2 % of Sicilian territory and 65.6% of resident population. In these contexts, the cactus cultivation plays an important role representing an important source of income and employment for the local communities, thus helping to prevent the depopulation phenomena and the abandonment of these areas (Nobel, 2002; Inglese, 2010).

In particular, cultivation is heavily concentrated in four areas referred to in previous studies conducted by the University of Catania as the 'San Cono Hills' (located between the provinces of Catania, Enna and Caltanissetta), 'South West Etna' (in the province of Catania), the 'Belice Valley' (in the communities of S. Margherita Belice, Menfi and Montevago, in the Province of Agrigento) and the 'Torto Valley' (Roccapalumba and other communities in the Province of Palermo), as shown in Figure 1. These areas are intensively cultivated concentrating much capital and labor, generating considerable income in all the associated agricultural services. Domestic and foreign demand seems to have grown as shown by modern consumer demand for tropical and sub-tropical fruits, among which the cactus pear is now included. Although Italian cactus pear cultivation has shown a positive trend, there are some weaknesses restricting its prospects.
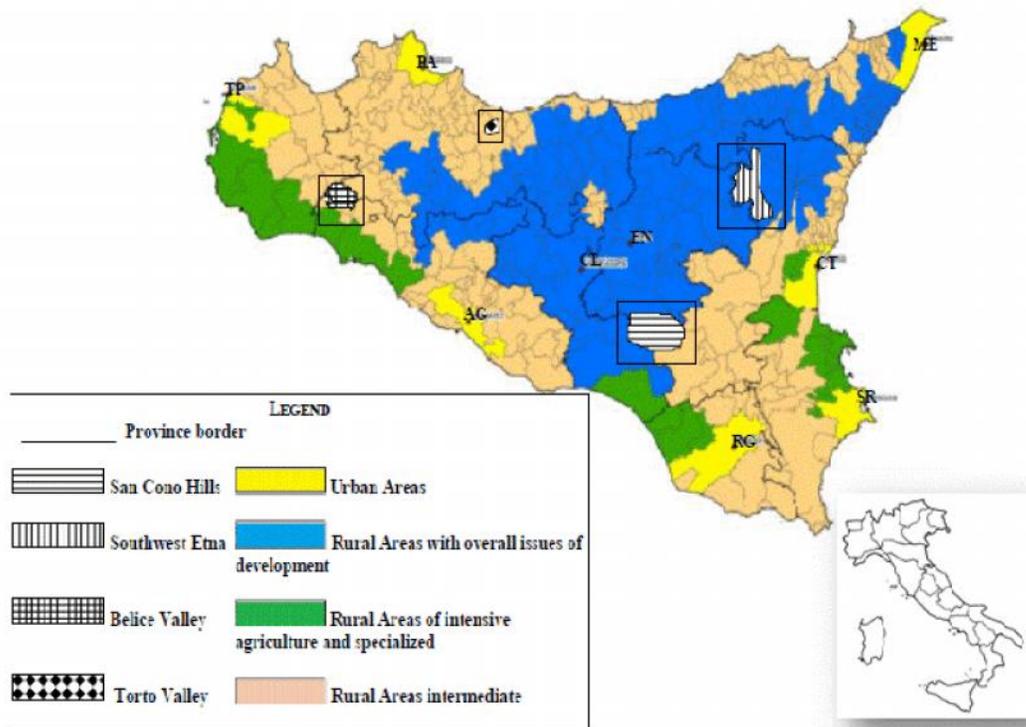
Figure 1. Location of the Italian producer's cactus pear areas (2013-2014).

This study describes two coordinated phases which define an update of the structure and competitiveness and prospects of Italian cactus pear cultivation. It was conducted because the current Italian cactus pear industry is almost exclusively directed to the production of "fresh fruit". Limited, in fact, are the activities of company diversification for obtaining other products (feeding livestock, biomass for energy, etc.). In this way, the business results are more and more conditioned by the volatility of international prices, economic policies international trade and financial speculation in the market for raw materials (FAO, 2011). Faced with a growing gap between the prices paid in the purchase of means of production and services (production costs) and prices received from the sale of cactus pears, the risk to which the company is exposed is the abandonment of production. The research therefore aims to establish a comprehensive framework of knowledge about the competitive potential of these companies.

Therefore, *ad hoc* economic surveys were carried out in the main areas of production, using a variant of SWOT methodology (Analysis of Strengths, Weakness, Opportunities and Threats), a technique for territorial and system analyses developed with the support of industry-based expert assessment named Multi-Sectorial Qualitative Analysis (MSQA).

MATERIALS AND METHODS

Economic research into cactus pear cultivation was carried out through territorial and economic surveys carried out in Italy's most representative cactus pear areas. *Ad-hoc* questionnaires were given to sector experts who were considered able to provide the necessary input regarding the organization and management of production processes.

The territorial surveys were begun towards the end of 2012 and completed during the course of 2013. The research was conducted in 'South West Etna' and the 'San Cono Hills' in eastern Sicily and in the 'Belice Valley' and 'Torto Valley', to the west of the island (Basile *et al.*, 2002). These areas account for 84 % of specialized cactus pear cultivation, but there are a few other areas of the region most of which are secondary cultivations. To carry out the territorial surveys, various public organizations (Operational Technical Assistance Section for Agricultural Development and the Council for Agriculture and Forestry) were interviewed as well as private entities operating in the survey areas and interested in various aspects of cultivation (single producers and/or associates, commercial enterprises, intermediaries, production equipment suppliers). Extensive data (physical environment, types of cactus pear companies, surface areas and production output, product destination and characteristics of the market of origin, evolving and prospective trends for expansion of the land area, etc.) helped define a targeted sampling of the companies to be further investigated for economic analysis.

The companies and specialized cactus pear plots, as a case study, were chosen by considering some of the stratification factors (type of concerns, extent of concerns, plantation age and cultivation regime), leaving all the other factors to emerge freely (ownership, varieties cultivated, methods of cultivation, harvest and commercial calendar, mode of selling, etc.). One hundred cactus pear farms mostly with specialized production were surveyed, among which 100 specialized plots were picked. The sample size was defined by their characteristics, the surface area of cactus pear cultivation and the location of the production units in the four zones. The initial sample was then reduced to 75, excluding cases of inadequate data for our analysis. All the units' surveyed area represents significant "case studies". Of the 75 farms detailed, 30 are located in the 'San Cono Hills', 25 in 'South West Etna', 10 in the 'Belice Valley' and 10 in the 'Torto Valley'. The survey was carried out directly over time using an *ad hoc* questionnaire (general property characteristics, structural characteristics of the companies, entrepreneurial characteristics, production obtained, method of selling, aspects of business and use of materials, labor and services, etc.), pinpointing management, costs and Gross Saleable Product to develop indices and make economic evaluations.

According to other methodologies adopted to enable analysis of farm income (Blank *et al.* 2009; European Commission, 2010) the aim of this study was to evaluate the remuneration of employed capital and the ability of smallholders to compete in the global market and for this purpose have been used two indicators the Farm Net Value Added (FNVA) and the Economic

Profit (Ep). The FNVA corresponds to the factor income used in the previous chapter. It is used to remunerate the fixed factors of production (work, land and capital), whether they be external or family factors. As a result, holdings can be compared regardless of the family/non-family nature of the factors of production employed, as follow:

$$FNVA = \left[(O + PI + PII + VAT) - (IC + FT + D) \right]$$

FNVA = Farm Net Value Added; O = Output; PI = Pillar I-type payments; PII = Pillar II-type payments; VAT balance; IC = intermediate consumption; FT = farm taxes; D = depreciation.

The Economic Profit takes into account not only intermediate consumption and depreciation but also costs for the remuneration of production factors (own and external). It corresponds to the amount remaining after remuneration of all production factors. Thus, as in the case of the FNVA, holdings can be compared irrespective of the family/non-family nature of the factors of production employed. However, a part of the costs is not taken from the FADN farm accounts but is estimated. The size of the estimates depends to a large extent on the methodological assumptions made when they are calculated, as follow:

$$Ep = \left[(FNVA + S) - (T + W + R + F + L + C) \right]$$

Ep = Economic profit; FNVA = Farm Net Value Added; S = subsidies on investment; T = taxes on investment; W = wages and social security charges; Rents = rent paid for farm land and buildings and rental charges; F = Family labor costs; L = costs of Own land costs; C = costs of Own capital costs.

Among the two indicators has been used the Economic Profit (Ep) considered more suitable for the characteristics of the farms surveyed. Production costs were calculated by dividing them into three large categories, such as 'materials', 'labor and services' and 'quotas and other attributes' (Table 1). The means of production and product area data were averaged over the four-year period 2010-2013 (agricultural year coincides with the solar year), while the saleable produce prices refer to 2013. Gross Saleable Product was determined from bulk sales (fruit on the cactus) where the purchaser arranges the harvesting, because this is the main means of sale practiced in the survey areas (Ochoa *et al*. 2009).

Table. 1. Detail of production costs and incomes in Italian cactus pear farms (2013).

Categories	Indications	Conditions of evaluation
Production cost		
Materials	Water; fertilizers; pesticides; weed killers; other	Quantity utilized to current market price
Labor and services	Farms works and mechanized services	Quantity utilized to current market rate
	Mediation	3% Gross Saleable Production
	Transport	flat-rate value in local customs
	Professional consulting	Quantity utilized to current market rate
Quotas and other attributes	Quotas on land investments	2% value investment reconstruction
	Quotas on stock investments	10% value investment reconstruction
	Family and Other labor costs	3% Gross Saleable Production
	Farm taxes and wages and social security charges	Amount paid
	Own capital cost	4% Gross Saleable Production
	Own land cost	1% land value
Output	Products of the cultivation	Quantity of cactus pear evaluated on agreed price with the trader
	Other incomes (Pillar I and Pillar II - Type payments)	Values perceived by cactus pear farmers (subsidies financed by the MS including national aids)

The competitiveness of regional cactus pear production was analyzed using SWOT methodology, a Spatial Analyses technique for evaluating regional programs (such as those in the EU's Rural Development Policy) and in strategic and operational marketing (planning of the territory). This analysis aimed at identifying the main strengths and weaknesses within Italian cactus pear cultivation as well as the Opportunities and Threats from outside from other regional cactus pear operators. At the same time a variation of *Multi-Sectorial Qualitative Analysis* (MSQA) (Roberts and Stimson, 1998) was carried out by considering the cactus pear sector within the entire regional fruit supply chain. To support the MSQA, all the information available from the literature was SWOT analyzed by various institutions like the

Regional Council for Agriculture and Forestry (which produces data both for the regional fruit industry and data on any EU intervention programs like the Rural Development Plan (RDP), other local government agencies (which detail regional planning projects), some public (Universities) and private (consultancies some of which are involved in marketing strategies and programs) research agencies as well as large private sector operators (growers organizations, farms etc.).

So, a list of useful factors was drawn up to describe unitarily the survey subject both from inside the system as well as from any outside. This data was collected through a special questionnaire given to various public and private sector operators, experts and focus group members which groups were asked to tackle the issue of the regional fruit sector and in particular cactus pears. Furthermore, the experts were asked to attribute 1 (low) – 5 (high) points per variable and preceded by a minus (-) for weakness/threat or a plus (+) for strength/opportunity or a zero (0) for neither weakness nor threat. The focus group sessions were conducted such that no opinion leaders were able to arise so as not to influence the opinions of the other experts. To verify this, a contrast index (Gambelli, 2007) was set up which varied from 0, evaluation convergence, to 1, absolute evaluation divergence and calculated thus:

$$IC_i = \left[Max_j \, (V_{ij}) - Min_j \, (V_{ij}) \right] / (V_{max} - V_{min})$$

Where i = 1, …, n; j = 1,…., and (n = no. variables; e = no. experts; V_{min} & V_{max} = min & max evaluation). In this way, even a single contrasting evaluation is highlighted and if not removed (requiring a subsequent individual interview), has been duly noted and could be removed from the subsequent graph (if ICi > 0.5).

The MSQA analysis measured the relations between a group of social, environmental and economic variables and the regional cactus pear and fruit industries. Through a series of qualitative opinions on the importance of each variable produced by the previous SWOT, numerical indices were subsequently produced by appropriate standardizations. The variables were grouped evenly by general characteristics, market orientation, human resources and management, market *status quo* and demand, finances and administration – all groups which characterize and influence these industries in varying ways. This produced two sets of indices (Gambelli, 2007), an Industry Performance Index (IPI) which reports the evaluations for each industry (regional cactus pear and general fruit) and an index of territorial competence (ITC) which shows the single territorially specific evaluations and their interactions with the two industries:

$$IPF = \sum_{i=1}^{N} P_{fi} / (N * P_{max}) \qquad\qquad ICT = \sum_{f=1}^{F} P_{fi} / (N * P_{max})$$

As regards the influence of the external macro-environment (opportunity/threat analysis), this analysis aimed at predicting possible future scenarios through two synthetic indicators valued 0 – 1 which are the risk/opportunity index (IRO) and the potential performance index (IPP) of the industries:

$$IRO_i = \sum_{f=1}^{F} pp_{fi} / (F * P_{\max}) \qquad\qquad IPP_f = \sum_{i=1}^{R} pp_{fi} / (R * P_{\max})$$

Where $pp_{fi} = n^{th}$ variable points for risk/opportunity for industry f; F = no. industries; R = no. risk/opportunity variables.

RESULTS AND DISCUSSION

Analysis of the structures and measurement of production capacity and profitability

The 75 cactus pear farms in the sample variously located in the main farming areas of Italy manage to reflect overall economic-territorial characteristics so, they can usefully represent the regional cactus pear industry (Table 2).

As regards the surface areas of the specialized cactus pear farms, a good part of the sample falls into the 1.5 – 5.0 ha (60% of 'South-West Etna' and the 'Belice Valley'; 53% of the 'San Cono Hills' and 80% of the 'Torto Valley'), although the 5 ha class is still significant especially in Eastern Sicily. Notwithstanding recent evolution, average farm sizes are still limited for applying economies of size which would have been able to influence economic results both in production processes and in organizing commerce and/or promoting the fruit.

As for farm types, as revealed by the territorial survey, the farmer-capitalist farms clearly prevail in the order of 43% in the 'San Cono Hills', 48% in 'South-West Etna' and 40% in the 'Belice Valley' and 'Torto Valley'.

The capitalist companies with salaried workers which are on the rise reflect both how much interest investors are showing in this market sector and how expansion has seen the progressive introduction of product and process innovation in regional cactus pear farming. Among the structural characteristics of the farms it is worthwhile focusing on the availability of irrigation and cultivation method because of their effects on the increase in real and economic productivity. In particular, is very important irrigation in Eastern Sicily, not only as an emergency intervention (especially in 'South-West Etna') but often as a seasonal cultivation practice (in the 'San Cono Hills') with strategic aims (increasing fruit size and/or improving general production quality). By contrast, in the 'Belice Valley' there is limited irrigation so the cultivation method is often 'dry' where other types of fruit would not survive.

Table 2. Principle structural characteristics of the pieces of land under cactus pear cultivation examined in the areas of the research (2013).

Indication	"San Cono Hills"		"South West Etna"		"Belice Valley"		"Torto Valley"	
	n.	%	n.	%	n.	%	n.	%
Extent of concerns								
- up to 1.5 ha	6	20.0	6	24.0	4	40.0	0	--
- from 1.5 to 2.0 ha	7	23.3	7	28.0	5	50.0	2	20.0
- from 2.0 to 5.0 ha	9	30.0	8	32.0	1	10.0	6	60.0
- over 5.0 ha	8	26.7	4	16.0	0	--	2	20.0
Plantation age								
- from 9 to 15 years old	7	23.0	8	32.0	2	20.0	8	80.0
- from 15 to 25 years old	22	73.0	15	60.0	7	70.0	2	20.0
- over 25 years old	1	3.0	2	8.0	1	10.0	0	--
Type of concerns								
- farmer-capitalist	13	43.3	12	48.0	4	40.0	4	40.0
- capitalist-farmer	8	26.7	9	36.0	4	40.0	5	50.0
- capitalist with salaried workers	9	30.0	4	16.0	2	20.0	1	10.0
Cultivation regime								
- dry	3	10.0	6	24.0	6	60.0	0	0
- irrigated	27	90.0	19	76.0	4	40.0	100	100.0

To summarize the economic results and cultivation costs, some indices were developed (Table 3). These values refer to a degree of fruit farm commerce prevalent in the survey area (cactus pears in fruition) and to the system of "strasatto" sales with harvesting by the buyer. In this way, the transaction in advance of the commercial ripening of the fruit reduces the risks for the producer attached to product delivery (seasonal and/or market fluctuations) but does significantly deduct a rate of added value (even as far as the end consumer) acquired by a series of intermediaries. Italian cactus pear production aims mainly at fruit of the second flowering known locally as 'bastardoni' or 'scozzolati' and are particularly sought after for their organoleptic properties. They come onto the market in the Autumn/early-Winter when there is little competition from other fruit (Targa *et al.* 2013).

Table 3. Synthesis of average economic results in the pieces of land used for cactus pears examined in the research zones (prices 2013, average quantity 2010-2013).

Indicators	"San Cono Hills"	"South West Etna"	"Belice Valley"	"Torto Valley"
Production, t/ha	16.6	15.1	13.0	14.0
Average price, USD$/t	505.00	515.00	460.00	480.00
GSP, USD$/ha	8,400.00	7,800.00	6,000.00	6,750.00
Cost of production				
- USD$/ha	6,000.00	5,800.00	4,500.00	5,150.00
- USD$/t	361.4	384.1	346.2	367.9
- USD$/kg	0.36	0.38	0.35	0.37
Economic Profit (Ec)				
- USD$/ha	2,400.00	2,000.00	1,500.00	1,600.00
- USD$/t	144.6	132.5	115.4	114.3
- USD$/kg	0.14	0.13	0.12	0.11
Labour, hour/ha	225	235	200	210
Work productivity				
- Kg/hour	73.8	64.3	65.0	66.7
- USD$/hour	37.3	33.2	30.0	32.1

To calculate farm incomes, the market value of the fruit in 2013 was on average higher in 'South-West Etna' at USD $515/ton where the crop is a better quality (rich volcanic soil combined with orographic and pedo-climatic conditions which have always favored cactus pears). For the other areas, on average market values are at -2% for the 'San Cono Hills', -7% for the 'Torto Valley' and -11% for the 'Belice Valley', this latter because of its lower commercial value. By combining average yields and prices, average farm incomes vary from USD $6,000/ha for the 'Belice Valley' to USD $8,400/ha for the 'San Cono Hills' (+40% of the minimum).

The highest incomes result from the average highest productivity areas in which sales and distribution are well established. Furthermore, there is great variability in average production costs which oscillate between the lowest for the 'Belice Valley' at USD $4,500/ha to the highest for the 'San Cono Hills at USD $6,000/ha. Three main categories were identified and their relative importance was evaluated. Overall, materials account for 12.9%, labor and outside services account for 50.7% and other costs account for 36.3%. In recent years, production costs have tended to rise despite increasing technology, higher levels of

entrepreneurial and managerial know-how, the application of economies of size to the production companies, openness to technological, organizational and professional innovation able to respond to opportunities on offer in international markets. This phenomenon is linked to the international volatility of raw materials, semi-processed and finished products, which have led to significant consequences for each production company by conditioning choice and product diversification apart from the demand for non-qualified work within the farm (FAO, 2011).

From the various relationships between costs and incomes of the survey farms, there emerges a significant profits picture in the production areas. While showing noteworthy variability, they remain positive in every single case and tendentially higher for the 'San Cono Hills' compared to 'South-West Etna', the 'Torto Valley' and the 'Belice Valley' (respectively USD $2,400, $2,000, $1,600 and $1,500/ha). These results are due to variable cost and income distribution by the cactus pear farmers; incomes and costs which in their turn depend on the yields and prices allocated by those who manage the cactus pear farms and therefore on the production means applied. In reality, these values must be linked to the evolutionary dynamics of intensive farming and/or the considerable investments and labor employed in the 'San Cono Hills' and to the peculiar intrinsic quality of the 'South-West Etna' fruit. In both areas, the highest profit levels correspond to both higher classes of Gross Saleable Production (GSP) and higher production costs. The restrained diversification of the production costs in the two survey areas seems to highlight the greater significance of their income levels compared with the costs of obtaining higher profit levels and therefore the need to encourage decisive support, promotion or evaluation of the fresh fruit on national and international markets.

The need to adequately contain costs should not be overlooked given that a significant proportion of them is labor, which despite being high generally, appear more moderate in the 'San Cono Hills' compared with 'South-West Etna' with correspondingly higher productivity in the former where the infrastructure is more developed. It should also be noted that the high levels of manual labor cannot for the moment be reduced since on average pruning, undersized-fruit removal and thinning out account for 60 to 65% of total labor (variable from 200 h/ha for the 'Belice Valley' to 235 h/ha for 'South-West Etna').

Competitiveness analysis of cactus pear cultivation through internal factors conditioning

Regional fruit cultivation is a sector under recent expansion compared to other modern fruit cultivation nationally and driven by crises in traditional cultivation (citrus and vines above all) and by the need to diversify income sources and agricultural jobs. Despite the advantage of medium-to-high quality crops, overall the sector suffers from a number of structural and organizational drawbacks which limit its competitiveness. Among the most critical factors are the lack of end-user market diversification, the restricted supply volume which is limited by the commercial set-up and cannot supply sufficient volumes to meet the needs of short-haul

channels ending up by being long hauled with too many intermediaries, high transaction costs, high supply chain costs and a widening gap between the prices at production and retail (Santeramo *et al*. 2012). A significant component of regional fruit cultivation is 'tropical and subtropical species' which includes the cactus pear, for centuries a feature of the Sicilian countryside.

An in-depth study on competitiveness in the cactus pear sector and its relative future prospects was carried out by SWOT analysis integrated with the AQMF variant of Robert and Stimson (1998). As described in methodology, a huge amount of data was collected on some environmental and socio-economic characteristics of the territory as well as on the production and commercial phases of the cactus pear which would have been difficult to obtain from official statistical sources. Among the strong points the pedo-climatic environment which is particularly favorable to cactus pear cultivation in the three survey areas should be cited and producing high quality crops (in terms of weight, color, pulp consistency and resistance to handling and transport) which are well-received by the markets (Paulina and Timpanaro *et al*. 2012; Timpanaro *et al*. 2014) (Figure 2).
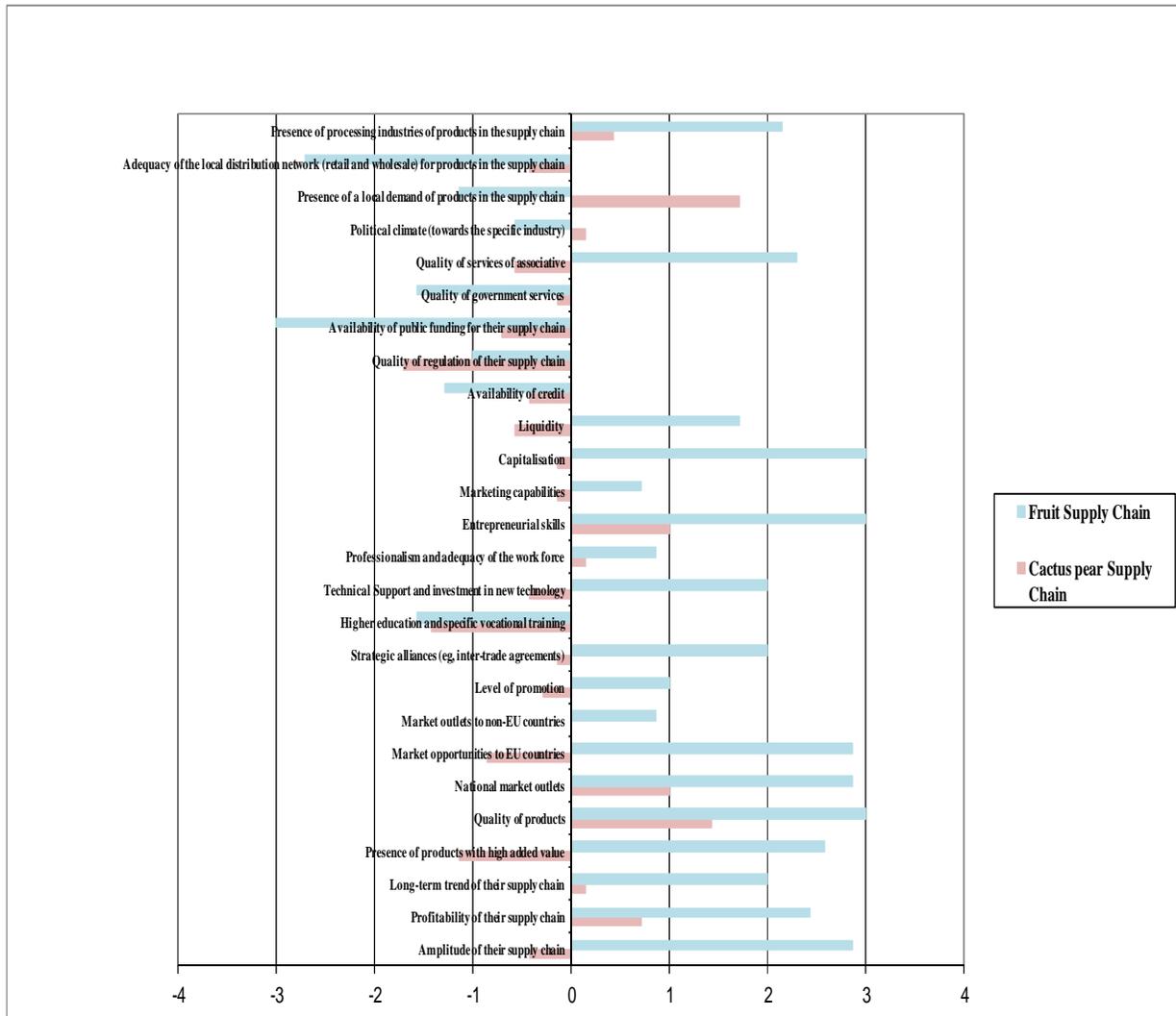
Figure 2. Representation of the Strengths and Weaknesses in regional supply chains cactus pear and fruit (2013)

This character is particularly evident in the 'San Cono Hills' and 'South-West Etna' and expressed through a specific institutional "ferment" around to local cactus pear industry typified by the number of specialized workers, the micro and small firms for transformation and commercialization, the active local market with a myriad of actors, the relationships between private companies and public institutions, the promotional strategies for the territory through the cactus pear etc. This character is particularly evident in the 'San Cono Hills' and 'South-West Etna' and expressed through a specific institutional "ferment" around to local cactus pear industry typified by the number of specialized workers, the micro and small firms for transformation and commercialization, the active local market with a myriad of actors, the relationships between private companies and public institutions, the promotional strategies for the territory through the cactus pear etc.

The special quality of these products and their close link to the territory is also backed up by awards such as Protected Geographical Indication (PGI) which the EU conferred with Reg.CEE 2081/92. This status which currently is held by 'South-West Etna' (Etna Cactus pear PDO, 2003) and more recently by the 'San Cono Hills' (2012), is an important award of quality for the cactus pear and the territory. Similar initiatives are on-going for the other two areas. Other peculiarities of the Italian cactus pear are associated with its wholesale export potential (especially to France, Germany and Belgium in the EU; USA, Canada and Israel non-EU). The socio-economic backdrop which is so vibrant in the cactus pear areas together with the creativity of the local artisans whose aim is to diversify the consumption of fresh fruit (with pharmacological, cosmetic and food applications – jams, rosolios, desserts etc.).

The weaknesses are within the production units, market organization (in the production phase and above all in wholesaling) and the macro political-institutional environment which in some cases are not in favor of the cactus pear. As regards agriculture there are some structural problems typical of Southern agriculture and due to the pulverization and fragmentation of the farms which are not sufficiently sustained by the creation of a movement of association capable of heading off certain negative tendencies towards cactus pear cultivation. This leads to frequent diseconomies of size which account for increased production costs, poor production concentration, and a tendency to long supply chains with hemorrhaging added value along the distribution chain. They amount to a collection of persistent problems in the regional cactus pear industry which are difficult to overcome due to excessive individualism, limited entrepreneurial strategies and/or reduced generational turnover. The youth are predisposed to change and full of positive energy but they often complain of limited access to credit. This particular problem is especially true in the 'Belice Valley'.

As regards the market, there is an overall reduction in the supply chain notwithstanding recent interventions through the EU- European Regional Development (ERDP), Sicily 2000–2006 and 2007–2013, the Rural Development Programs (RDP) Sicily 2000–2006 and then with the European Regional Development Fund (ERDF) Sicily 2007–2013 which are aimed at creating Commercial Macro-Organizations (CMO) and evaluating supply chain quality and organization even as regards the cactus pear (often alongside citrus and other fresh fruit).
Definitively, apart from the odd cooperative with limited capacity for market intervention (made up of cactus pear farmers who usually don't put their own fruit on the market) as in the case of 'Belice Valley' and the 'San Cono Hills', the cactus pear market has an army of intermediaries, national wholesalers and exporters but also has a limited number of large-scale farmer/merchants particularly given the absence of efficient large-scale fruit/vegetable markets.

Still today, the fruit is poorly differentiated and sold in traditional packaging (4-5 kg crates of mixed color fruit to create an attractive chromatic mix), and is difficult to transport and handle. A novelty in fruit presentation/packaging was introduced by Large-Scale Retail Trade (LSRT) which requested the use of small transparent plastic trays (max 1 kg). This development has only had a limited success because LSRT is only a small buyer. Among recent innovations

linked to widening the range of services added to the commercialized product is the rise in minimally processed foods. Thus, the cactus pears are peeled and displayed in cooler sections 4 or 6 fruits at a time to meet the expectations of the modern consumer by reducing handling (saving time, effort and wastage) which is significant in the case of the cactus pear when people often don't know how to peel or use them as well as complying to health and hygiene requirements. These processes are still only applicable to a limited volume of goods and are carried out in very well-equipped buildings to meet market challenges in terms of technology, efficient logistics, and production and commercial organization. Minimally processed cactus pear fruits, such as innovative products, have become a growing consumer preference (Rothman *et al.* 2013).

Public and private investment into new technology overall have been insufficient compared to the level of development of cactus pear cultivation and its relative future prospects. There has been the introduction of de-thorning machines but in most cases they are not modern machines which are able to select and calibrate the fruit. Likewise, alternative uses for cactus pears are still uncommon.

Competitiveness analysis of cactus pear cultivation through external factors conditioning

Other than the numerous strengths/weaknesses of the industry surveyed, the numerous opportunities/threats should also be mentioned which derive from the external macro-economic context and are therefore difficult to modify through policies and/or specific sector interventions (Figure 3). Among the factors which could play a positive role for Italian cactus pears, the rising demand for fresh fruit should be remembered in line with the demands of the modern consumer's desire for a healthy diet in which fruit and vegetables occupy a growing niche. Add to this the spread of organic farming which has influenced the cactus pear (especially in 'South-West Etna') given consumer demand for fruit with low chemical residues.

It is well known that because of their rustic and adaptable characteristics, in normal seasons cactus pear orchards use fewer chemicals and that demand in terms of higher *per capita* income is oriented towards 'green' products for which the price advantage is growing. This can be further pronounced by using distinctive quality and origin brands which endear customers and further segment the market (Foti *et al.* 2011). Finally, among the opportunities, the possibility of integrating income and agricultural diversification should be noted in areas where there is a high 'ruralness' index as happens within 'South-West Etna' and the 'Belice Valley'. In these areas there are various initiatives where culture, territory, agro-food and artisan products compete to sustain the local economy along the lines of a modern vision of sustainable and integrated development (Manzano-Agugliaro & Cañero-Leon, 2010).
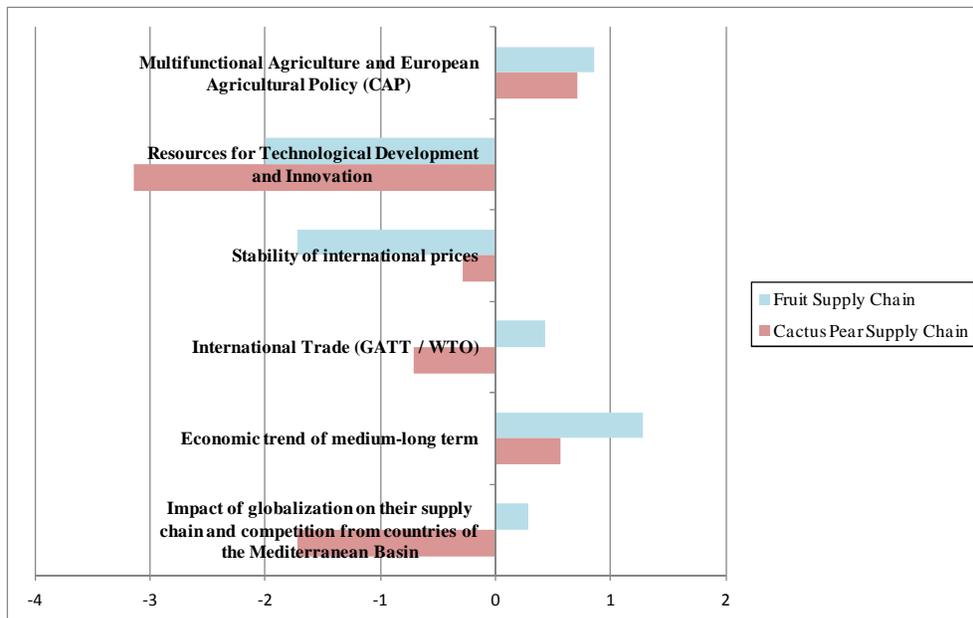
Figure 3. Representation of the Opportunities and Threats in regional supply chains cactus pear and fruit

Among the threats there is the importation of other fresh fruit (including cactus pears) above all from other Mediterranean countries which compete with the more highly invested domestic markets as well as flooding the market with cheaper and more inferior products.

On the international scene, Morocco and Tunisia are slowly making a name. This problem also influences regional cactus pear cultivation because of the significant spread of street peddlers through whom warehouse rejects (low weight) are sold untreated and/or in bulk at low prices which damages the cactus pear market of larger and higher quality fruit. Lastly, the resources for research into this industry are limited given the lack of specific regional or national programs.

CONCLUSIONS

Italian cactus pear cultivation has become a growing production sector over the last twenty years. It has raised its relative importance in terms of the surface areas invested in and their resulting cultivations and continues to play a strategic role in certain areas where it has become particularly diffuse raising employment and creating income for the primary sector and territory.

Through this work has raised the problem of the profitability and competitiveness of the crop geared almost exclusively to the obtaining of the "fresh fruit" for human consumption. In fact, the economic results are now scaled by the recent phenomenon of volatility in international prices, and we must help the stakeholders to look for a possible future development, so as

not to compromise the current spread reached by cactus pear cultivation. To this end, it has been proposed an analytical model for the analysis of production structures and their relationship with the land and the market for the measurement of capacity and profitability of the company and for the determination of the management results.

This survey has identified certain basic characteristics of this industry:

- There are numerous small-medium working farms compared to other regional production sectors (fruit and other).
- The economic results confirm that productivity rises with farm size whereas conversely, income (another indicator of farm performance) shows the opposite behavior due to switching to high-quality crops.
- The farms' economic performance is linked not only to farm size but also to the structure and socio-economic environment in which they operate. In the regional cactus pear areas the relative sector concentration and specialization has a generally catalytic effect on the whole local system causing income and productivity increases in all sectors.
- Cactus pear exports are growing although very limited to just a few farms.
- The introduction of technological innovation and the propensity to invest is strongly on the rise with larger farms. The innovations have mostly regarded the commercialization phase with the introduction of de-thorning machines so that consumers can easily handle the fruit.

In conclusion, in the light of the assumptions made is possible to apply techniques and strategies to reduce costs, the creation of new industries, the best and most economic utilization of by-products, in order to encourage the development of integration processes for competitiveness and innovation, with the final assumption to increasing the competitiveness of Italian cactus pear cultivation. To this end, a comprehensive integrated intervention strategy is suggested which would be aimed at various parts of the supply chain to empower scientific research, innovate cultivation techniques and mechanize the main operations, improve supply chain coordination, reduce the fragmentation and pulverization of the farm and commerce base, encourage product differentiation through the effective use of badges of quality and origin, promote the spread of real and financial services to the enterprises, transform and/or introduce alternative jobs and promote this fruit's consumption. The possible future research developments will attempt to detect the extent of the changes introduced in the organization and business management, for a full multi-functional use of the as cactus pear production.

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