Competitiveness and sustainability of extreme viticulture in Pantelleria Island

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1. Introduction

In Pantelleria Island viti-culture represents a very important productive sector of economy, both for employment and for the income produced.

From Zibibbo variety, cultivated according to "*alberello a conca*" farming system, we obtain two sweet fortified wines like '*passito*' and '*moscato*' that, together with capers and o-lives, represent today the "agricultural competitive advantage" of Pantelleria. In the Island there are 923.62 ha of vineyards. During the last years, this surface has significantly decreased for the lack of labour force required for the cultural practices and for the particular geomorphology of the Island. In fact, 75% of vineyards are located in soils with high slopes (40-70%) that forced the farmers, over the centuries, to build a series of terraces and "*muretti a secco*" (dry stone walls).Thus, the development of Pantelleria's viticulture seems to be possible thanks to the introduction of new technologies that could compensate the lack of labour force and recover the abandoned surfaces.

In this context, from 2004 to 2008 the University of Palermo (Engineering and Agroforestry Technologies Department and Economics of Agroforestry Systems Department) carried out a research in order to mechanize the vineyards of Pantelleria and to limit their abandonment.

Abstract

The environmental and land protection could be obtained promoting an agricultural activity that encourages the business competitiveness respecting the traditions.

In Pantelleria, '*black island*' in the middle of Mediterranean, the viticultural surface has significantly decreased in the last years, causing a massive rural exodus.

The University of Palermo, to block this phenomenon and to contain the progressive abandonment of vineyards, carried out several experimental proofs in order to increase the mechanization of cultural practices in the vineyards cultivated according to '*alberello a conca*' farming system.

In this context, the aim of this paper is to analyze as the process innovations contribute to farm competitiveness and to the safeguard of a viticultural heritage unique in the world.

Keywords: viticulture, competitiveness, economic development

Résumé

La protection de l'environnement et du territoire peut être atteinte à travers la promotion d'activités agricoles qui respectent les traditions propices à la compétitivité de l'entreprise.
Sur l'île de Pantelleria,'l'île noire' au cœur de la Méditerranée, la surface viticole a subi une baisse énorme ces dernières années.
Pour mettre un frein à ce phénomène, l'Université de Palerme a lancé une série d'activités expérimentales pour favoriser une plus grande mécanisation des vignobles en gobelet (alberello a conca).
Cette étude vise à analyser comment les innovations contribuent à la compétitivité des exploitations agricoles et à la protection d'un patrimoine viticole unique au monde.

Mots-clés: viticulture, compétitivité, développement économique

Starting from these assumptions, the aim of this paper is to analyze the principal technical-economic aspects of Pantelleria's viticulture and to value its profitability through the management results expressed by profit margin.

The research is structured in different parts.

The first part analyzes the socioeconomic and territorial context of Pantelleria to highlight the elements of specificity that create value for the territory.

Subsequently, we highlight the importance of innovation – that represents the strategic variable for the development of business – and trough an appropriate empirical survey, we determined the principal economic parameters of wine-producing businesses of Pantelleria.

Besides, the convenience of investments is analyzed through economic-financial parameters as Net Present Value (NPV), Cost-Benefit ratio (B_o/C_o) and Internal Rate of Return (IRR).

Finally, a sensitivity analysis is carried out to extend the assessments to a variability field linked to the market differences and to the discount rates.

2. History, territory and landscape

Pantelleria island, with a surface of 83 square kilometres, is the largest among the Sicilian isles. The geomorphology of Pantelleria, the rocky coasts of black lava, the obsidian and the innumerable active hot springs show its volcanic nature.

This determines a very variegated landscape that includes, for example, the wood of "*Montagna Grande*" (826

meters above sea level), the level land of "*Ghirlanda*", the maquis and steep slopes with many emerging rocks.

On the island everything seems to adapt to the wind which blows almost every day of the year (337 days on average). The wind modifies both the climate and the agricultural techniques.

Its particular geographic position places Pantelleria at the same latitude as Tunis (85 km from Sicily and 67 km from Tunisia), becoming during the history a coveted and strategic point in the Mediterranean routes and object of some dominations.

The first people that colonized Pantelleria were Sesiots (coming from Libya) in the third millenium B.C. for the presence of obsidian from which tools and jewels were manufactured.

Then the Island was colonized by the Phoenicians in the 9th century B.C., which transformed it in an important commercial base with the construction of a big seaport, the introduction of "*alberello*" (head-trained vines) and underground storage tanks.

During the third Punic war (217 B.C.), Pantelleria was conquered by the Romans that, over the centuries, intensified the agriculture and the vine growing (from which they obtained "*passum*" wine), built some settlements and brought richness and prosperity to Pantelleria until the end of the Roman empire (439 A.D.).

The people that left the major signs in the Island's history, however, were the Arab which settled in Pantelleria in the 9th century. Today an evident testimony of Arabic domination is given by the names of many localities and agricultural objects of Pantelleria which have an Arabic origin.

Indelible signs of Arabic culture are "*dammusi*", the typical houses of Pantelleria. They are cubic houses of stone quoins that have a top with one or more buckles for the scroll and storing of rainwater in apposite storage tanks.

During this domination, agriculture began the prevalent activity of the Island with the introduction of olive, carob, caper and "*Zibibbo*" (or Muscat of Alexandria) grape, which the Arab dried for export.

The Arab domination finished in the 12nd century, when the Muslims were chased away by the Christians.

During the years Pantelleria has been occupied by the Normans, Swabians, Anjou, Aragon and Bourbons, until it was annexed to Italy in 1861.

Its strategic position in the centre of the Mediterranean was of great importance also during the second world war. In particular the Italian liberation began in May of 1943 from Pantelleria, which was subjected to the most massive American bombardment of all wars (it was filmed for propaganda purposes).

Today Pantelleria is known in the world as the "Mediterranean black pearl".

3. Socio-economic context

In 2008 Pantelleria had a resident population of 7,736 units, equally divided between sexes (Tab. 1).

From 1961 the resident population has dropped by 19.4%, more in females (-20.0%) than in males (-18.8%). In the same time, the labour force halved (-50.9%) with a value of 1,949 units.

Tab. 1 - *Socio-demographic characteristics of Pantelleria's Island.*

| Items	1961	1971	1981	1991	2001	2008(1)	Var.% 2008-1961
Resident population (A)	**9,601**	**8,327**	**7,914**	**7,484**	**7,224**	**7,736**	**-19.4**
of which:							
-Males	*4,723*	*4,097*	*3,902*	*3,713*	*3,564*	*3,833*	*-18.8*
-Females	*4,878*	*4,230*	*4,012*	*3,771*	*3,660*	*3,903*	*-20.0*
Labour force* (B)	**3,982**	**3,073**	**2,414**	**2,379**	**1,949**	**1,957**	**-50.9**
of which:							
-Agricolture	*2,662*	*1,778*	*1,038*	*630*	*288*	*285*	*-89.3*
-Industry	*494*	*509*	*427*	*401*	*361*	*357*	*-27.7*
-Services	*826*	*786*	*949*	*1,348*	*1,300*	*1,315*	*59.2*
(B/A)*100	**41.4748**	**36.904**	**30.5029**	**31.7878**	**26.9795**	**25.2973**	**-**
Housing number	**3,267**	**3,279**	**5,475**	**5,656**	**5,739**	**-**	**-**
-Occupied**	*2,669*	*2,609*	*2,660*	*2,771*	*2,859*	*-*	*-*
-Unoccupied	*598*	*670*	*2,815*	*2,885*	*2,880*	*-*	*-*

(1) Registry Office of Pantelleria municipality data.
* It includes Employees and people searching for their first job.
** Houses occupied by residents.
Source: our processing of ISTAT data. Population and Housing Censuses.

This decrease is due to people which left the primary sector in 1961-2008 period (-89.3%); they, in fact, passed from 66.9% of labour force (1961) to 14.6% (2008) (Fig. 1).

There are some reasons that caused this massive phenomenon of rural exodus.

First of all it is the geomorphologic nature of the Island. Pantelleria, in fact, is characterized by soils with high slopes that forced the farmers, over the centuries, to build a series of terraces and "*muretti a secco*" (dry stone walls) to exploit the high fertility of volcanic soils. Terraces, however, if on the one hand allow the agricultural activity, on the other hand require high management and maintenance costs and hinder the business mechanization.

Fig. 1 - **Pantelleria's labour force trend as for economic sector.**
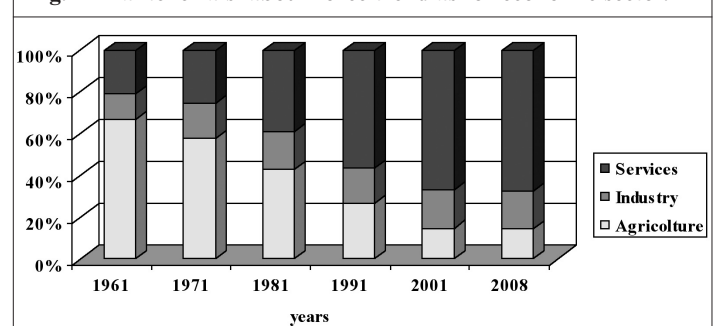
Source: our processing of Population and Housing Censuses and of Registry Office of Pantelleria municipality data.

Another reason of agricultural activity abandonment is the geographical location of the Island that, placed in the centre of the Mediterranean, increases costs of extra-business means for distant and few links with Italy that are also subject to climatic conditions.

Finally, not secondary factors are the meagre domestic offer of workforce that obliges businessmen to employ it in Sicily (including in the salary the costs of being away from home), the lack of infrastructures (there are many unpaved streets), the landscape, archaeological and forest constraints (e.g. recovery of dry stone walls).

All these factors increase the business costs that are higher than the national ones. In this way many farmers of Pantelleria abandon the primary sector for other activities linked to the service industry that, during the 1961-2008 period, increased its labour force by 59.2% (passing from 826 to 1,315 units) and showed an opposite trend compared to the agricultural one.

This is due essentially to the development of tourism, activity that attracted also the labour force of the secondary sector[2].

The principal confirmation of this interest in tourist activity, is represented by the constant increase of houses built at Pantelleria, that passed in 1961-2001 period, from 3,267 to 5,739 units (+75.7%). In particular, such increment has been determined by the building explosion of non-residential housing (+381.6%).

This trend is correlated to the constant increase of tourist demand that, from the eighties, encouraged Pantelleria's inhabitants and not only, to build some structures (hotels or apartments) or to the rehabilitation of ancient dammusi.

In the past, in fact, *dammuso* was often divided into two rooms and lodged both men and animals; today, instead, it is made up of several rooms and, in the majority of cases, has the function of summer residence.

Besides, a determinant factor for the rediscovery of Pantelleria as touristic destination has been the promotion made in the last years by many celebrities. They, in fact, began to invest in the Island, both becoming owners of dammusi where they spend their summer holidays, and buy agricultural lands to produce "*Passito*" wine.

In this way Pantelleria and its typical products (among all the Passito wine) begin to be known also in the world and Pantelleria's economy is no more based only on agricultural products but also on Tourism.

4. Pantelleria's Agriculture

Agriculture, over the centuries, represented the prevalent sector of Pantelleria's economy and it always characterized and modified the Island landscape.

During the years, the constant dedication of islanders to agriculture caused a specialization of agricultural techniques, which are typical of Pantelleria.

The first unequivocal signs of this activity are both innumerable dammusi, terraces and dry stone walls built by farmers to exploit the high fertility of volcanic soils.

Another characteristic of Pantelleria's agriculture is the farming system of crops which, to resist to the continuous

action of wind and to exploit the water resources, are cultivated in width rather than height and so they appear along the ground.

In this way, there are centuries-old olive trees high no more than 1-1.5 meters which seem a shrub and vines grown according to "*alberello a conca*" (gobelet-training in pit) farming system. In this type of farming the pit around the stump includes a part of plant, which is repaired by wind and accumulates the night dew (Pipitone et al., 2008).

Besides, over the centuries, the wind pushed farmers to build "*jardini*" (gardens) that are circular walls which contained one or two citrus fruit trees to protect them from Pantelleria's winds.

Pantelleria's farms are 997 units (ISTAT, 2000) distributed over a utilized agricultural area (UAA) of 1,340.02 hectares (Fig. 2). The average surface of farms is 1,34 hectares, denoting a very small size. From 1990 to 2000, the Island registered a high reduction both in the utilized agricultural area (-42.7%) and farms (-37.6%), for the abandonment of agricultural activity by Pantelleria's inhabitants.
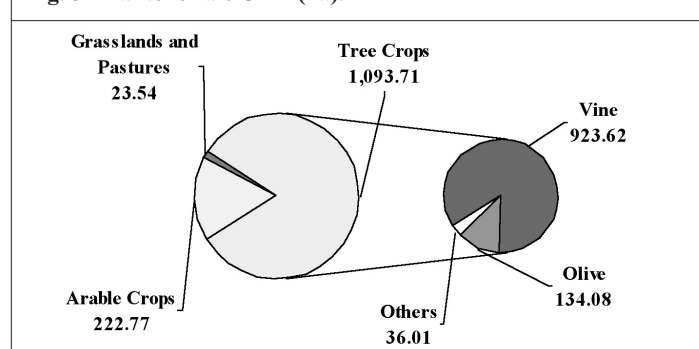
Fig. 2 - Pantelleria's farms and UAA trends.
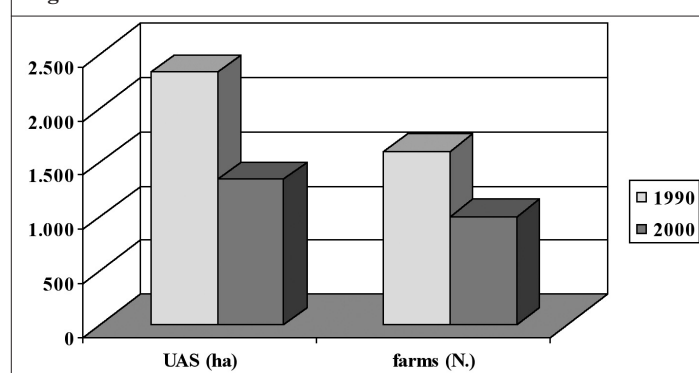
Source: Our processing of ISTAT data. General Agricultural Censuses, 1990 and 2000.

In 2000, the tree crops constituted 81.6% (1,093.71 hectares) of island's utilized agricultural area, followed by arable crops (16.6%) and by grasslands and pastures (1.8%) (Fig. 3).

Fig. 3 - Pantelleria's UAA (ha).

Source: Our processing of ISTAT data. General Agricultural Census, 2000.

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[2] During the 1961-2008 period, the labour force of Industry decreased by 27.7%.

Among the tree crops, the vine represented the principal growing of Pantelleria, with 892 farms (89.5% of the Pantelleria's farms) and 923.63 hectares of vineyards (68.9% of utilized agricultural area), followed by olive (134.08 ha).

As regard the varieties, in 2008 the vine growing of Pantelleria is exclusively based on "*Zibibbo*" (or Muscat of Alessandria) which is cultivated in 93.7% of the vineyards, followed by "*Catarratto*" (2.2%) and "*Moscato Bianco*" (1.2%).

Today Pantelleria's agricultural economy is based on Zibibbo cultivar that has been introduced during the Arab domination. This variety is essentially utilized to obtain sweet fortified wines like "*passito*" and "*moscato*". In particular, the grape harvest is carried out manually from the second decade of August to September. After the harvest, the best grapes (that have a high sugar content) are selected and dried in the "*stinnituri*", a traditional dryer utilized also for the production of dried tomatoes and figs. The drying process approximately lasts twenty days, after that grapes reduces them weight of 60% for action of wind and sun. Then the grapes are trodden, they ferment for some months and the wines can be commercialized from the 1st July of the next year.

Moscato and passito wines received the Controlled Designation of Origin (CDO) in 1971. The production of CDO Pantelleria in 2007, in accordance with the FederDoc data, has been 11,134 hectolitres and it represented the 7.4% of Sicilian CDO production.

As regard the type of farming, finally, the majority of vineyards (96.6%) is cultivated according to "alberello a conca", that is strongly linked to Zibibbo cultivar and characterizes Pantelleria's landscape.

5. The innovation as motor for the economic growth

The first theoretical elaboration on development phenomenon was the innovation theory by Joseph A. Schumpeter. He affirmed that in the evolution of economic systems it is possible to note that in certain historical moments 'something' happens that causes the displacement of equilibrium point toward a new equilibrium position. He defined it as *development* (Schumpeter, 1971). The innovation, intended as the introduction of new economic combinations within the system, can take place in one of the following cases:
– production of a new good or its quality;
– introduction of a new production method;
– opening of a new market;
– achievement of a new supplying source for raw materials and semi-finished products;
– reorganization of any business.

The innovations usually rise with a new business and because it has a life comparable to the biological one, they come during the years to natural death. So, the essential condition to survive is to innovate continually.

In the agricultural businesses, compared to secondary and tertiary sectors, the innovations have to respect restrictions imposed by the environment. In fact, the agricultural crops are located in pedological and climate contexts adapted to their needs. The innovations, therefore, can regard: the introduction of new crops; the introduction of new varieties; new production techniques (cultural practices) that allow a minor use of productive factors with the same outputs.

Determinant factor for the innovation process is the credit system. In fact, in general, to realize the new combinations the businesses don't draw on from unused sources, but they utilize in a different way the availability of production means already present in the economic system. In absence of public intervention, the businesses have to recur to the credit institutions to find the financial means necessary for the innovations. It needs to highlight that every innovation process is marked also by a series of difficulties for the absence of knowledge regarding the new economic environment in which the new idea has to insert itself and for the resistances against who wants to innovate.

The innovations in the short term conduct to a leadership position in terms of competitive advantage. In fact, according to Schumpeter the price fixed initially by the innovator doesn't correspond to own production costs, but it is determined by costs of other businesses that don't innovate yet. The selling price is going to decrease only when the other businesses are able to reply the innovation, in compliance with the usual mechanisms of adjustment between the demand and supply (Schumpeter, 1977).

6. Materials and methods

A microeconomic analysis has been carried out on a reasoned sample[3] of 20 viticultural farms, that produced CDO wine, to determine planting costs, production costs and gross saleable production (GSP) for the several phases of productive process of vineyard. This is required for the individuation of profitability parameters and for economic convenience to realization of investment. In particular, the 20 farms of the sample had vineyards with a management phase that presented homogeneity with the majority of Pantelleria's wine farms (land plan, terraces, variety, farming system, planting crowding). The detected data, for different phases of economic cycle of vineyard, concerned the cultural practices, the extra-business materials used, the human labour, the utilization of machines, the average yields of grape production.

In the planting phase the costs of the first year have been reduced by free grant expected by public operator[4], while at the second, third and fourth year the value of grape produc-

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[3] The reasoned sample, even if it doesn't permit the application of probabilistic proceedings, allows to obtain a sufficiently reliable vision of overall that needs to study (Marbach, 2006).

[4] According to the restructuring and conversion plan of vineyards of Sicily (January 2009), for Pantelleria's Island the contribution, that is totally 14,000 €, includes: 75% of eligible costs necessary for restructuring (12,000.00 €), the compensation for loss of incomes (1,470.00 €) and for pulling out of the old vineyard (530,00.00 €).

tion has been deducted. The annual costs have been anticipated financially at the beginning of the first year and then added to obtain the total planting cost of vineyard from which the reinstatement fee is determined. To realize economic assessments in the management phase of vineyards, the quantities of obtained grape, the technical means and the employment are referred to the average of the last four cropping years (2006-07/2009-10).

For the decrease phase we used data of similar farms for planting typology and the monetary quantification is referred to 2009-10 crop year. The production cost has been determined according to the cultural practices of grape

growing: winter pruning, fertilization, tillage of soil, manual processing (cleaning and adjustment of "*conca*", maintenance of dry stone walls), summer pruning, treatments, harvest and transport. The costs determined in this way included human and mechanized labour[5] and the used extra-business materials; so to these costs, we added the direction, administration and surveillance costs, the taxes, the reinstatement fee of planting, the interests on anticipation capital and on land value.

The farms of the sample covered a total surface of 89.80 hectares, of which 73.25 ha were vineyards. In 13 farms the cropping system was specialized wine, while in the other 7 it was wine and olive oil. The average age of plants was 8 years and the planting crowding was 3,850 plants/ha. In all farms of the sample the cultivar was Zibibbo (or Muscat of Alessandria) and the farming system was the typical "*alberello a conca*"[6]. The vineyards located in terraces are delimited by "muretti a secco" (dry stone walls) for the high inclination of soils. The annual average quantities of grapes (in the management phase) were between 65 and 75 q/ha.

To carry out the financial analysis of viticultural investments the cost-benefit analysis (CBA) has been utilized. The aim was to verify if predictable costs of investment were lower than achievable benefits. For the CBA we used the costs and the benefits related to the economic life of vineyard, equal to 50 years[7].

In the first phase we considered the annual planting costs (as cash flows) reduced by free-grant contribution expected by public operator[8] and the profits of realized productions (from the second to the fourth year). In the management phase we estimated the total production costs (passive flows) and the gross saleable product (active flows) for each year, maintaining constant the respective average values of 2006-07/2009-10 crop years. Finally, in the decreasing phase, we calculated also the total costs and the GSP.

The costs and benefits estimated in this way, have been presented using a 4% discount rate to determine, subsequently, the Net Present Value (NPV)[9], the Cost-Benefit ratio (B_o/C_o)[10] and the Internal Rate of Return (IRR)[11].

In order to carry out an exhaustive evaluation of economic convenience of viticultural investments of Pantelleria, we realized some simulations depending on different grape prices, to quantify the corresponding variations of economic-financial results. Starting with the price of 2009/10 crop year (95.00 €/q), we hypothesized five different grape prices (from 85.00 to 110.00 €/q) depending on favourable or adverse crop years, and at these simulated prices we crossed five different discount rates (between 4 and 6%). In this way the simulations determined many values of NPV and B_o/C_o ratio for each simulated price and applied discount rate. So, we calculated five different average values of IRR and net profits (in the management phase) for hypothesized prices. The results of simulation permitted to obtain a series of values that could easily come true at the variation of economic-financial situation.

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[5] As mentioned in the Introduction, in order to contain the progressive abandonment of vineyards, the University of Palermo carried out several experimental trials in Pantelleria. In particular, a crawler tractor (60 HP) has been utilized adapted to the soils with high slopes of the Island, coupled with a series of farm implements (chopper, cultivator, atomiser, sprayer and car). For the cultural practices executed according to these new modalities, we assumed the hypothesis that businessmen used the renting with the respective hourly cost.

[6] This farming system concerns almost all of Pantelleria's vineyards. The pit around the stump includes a part of plant and has a dual function: on the one hand it protects the plant by wind, while on the other hand it allows to accumulate the night dew (Pipitone et al., 2008).

[7] The hypothesis to choose 50 years as economic life, is due to the ordinariness principle for vineyards of Zibibbo variety with 'alberello a conca' farming system and the productive cycle has been divided in 3 phases: planting (0-4 years), management (5-40) and decreasing (41-50).

[8] Cf. note 3.

[9] The NPV is determined discounting the annual costs obtained as the sum between the realization and functioning costs of investment and the annual profits with an established discount rate according to the following formula:

$$NPV = \sum_{i=1}^{n} \frac{B_i - C_i}{(1+r)^n}$$

The difference between the present value of benefits and costs expresses the net value (or benefit) that a subject is willing to pay to begin an investment without worsening its initial situation. It is evident that the discount rate is very important. In particular, the rate has to be chosen according to the economic financial context in which the valuation is referred. The investment is convenient when the NPV is positive.

[10] The Cost-Benefit ratio is due to the sum of present benefits (incomes) divided the sum of present costs (expenses) and represents the profitability of each units of employed capital. The investment is convenient when the ratio is major than the unit.

[11] The IRR is a discount rate in which the present benefits are equal to the present costs and it renders the NPV equal to zero. In mathematical terms the IRR is due to the following equation:

$$\sum_{i=1}^{n} \frac{B_i - C_i}{(1+r)^n} = 0$$

The investment will be convenient when the IRR is major than the prefixed discount rate.

7. Economic results and financial analysis

The first economic indicator that we determined was the planting cost of vineyard, which has a value of 17,043.93 €/ha (Tab. 2).

Tab. 2 - *Analysis of vineyard's planting costs cultivated according to 'alberello a conca' farming system with a density of 3,850 plants/ha (euro).*

Costs	I year	II year	III year	IV year
Arrangement of dry stone walls	550.00			
Tillage of soil	2,315.00	1,055.00	1,020.00	955.00
Fertilization		160.00	160.00	160.00
Treatments		80.00	85.00	98.00
Rooted grafts	3,080.00			
Plant setting	307.20			
Manual processings	1,360.99	2,931.39	2,859.39	2,480.00
Taxes	253.00	759.00	761.53	764.06
Salaries	314.65	199.42	195.44	178.28
Interests on anticipation capital	163.62	103.70	101.63	92.71
A) Total	8,344.45	5,288.50	5,182.98	4,728.05
B) Grape production value		466.20	1,633.10	3,850.00
C) Planting cost net of production value (A-B)	8,344.45	4,822.30	3,549.88	878.05
Total cost at the beginning of first year	17,043.93			
Contribution expected by public operator	14,000.00			
Planting cost net of pubblic contribution	**3,043.93**			
Annual reinstatement fee	**86.97**			

Suorce: Our processing of directly collected data.

Tab. 3 - *Economic results and financial analysis of vineyardsro).*

Items	Value		
	Min	Max	Average
Economic results (€/ha)			
A) GSP	6,175.00	7,410.00	6,692.75
B) Costs of cultural practices	3,273.69	4,093.66	3,648.57
Fertilization	223.00	386.00	291.73
Tillage of soil	285.00	489.00	355.99
Manual processings	875.00	1,345.00	1,010.85
Winter pruning	215.36	282.66	246.29
Summer pruning	362.50	503.60	438.72
Treatments	215.00	525.00	343.70
Harvest and transport	850.63	1,250.00	961.28
C) Gross profit (A-B)	2,869.64	3,316.34	3,044.18
D) Calculated cost*	948.44	1,014.24	976.65
E) Total cost (B+D)	4,222.13	5,107.90	4,625.22
F) Net profit (A-E)	1,920.56	2,302.10	2,067.53
Financial parameters			
G) NPV	13,676.55	23,354.80	19,382.74
H) B_o/C_o	1.15	1.22	1.19
I) IRR	0.0904	0.1065	0.0968

* Salaries, interests on anticipation capital, planting reinstatement fee, interests on land value.
Suorce: Our processing of directly collected data.

Among the years of the planting phase, the major costs were in the first year, in which the rooted grafts were the most important cost (3,080.00 €), followed by tillage of soil (2,315.00 €) and manual processing (1,360.99 €). From the second year the costs of manual processing began to increase constantly until to represent more than 50% of the annual cost. This is determined by the particular farming system of vineyards. In fact among the manual processings, in addition to the winter and summer pruning, there is also the cleaning and the adjustment of '*conca*' (pit) that is necessary to secure the vine from the strong winds of the Island. The total cost referred to the first year was 8,344.45 €/ha, while in the other years it was 4,822.30 €/ha (second), 3,549.88 €/ha (third) and 878.05 €/ha (fourth). The reinstatement fee of planting, considering the linear proceeding, was equal to 86.97 €/ha.

The economic results of management phase (from 5th to 40th year) and the financial analysis are both reported in table 3.

The value of GSP, referred to the average selling prices of the 2009/10 crop year, varied from a minimum of 6,175.00 €/ha to a maximum of 7,410.00 €/ha, with an average value of 6,692.75 €/ha. Considering that the selling price was 95.00 €/q, the differences among the gross saleable production values were due to the different yields of examined vineyards.

The total production cost registered an average value of 4,625.22 €/ha, included between 4,222.13 and 5,107.90 €/ha. The costs of the cultural practices, on average, amounted to 3,648.57 €/ha (78.9% of total production cost). Among the cultural practices, those that had a major incidence on the total production cost (21.9%) were the manual processing (cleaning of 'conca', maintenance of dry stone walls), followed by the harvest and transport (20.8%) and by winter and summer pruning (14.8% altogether).

In all examined cases both the gross and net profits were positive; in particular, the gross profit registered an average value of 3,044.18 €/ha, while the net one denoted a value of 2,067.53 €/ha.

In the decreasing phase, the total production cost (3,977.69 €/ha) and the GSP (5,086.49 €/ha) decreased, respectively, by 14% and 24% with respect to the management phase; the average value of net profit was 1,108.80 €/ha.

As regard the financial parameters, the data showed that, in the actual market conditions and using the results

Tab. 4 - *Evaluation of economic results and financial parameters depending on grape price and discount rate.*

Grape price (€/q)	Net profit (€/ha)	Discount rates										IRR
		4%		4.5%		5%		5.5%		6%		
		NPV	B_0/C_0	NPV	B_0/C_0	NPV	B_0/C_0	NPV	B_0/C_0	NPV	B_0/C_0	
85.00	1,391.21	7,587.86	1.07	5,658.40	1.06	3,971.47	1.05	2,492.59	1.30	1,192.72	1.02	0.06522
90.00	1,729.37	13,485.30	1.13	11,015.63	1.12	8,855.23	1.10	6,959.75	1.09	5,291.91	1.07	0.08178
95.00	2,067.53	19,382.74	1.19	16,327.87	1.17	13,739.00	1.16	11,426.90	1.14	9,391.10	1.12	0.09679
100.00	2,405.69	25,280.18	1.25	21,730.10	1.23	18,622.76	1.21	15,894.06	1.19	13,490.29	1.18	0.11070
105.00	2,743.85	31,177.62	1.30	27,087.34	1.28	23,506.52	1.27	20,361.21	1.25	17,589.47	1.23	0.12379
110.00	3,082.01	37,039.09	1.36	32,416.28	1.34	28,367.99	1.32	24,810.79	1.30	21,674.79	1.28	0.13619

Suorce: Our processing of directly collected data.

of experimental trials, the values of financial parameters expressed a positive convenience judgment for the analyzed investments[12]. In particular, the NPV is included between 13,676.55 and 23,354.80 €, with an average value of 19,382.74 €; the B_0/C_0 ratio was always hhigher than the unit, from a minimum of 1.15 to a maximum of 1.22 and with an average value of 1.19; the IRR presented a 9 - 10.7% range (9.7% average value).

The results of realized simulations registered in all cases positive economic values, both in the economic management of vineyard (net profits) and in the financial valuation of investment (financial parameters) (Tab. 4).

As regard the IRR, in the worst market hypothesis (grape price equal to 85.00 €/q) a discount rate of 6.5% has been registered against a value of 13.6% in the best hypothesis (110.00 €/q).

8. Conclusions

The innovations are a necessary condition for the development and the survival of business and its territory. In particular, the process innovations have positive effects on business management, because they reduce the production costs and improve the profit.

The outcome of research, thanks to the experimental trials carried out by the University of Palermo (the use of a particular crawler tractor adapted to the soils with high slopes of the Island, coupled with a series of farm implements), shows economic results higher than in the traditional Pantelleria's viticulture.

In fact, the economic results obtained by the empirical

analysis permit to express a positive judgement on vineyard management (net and gross profits).

Positive values are denoted also for the financial management of related investment. In particular, both the average values of NPV (19,382.74 €/ha) and of the B_0/C_0 ratio (1.19), allow to express a positive judgment at the diverse scenario hypotheses (at different grape prices and discount rates). The same judgment is for the IRR analysis that shows convenience values higher than current rates of alternative investments.

These economic performances are the result of elevated Island's viticultural vocation and of wine names (Passito and Moscato) that, thanks to the information technologies (internet), are known worldwide.

However, the positive results of the study are also due to the process innovations: only in this way, in fact, it is possible to maintain and increase Pantelleria's viticulture. The quality productions, combined to cost advantages, allow to Pantelleria's viticulture to resist heroically on the global market, despite its particular conditions (soils with steep slopes, terraces), that make difficult the cultural practices. The sustainability of the agricultural production is a way to realize a constant control of territory and to promote its preservation. These issues assume a great importance in Pantelleria's economy (agriculture, tourism, employment, etc.).

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[12] The viticultural investments denoted for the first four years costs higher than benefits (negative net benefits), while both in the management and in decreasing phases they showed an opposite situation (positive net benefits).

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