



Measuring the financial sustainability of vine landraces for better conservation programmes of Mediterranean agro-biodiversity



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ABSTRACT

The Apulia region, in southern Italy, has a long tradition of vine cultivation for winemaking. However, in the last decades, regional farmers substituted local landraces with more productive non-native varieties. Regional institutions introduced regulations aimed at preventing the extinction of the local and historic ecotypes in the form of financial subsidies to reduce planting and operating costs.

In this paper, we compared the financial sustainability of a non-autochthonous, a typical and a landrace variety for wine production, in intensive and semi-extensive cultivation systems, with and without financial supports. The analysis referred to northern Apulia, considering a 26-year economic duration of vineyards. The results showed that the non-autochthonous variety was more profitable due to its higher yields, while investments regarding landrace-based plants were characterized by lower economic convenience, despite financial aid.

These estimates shed light on the effectiveness and efficacy of the present regulations, as well as on the development of future strategies for a better restoration of vine landraces in Apulia. This new framework will help to increase farmers' profits, improve environmental conditions for the community and ensure higher quality, security and safety for consumers.

1. Introduction

Landraces play a prime role in agricultural biodiversity; these are local varieties of domesticated plant species that have adapted to the natural and cultural local environment (Pascual et al., 2013; Krasteva et al., 2009; Scholten et al., 2009), enabling food and forage production, yield stabilization and improved soil structure (Brussaard et al., 2007; Mahon et al., 2016; Sardaro et al., 2016). They also allow agricultural practices based on low levels of technology and inputs (Altieri, 2004; Jackson et al., 2013; Caldeira et al., 2001; Martin et al., 2009; Srivastava et al., 1996; Hammer and Diederichsen, 2009; Veteläinen et al., 2009; Xie et al., 2011; Sardaro et al., 2017). Over the last decades, agricultural ecosystems increasingly lost their biological diversity based on local landraces and modern intensive cropping systems are now based on monoculture farming in order to increase the global food supply by using genotypes with high yields, but also requiring high levels of inputs (Matson et al., 1997; Evenson and Gollen, 2003; MEA, 2005).

In Apulia, southern Italy, the market forces over the last fifty years gradually caused the replacement of the local vine landraces used for winemaking (e.g. Somarello rosso, Minutolo, Moscatello selvatico and Ottavianello) with more productive varieties, also imported from

northern Italy (e.g. Trebbiano, Montepulciano and Sangiovese). Moreover, farmers widely replaced the traditional and extensive “alberello” and espalier plants with more intensive structures (“tendone”), which, being based on several vine-shoots per vine (even more than four), allowed yields to increase (even four/five-fold). These varietal and structural changes led to a modern approach to wine growing that uses higher levels of inputs (i.e. fertilizers, water, power and pesticides required because the new varieties are less disease-resistant), with a consequent reduction in production quality and the loss of local and historical traditions. To date, vine landraces are cultivated in just 300 farms on 150 ha; besides, a 66% reduction in area and a 47% drop in the number of farms was recorded between 2000 and 2010 (ISTAT, 2016).

In order to prevent the extinction of these local vine ecotypes, Apulia Regional Government introduced several regulations aimed at encouraging their restoration by reducing the planting and operating costs. However, the success of this strategy was rather uncertain and farmers in several areas of the region did not demand at all to the aids, but continued their intensive wine growing based on non-autochthonous varieties, high yields and massive use of inputs. Moreover, in these areas, farmers produced only grapes, which they then sold to wholesalers for winemaking. Possible reasons could be the following: farmers'

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lack of awareness about the difference in costs and revenues among the several production systems; their lack of knowledge about the technical, economic and administrative aspects of wine-making; the high investment costs involved in the construction of new private wineries; the difficulties inherent in the social fabric, which does not allow the implementation of cooperative strategies in the stages of wine-making, so to reduce the aforesaid costs. Hence, along the entire supply chain, insufficient economic information was available concerning the regional vine landraces. This meant that there was a need for a financial analysis focusing on their cultivation, which would then enable evaluation of the outcomes of the regional strategies in the light of market dynamics and help farmers to be more effective and efficient in their decision-making.

In order to fill this gap, we compared the financial sustainability of the following varieties: a) a non-autochthon variety (Sangiovese) in an intensive system (tendone); b) a typical regional variety (Uva di Troia) in a semi-extensive system (espalier); c) a vine landrace listed in the regional regulations (Somarello rosso) in a semi-extensive plant (espalier). This approach was chosen in order to understand the market forces driving wine growing in the area and consequently to evaluate the existence of concrete economic possibilities to preserve the region's vine landraces.

The present paper contributes to the literature in two ways. Firstly, no applied economic study investigated the financial results of typical vine landraces in the Mediterranean area in general, and in southern Italy in particular. Secondly, this study adds to the growing literature that takes a financial approach to estimating the sustainability of Mediterranean agricultural components. Our findings have implications for the debate concerning the conservation of Mediterranean plant species based on the related costs and benefits, allowing verification of the suitability of conservation strategies already in place, and enabling the design of future *ad hoc* cost-effective programmes.

2. Vine biodiversity in Apulia

World vine production is ca. 74.5 million tonnes yr^{-1} on 7.1 million hectares, of which about 45% of the area and 33% of production are in Europe. In turn, Italy is the third European country in terms of vineyard area (about 0.7 million hectares, i.e. 22.1%), following Spain and France, and is the leading producer (about 0.7 million tonnes, 28.4%), preceding the previous Countries (FAOSTAT, 2014). In Italy, Apulia accounts for 12.7% of the national vineyard area (86,000 ha, second to Sicily Region), 16.3% of the national grape production (1 million tonnes, second to Veneto Region) and 13.3% of the national wine production (5.6 million hectolitres, in third place behind Veneto and Emilia-Romagna Regions). Apulia plays a leading role in the Italian wine sector (ISTAT, 2016) and vine growing in the region is particularly adapted to the local climate. The region produces a large amount of high-quality wine, with approximately 20% of production labelled as Protected Designation of Origin (PDO), and 40% as Protected Geographical Indication (PGI), while the remaining 40% is table wine.

In the past, the large number of farmers and the limited availability of land led to a significant number of small-sized farms with an area of

less than 1 ha (ISTAT, 2016), often based on family management. This structural characteristic, also common to other productive sectors such as olive and fruit growing, fostered vine production mainly based on local varieties and contributed to the maintenance of agro-biodiversity in Apulia. In the last decade, 50 regional vine landraces were recognized and a further 118 were cited in bibliographies but have not yet been identified (INEA, 2013).

The 2014–2020 Rural Development Programme of Apulia (RDP – Apulia Region, 2015) provided funds to farmers to incentivize on-farm conservation and reintroduction of the region's vine landraces (sub-measure 10.1.4). These local varieties were inserted into a regional list (pp. 699) and were selected on the basis of their genetic erosion risk (two classes), concerning the speed of genomic variety loss, the greater difficulty in finding reproductive material and the lack of demand. The premium per hectare/year for farmers who undertook to cultivate the local varieties for at least five years was set at 397 € ha^{-1} for the ecotypes at the first risk level and 417 € ha^{-1} for the varieties with a high extinction risk (level 2). The payment considered the additional costs and income losses consequent to the cultivation of the local varieties with respect to the more widespread commercial varieties. In addition, Apulia Regional Government (BURP no. 5, 21/01/2016, Regulation EU no. 1308/2013) also provided funding to favour the restoration of specific local landraces with high oenological and commercial value (listed in BURP no. 16, 31/01/2013), cultivated in extensive or semi-extensive systems, i.e. guyot and espalier. For these investments, financial aid amounted to 75% of restoration costs, including compensation for income loss, up to 18,000 € ha^{-1} .

3. Materials and methods

3.1. Study area and data collection

The study focused on Barletta-Andria-Trani (BT) Province of northern Apulia, where replacement of vine landraces with more productive varieties was particularly intense in the last fifty years, leading to the almost complete extinction of the local ecotypes. Revenues were related to high yields rather than to the production of high quality wine. In particular, most farmers only produced grapes, which were then delivered to private wineries, so that farm income did not include any profit from wine-making.

Primary data concerned agronomic practices, quantities of productive factors (pesticides, fertilizers, irrigation water, etc.), yields, revenues and costs, which were collected through face-to-face based questionnaire interviews of approximately 50 min in eight farms (Table 1). The sampled farms were selected according to their classic agronomic and economic management, but also for the availability of their historical data (from the first year of planting up to the present). In addition, only small landrace-based vineyards were investigated in the study area, so that small farms were also selected for the other two grape varieties. This approach made it possible to compare farms with similar economic dynamics connected to farm size, i.e. economies of scale.

In the sampled farms, technical and economic management was

Table 1
Characteristics of the sampled farms.

n	Variety	Plant type	Management	Area (ha)	Vine spacing (m)	Age of vineyards (years)	Yield (ton ha^{-1})	Production value (€ ton^{-1})
1	Sangiovese	Tendone	Direct by farmer	2.2	2.3 × 2.2	4	38.4	208.3
2	Sangiovese	Tendone	Direct by farmer	2.7	2.2 × 2.1	11	41.1	208.3
3	Sangiovese	Tendone	Direct by farmer	2.1	2.2 × 2.1	24	25.3	208.3
4	Uva di Troia	Espalier	Direct by farmer	1.3	2.2 × 0.5	7	12.6	383.6
5	Uva di Troia	Espalier	Direct by farmer	1.1	2.2 × 0.4	15	16.2	383.6
6	Uva di Troia	Espalier	Direct by farmer	1.4	2.2 × 0.4	23	10.1	383.6
7	Somarello rosso	Espalier	Direct by farmer	1.2	2.2 × 0.4	17	11.4	431.1
8	Somarello rosso	Espalier	Direct by farmer	1.8	2.2 × 0.4	26	9.6	431.1

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