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Recreational Services Provision and Farm Diversification: A Technical Efficiency Analysis on Italian Agritourism

Brunella Arru, Roberto Furesi, Fabio A. Madau * and Pietro Pulina

Department of Agriculture, University of Sassari, Via Enrico de Nicola 1, 07100 Sassari, Italy; brarru@uniss.it (B.A.); rfuresi@uniss.it (R.F.); ppulina@uniss.it (P.P.)

* Correspondence: famadau@uniss.it; Tel.: +39-079-229258

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Abstract: Recreational functions are among the most important practices to improve farmers' income and to promote sustainability in the rural territories. Two crucial issues are the ability to rationally allocate farm resources and the ability to efficiently produce different sorts of food and non-food goods. Possible cost savings due to the co-presence of different activities can generate positive effects in the creation of value by agritourist farmers. This paper aims to investigate technical efficiency related to agritourism and recreational functions in Sardinia. Based on a sample of 37 farms and using a data envelopment analysis (DEA) approach, we aim to estimate the technical efficiency of double attitude processes, such as those that characterise agritourism practices. Our findings suggest that efficiency can improve if technical inputs are adequately used; however, the scale appears to be close enough to optimal. Furthermore, we estimated that the margins for improving the efficiency are larger for recreational services and that technical factors contribute to efficiency with a different magnitude. Furthermore, we estimated whether agricultural and non-agricultural resources are efficiently allocated. To our knowledge, this is one of the first attempts in Europe at using an efficiency analysis in agritourism.

Keywords: agricultural multi-functionality; farm pluriactivity; rural development; farm income sources; Data Envelopment Analysis (DEA)

1. Introduction

Today, farmers operate in increasingly complex scenarios, which causes difficulties, especially for small- and mid-scale farms, worldwide. It is getting harder for these farms to be profitable in an economic context marked by deep and continuous changes in global agricultural markets, a steady decrease of the "terms of trade" between agricultural product prices and manufactured goods prices, including inputs from agriculture, strong competition for land grabbing and use—produced by urbanisation, particularly in the form of urban sprawl and infrastructure construction—as well as fast and drastic transformations in agrifood chains, which often make small farmers contractually weaker [1–5]. Furthermore, agricultural income is highly unstable, and farming is a hazardous business due to sudden changes in both yields and prices that are not completely manageable over time [6] and which are driven by production, price, and technological and policy uncertainties [7].

To tackle these disadvantages and try to increase (or stabilise) their incomes, small farmers have activated a wide range of strategic adjustments [8–11]. Among others, diversification plays a crucial role. Diversification might include introducing new and alternative crops, often combined with marketing strategies focused on niche markets and direct marketing (agricultural diversification), re-locating farm resources to off-farm activities (income diversification), and starting and enhancing new on-farm activities (structural diversification) [12–15].

Among these new on-farm activities, those related to tourism—the so-called sensu latu agritourism—have considerably increased, emerging as one of the most relevant and innovative phenomena in agriculture [16–21]. More generally, agritourism is a style of holiday that is spent on farms [22]. It mainly concerns two tourist services: overnight accommodation on the farm for one or more days and consumption of a meal—predominantly derived from the farm and/or local products—in loco. Regulations surrounding this form of activity vary among countries and regions, but a common feature is the supply of recreational services by parts of farms or by firms that operate in rural areas.

Reasons that influence farmers' participation in agritourism do not only refer to what are ordinarily called "push factors", such as risk distribution within a wider portfolio of assets, they also include more efficient allocation of production factors (particularly labour) in the presence of high competition for land induced by urbanisation, industrialization and population pressure, which then shortens the supply chain length or reduces transaction costs, increasing the farm's profitability [23–26].

Other extremely important reasons that can be considered so-called "pull-factors" are the opportunity to exploit an increasing demand in nature-based outdoor recreation, the potential economic benefit from strategic complementarities between agricultural and livestock production and recreational activities, and any advantage deriving from cultural and social interactions with guests [27–30].

The benefits derived from the expansion of agritourism are related to the economic/social, environmental and touristic demand areas [31]. They concern both private economic gain and public benefit [32]. More generally, today, recreational function related to farms is one of the most relevant tools for promoting (farm and environmental) sustainability, incentivising good farming practices, and enhancing rural territories [33,34].

The scientific community has debated at length on the role of recreational services in promoting farm and rural development. On the supply side, some scholars have focused their attention on the relationship between the types of services supplied, e.g., facility-based or local culture-based, on the expected benefits of agritourist services, and on differences between agritourist farms and other farms from structural and economic points of view [32,35,36]. This debate has occurred especially with reference to the situation in Italy, a country where agritourism sensu stricto has widely diffused since the first decades of the twentieth century. On the demand side, some studies have investigated the main features that characterize this type of tourist and have profiled them against the general tourist demand [37].

However, agritourism research has been especially focused on its sociological aspects, often underestimating the crucial role of the economic dimension of farm recreation [26]. However, agritourism could also be a tool for increasing a farm's profits by expanding its range of activities and/or better enhancing farm products. Indeed, agritourism is typically adopted by traditional family farms that can be forced to combine several agricultural and non-agricultural resources to improve their incomes [22]. Vogt [26] underlined that considering agritourism as a complementary source of income represents one of the main motivations that lead farmers to adopt this practice.

A focal issue concerns the ability to rationally allocate farm resources and efficiently produce different sorts of goods. On the one hand, activity diversification can produce additional effects of technical input by saving costs, e.g., reducing transaction costs due to vertical integration of productive steps into the agro-food supply chain and minimising conjoint and general costs, or vice versa, it can be a source of inefficiency due to difficulties in allocating inputs. On the other hand, considering an output-oriented approach, the economic objective of maximising the value of total production—given a certain bundle of inputs—can easily be achieved in a multifunctional context where recreational services are combined with conventional farming production. Indeed, the co-presence of different activities can lead farmers to expand their income sources and can generate positive effects in terms of the creation of value (e.g., selling food with a premium price through meal provision).

In light of these considerations, this study aims to investigate the technical efficiency related to agritourism and recreational functions in Italy. Based on a sample of 37 farms in the Sardinia region, and using an output-oriented approach, we aim to estimate the technical efficiency according to a double attitude process, i.e., primary products sold "at the farm gate" (agricultural) to grocers or to retailers and recreational services provided by the farm (non-agricultural). Furthermore, we estimate whether the technical inputs used are efficiently allocated by agritourist farmers.

A data envelopment analysis (DEA) model is applied to estimate technical efficiency by using technical inputs and the single-input efficiency related to agricultural and non-agricultural inputs. A two-output frontier is estimated to take the double production attitude of the farm into account. Basically, we describe a production process that separates the two categories of products (agricultural/recreational) and handles them as two different output categories.

It must be underlined that several technical efficiency and productivity analyses have been applied in the recreational sector [38–40]. However, these studies have prevalently concerned traditional accommodation (e.g., hotels) rather than agritourism or, more generally, rural tourism. Recently, Ohe [41] estimated efficiency in Japanese dairy farms that provide educational tourism. Using a DEA approach, the author evaluated the managerial efficiency of educational dairy farms taking into account both provision of milk produced and educational tourism. This study is the unique example, to the best of our knowledge, that has tried to estimate technical efficiency in farms that provide tourist services even if these farms show different characteristics with respect to the European and Italian agritourist farms (e.g., in terms of regulations).

As a consequence, our application of DEA is one of the first attempts to use this methodology with a focus on agritourism in a narrower sense in Europe, and it represents the main novelty of our study.

2. Agritourism Definition and Some Data on Italian Agritourism

The provision of tourist services by farmers is a recognisable activity that has occurred for over a hundred years in Europe [42]. The term "agritourism" (or agri-tourism or agro-tourism) became common during the 1980s to indicate this sort of practice, although its meaning is rather controversial in the scientific literature and in normative use [39,40]. Basically, this occurs because the term "rural tourism" has taken over in recent decades. A common opinion is, however, that agritourism and rural tourism are intended to be different concepts, with agritourism representing a sub-sample of rural tourism [33,41].

According to Busby and Rendle [43], additional definitions of agritourism can be provided, even if it is seen as being virtually identical to the European concept of "farm tourism". It is a typology of rural tourism that is based on the role of farmers in providing recreational services and promoting enjoyment of rural areas using the resources in their own disposability [33,42,43]. It means that agritourism is intended as an intra-farm activity that is aimed at supplying some recreational services, thereby enhancing farm (and local) resources [44–47].

The presence of agritourism has dramatically increased in recent decades throughout the world. The difficulty of achieving sufficient revenue from farming alone has fostered a situation where more farmers are promoting pluriactivity—intended as intra- and extra-farm diversification from the agricultural base [26]—and in this context, agritourism represents one of the most appropriate tools for researching alternative income sources. The lack of data and the heterogeneity that characterises this activity in terms of discipline, organisation, and services supplied does not allow for a statistical outlook of single countries. However, some data can be extrapolated from related literature.

In the US, the number of agritourism farms providing other recreational services increased from about 23,000 in 2012 to about 33,000 in 2017—an increase of 43% [48].

In Germany, touristic services were offered by around 25,000 farm operators in 2006, and it is estimated that services contribute to between 25% and 35% of their overall income [49].

In Austria, 6% of all farms offer touristic services, and the overnight accommodation provided by agritourism represents more than 10% of the country's total accommodation supply, in terms of the number of beds [50].

In Poland, the number of agritourism facilities increased from 1000 in 1998 to 9000 in 2007 [51].

In France, the incidence of agritourism in 2011 amounted to 3% of the country's farms [51].

Italy is one of the European countries where agritourism has grown more quickly. In 2016, more than 12 million people were hosted by Italian agritourist farms [52]. In the period from 2007 to 2016, the number of farms engaging in touristic activities increased from about 17,720 to 22,661 (+28%), and the bed capacity increased from 179,985 to 245,473 (+36%) [52]. In the same period, the total number of farms decreased from 921,000 to 756,000, meaning that incidence of agritourism with respect to the total number of farms has increased from 2% to 3%. This counter-trend suggests that farms oriented towards providing recreational services are more resilient than farms only devoted to the production of primary (food/non-food) goods and that the inherent diversification related to agritourism is a strategic tool that enables them to face challenges, such as the economic crisis that affected Italian agriculture in this reference period.

Farms are mainly located in mountainous and hilly areas (84%), and more than one-third of the farms are managed by women (36%). The latter point is important, as it shows that female entrepreneurship in Italian agriculture is oriented towards farming diversification [53], and often, agritourism guarantees labour for the entire family due to the ability to combine farming and recreational services and to possibility subdivide tasks among family workers.

According to Italian Law 63/2006, agritourism is an activity that is necessarily related to agriculture, and it can be only carried out by agricultural entrepreneurs. From this perspective, in Italy, agritourism strictly reflects the more common definition in the European Union, emphasising an indispensable relationship between farms and tourism. Indeed, the Italian Civil Code (art. 2135) categorises "agricultural activities" as those aimed at enhancing farm products and supplying products "on the farm" (the so called "activities related to agriculture").

According to the Italian regulations, however, the nature of "related activity" to agriculture implies that recreational services cannot be more relevant, in terms of income or of labour spent, with respect to the farm's core business, which is typically the production of food/feed/energy goods. In other terms, the prevalence of the relationship between farming and recreational activities—measured by or according to income related to the two types of activity or to the labour separately spent for each activity—must be in favour of the former.

3. Materials and Methods

3.1. The Technical Efficiency Estimation

Technical efficiency (TE) is a measure of the ability of a firm to obtain the best production from a given set of inputs (output-increasing oriented), or a measure of the ability to use the minimum feasible amount of inputs given a certain output level (input-saving oriented) [54,55].

A data envelopment analysis (DEA) is a non-parametric approach for estimating technical efficiency, which was initially proposed by Charnes et al. [56] based on Farrell's model [57]. Solving a linear programming problem, DEA calculates the efficiency by comparing each production unit against all other units. A piecewise linear envelopment surface represents the best practice frontier, i.e., the maximum level of output achievable for each level of input(s). Therefore, TE scores that arise from DEA are invariant to technology, because they are obtained through comparisons between observations and each other and do not concern an estimated frontier.

Among others, DEA allows us to estimate the efficiency in possible multi-output situations and without assuming an a priori functional form for frontier production. Furthermore, invariance to technology permits it to be easily applied on small-sized samples [58].

An output-oriented approach was used to calculate the constant return to scale (CRS) DEA and variable return to scale (VRS) DEA measures. This choice arises from the need to investigate farmers' capacity for producing and enhancing more products and services, given the bundle of inputs at their disposal. It means that we calculated the technical efficiency by hypothesising that, theoretically, production could increase up to the level allowed by technology.

The CRS TE for a single output is derived by solving the following linear programming model [59]:

$$\begin{array}{ll} \max \theta, \lambda & \theta_i \\ \text{subject to} & \sum_{j=1}^{n} \lambda_j \, y_j - \theta_i y_i - s = 0 \\ & \sum_{j=1}^{n} \lambda_j x_{kj} + e_k = x_{ki} \\ & \lambda_j \geq 0; \quad s \geq 0; \quad e_k \geq 0 \end{array} \quad (1)$$

where θ_i is the proportional increase in output possible for the i-th farm, λ_j is an N $\times$ 1 vector of weights relative to the efficiency observation, s is the output slack, and e_k is the k-th input slack. Banker et al. [60] suggested that the CRS DEA model should be adapted to account for a variable returns to scale situation. Thus, by adding the convexity constraint $N1'\lambda = 1$, the model can be modified into the VRS DEA.

A farm has efficient results when the values of θ and λ_i are equal to 1, and $\lambda_j = 0$. In contrast, an observation is inefficient when $\theta > 1$, $\lambda_i = 0$ and $\lambda_j \neq 0$. Solving (1), we can obtain a measure of TE that reflects the "distance" between the observed and optimal output production for a certain input bundle:

$$\text{TE}_i = \frac{Y_i}{Y_i^*} = \frac{1}{\theta_i} \qquad 0 \leq \text{TE}_i \leq 1 \quad (2)$$

where Y_i and Y_i^* are the observed and maximum possible (optimal) outputs, respectively.

A measure of SE can be obtained by comparing the TE^{CRS} and TE^{VRS} scores. Any difference between the two TE scores indicates that there is scale inefficiency that limits the achievement of an optimal (constant) scale, which can be calculated as follows [42]:

$$\text{SE}_i = \frac{\text{TE}_i^{CRS}}{\text{TE}_i^{VRS}} \qquad 0 \leq \text{SE}_i \leq 1 \quad (3)$$

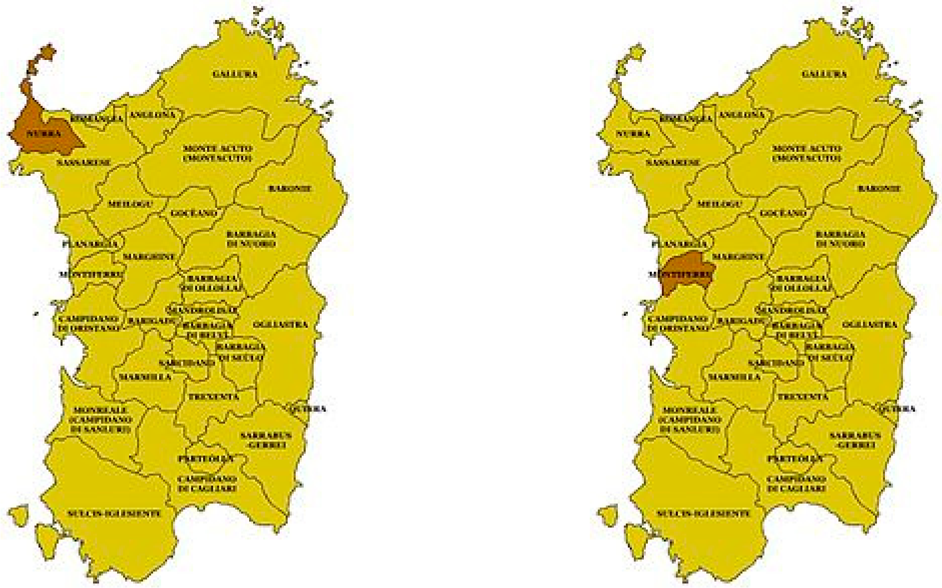
where $\text{SE}_i = 1$ indicates full-scale efficiency and $\text{SE}_i < 1$ indicates the presence of scale inefficiency.

Imposing a non-increasing return of scale (NIRS) condition on the DEA model by changing the convexity constraint $N1'\lambda = 1$ of the DEA VRS model into $N1'\lambda \leq 1$, we estimated whether the observations are operating under increasing ($\text{TE}^{\text{NIRS}} \neq \text{TE}^{\text{VRS}}$) or decreasing ($\text{TE}^{\text{NIRS}} = \text{TE}^{\text{VRS}}$) returns to scale (IRS or DRS, respectively).

Taking advantage of the DEA approach, a two-output function was used to consider both agricultural products and other services provided by farmers. In other words, we distinguished between (1) food produced and sold at the farm gate and (2) agro-tourist services, including meals distributed to visitors.

3.2. The Data

Farms were selected from two areas of the Sardinia region: "Nurra" and "Montiferru" located in the northwest and middle-west of the Sardinian Island, respectively (Figure 1). These areas are characterised by different agricultural systems and tourist dynamics.



(**a**) (**b**)

Figure 1. Geographical collocation of Nurra (**a**) and Montiferru (**b**) in Sardinia (maps by Wikipedia).

The Nurra region consists of flatlands where agriculture is mostly characterised by arable crops, horticulture, arboriculture (mainly olive- and grape-growing), and livestock (sheep and cattle). Agricultural productivity is generally higher than the average in Sardinia due to the presence of physical and climatic characteristics that favorite high value cultivations. Furthermore, diversification is promoted by farmers by implementing more agricultural practices in farms, e.g., olive- and grape-growing, horticulture and arboriculture, and horticulture and sheep livestock; or by integrating phases "downstream" of the agro-food supply chain, e.g., grape-growing and wine production; or by providing recreational services. Considering the latter, agritourist supply has been developing in Nurra since the 1960s contextually to the tourism development. Indeed, several tourist sites are located in this region and some amenities, e.g., the ancient city of Alghero, the numerous and attractive beaches, archeological remains, and natural parks, are well known throughout the world. The popularity of this region to tourists has encouraged a remarkable expansion of agritourism in Nurra, and some of the most appreciated agritourist farms in Sardinia are located here.

Montiferru is a hilly region where tourist flow has become significant only in recent decades. However, it is not capable of intercepting large tourist flows, at least compared to many other regions of Sardinia, including Nurra. On the other hand, in recent decades, agritourism has rapidly spread as a result of the need to enlarge the rural sources of income. Sheep livestock, grape-growing and some arable crops are practices that characterise these rural landscapes. A great part of the land is devoted to sheep grazing, as sheep dairy represents the main industry practiced in this region. The core business of many agritourism businesses located in Montiferru is sheep grazing, which is conducted extensively (due to the high disposability of land and low capital intensity).

There were 20 and 17 farms observed in Montiferru and Nurra, respectively. Information was collected by face-to-face interviews with farmers in 2017. Data used in the DEA model are reported in Table 1 (including the mean value for each observed variable).

It must be underlined that high variability was found in the observed data (generally standard deviation is higher than the mean). However, high variability is a common drawback of small samples. In our case, a small size was used due to the need to only consider farms inscribed in the "Regional Register of Agritourist Farms". Despite the small amount of data, this choice allowed us to only select "real" agritourist farms, excluding other forms of rural tourism.

Table 1. Explanatory variables involved in the data envelopment analysis (DEA).

Item	Description	Unit	Observed Values					
			Total		Montiferru		Nurra	
			Mean	SD	Mean	SD	Mean	SD
Output								
Farming production	Value of farming output produced	EUR'000	52.8	105.6	54.7	68.4	49.1	133.4
Recreational services	Value of recreational services provided	EUR'000	134.5	146.5	128.4	107.3	149.8	180.2
Input								
Land area	Land area covered	Hectares	43.9	45.2	54.3	48.5	30.3	37.8
Labour	Cost of labour (wages and hired labour)	EUR'000	20.9	23.5	22.6	27.0	20.5	19.3
Capital	Depreciation cost of machinery and plant	EUR'000	70.1	71.6	66.2	50.0	74.8	85.8
Variable costs	Cost of variable inputs (e.g., feed, seed, energy)	EUR'000	37.1	55.3	47.3	74.1	27.0	23.6
Provision of meals	Number of places available at the table	Number of.	92.2	98.5	76.7	89.7	105.3	102.9
Accommodation	Number of beds available	Number of.	12.3	7.5	11.4	7.1	12.7	8.2

SD, standard deviation.

On the other hand, as reported above, DEA is particularly suitable for small-sized samples, because a frontier is built without considering the statistical variability of the observed data and technology. For this reason, DEA has widely been applied on small scale samples [61].

The measured output was the value of production, and we distinguished two output categories, as follows:

1. Production derived from agriculture and directly sold to final consumers, grocers or the agro-food industry. In other terms, we considered the activity of the selected farmers (production and supply of food to the market). Values were calculated considering prices "at the farm gate".
2. Services provided to tourists. This output mostly comprised the value of accommodation and meals served in loco. Concerning the latter, food produced by the farm and served on the farm to tourists was exclusively considered in this category to avoid double counting.

All values are expressed in Euro currency.

Among the technical factors, we introduced two variables specifically related to recreational activities: the number of beds and the number of places available at the table. This choice was done to analyse the relationship between the hospitality provided by farm facilities and the value of these recreational services. It must be underlined that, as we aimed to estimate efficiency, we included two variables that reflect the capacity of the farms independently of the real use of the farms.

The only technical factor used that is exclusively associated with farming was the land covered by agricultural and livestock practices, whereas the other variables were related to agritourist farm activity as a whole. Capital was included in terms of the depreciation of the farms and their machinery and the variable costs of farming and recreational services. Also, labour was expressed in monetary terms as wages paid to workers, including implicit wages—the latter was calculated on the basis of price per hour worked—that are given to farmers and/or their relatives in cases where they are also workers.

The collected information indicates that the prevalent weight of farming production with respect to recreational services provided—as reported above, there is a legal constraint on Italian agritourism—is, on average, ensured by employed labour and not by income achieved. Indeed, revenue related to agritourist activities is generally higher than that obtained by farming, whereas an inverse relationship is found in terms of salaries and annual hours spent.

4. Results

All efficiency measures were estimated using the DEAP 2.1© program created by Coelli [58].

The results indicate that the average TE values for the CRS and VRS frontiers are 0.726 and 0.789, respectively (Table 2). Considering the latter measure, which represents the so-called "pure efficiency", the results suggest that agritourist farmers would have been able to increase their output by 20.1% by using their disposable resources more efficiently (under the present state of technology).

Table 2. Estimation of technical and scale efficiency by Data Envelopment Analysis (DEA).

	TE (CRS)	TE (VRS)	SE
Sample (n. 37)			
Mean	0.726	0.789	0.907
SD	0.291	0.255	0.147
Max	1.000	1.000	1.000
Min	0.296	0.316	0.382
Montiferru sub-sample (n. 20)			
Mean	0.677	0.770	0.871
SD	0.313	0.278	0.185
Nurra sub-sample (n. 17)			
Mean	0.769	0.839	0.910
SD	0.260	0.231	0.066

Constant returns to scale (CRS) = technical efficiency (TE) under constant returns to scale hypothesis, Variable returns to scale (VRS) = TE under variable returns to scale hypothesis. * *p*-values for *t*-tests on the mean difference between the two sub-samples: TE = 1.12×10^{-4}, SE = 1.05×10^{-4}.

A significant difference (for $\alpha = 0.05$, applying the *t*-test) was estimated between the average TEs in the Montiferru and Nurra regions. The TE of the Nurra sub-sample was about 7 percentage points greater than that of the Montiferru farms.

In the light of this difference, we verified whether it reflects the difference in ability to use technical input or whether it is the result of separate frontier functions. In other words, the higher technical efficiency that agritourism shows in the Nurra might depend on whether the farms are really using more efficient technical resources (difference in efficiency) or whether they are using more productive technology (difference in productivity). Using the efficiency analysis as both a unique reference frontier and to separate (Nurra and Montiferru regions) frontiers could lead to a more realistic interpretation of technical efficiency differences. Due to this methodological opportunity, in a second step, the technical efficiency was estimated separately for the two sub-samples using specific observations from the reference group [62,63]. In this way, a productivity measure for each group was obtained as the ratio of technical efficiency relative to its own reference group frontier and as the aggregate (overall) technical efficiency measure:

$$\varphi = \mathrm{TE}_o/\mathrm{TE}_g \tag{4}$$

where φ is the productivity factor indicating the difference between the two sub-sample frontiers, TE_g is the technical efficiency for each farm compared to the specific subgroup frontier (Nurra and Montiferru sub-sample) and TE_o is the efficiency for each farm compared to the overall group. If the difference between the specific φ measures is significant, it means that the two techniques operate on different technological grounds (no technological homogeneity). The results of (4) are also reported in Table 3.

Despite the revealed differences in technical efficiency, the empirical findings suggest that there is homogeneity in the agritourism technology in Nurra and Montiferru. Indeed, the values of the estimated productivity term φ were not statistically significantly different ($\alpha = 0.05$) between the two groups; therefore, all firms lie on the same frontier and any differences in technical efficiency would be exclusively related to the ability to use technical factors.

Most likely, the higher ability to use technical inputs observed in the Nurra sub-sample is derived from the greater experience of those farmers in providing agritourist services. Furthermore, some Montiferru farms show inadequate revenue from recreational services provision as compared with the plant capacity regarding the number of beds and places at the table. Among these farms, some are in the initial stages of providing agritourist services; therefore, they have not yet achieved full maturity in terms of being able to use their own plant capacity efficiently.

Table 3. Overall and specific (group) technical efficiency, productivity and scale efficiency.

	Mean *	SD
Technical Efficiency (overall)		
TE Montiferru sub-sample	0.770	0.278
TE Nurra sub-sample	0.839	0.231
Technical Efficiency (specific group)		
TE Montiferru sub-sample	0.792	0.405
TE Nurra sub-sample	0.858	0.383
Productivity		
Productivity φ Montiferru sub-sample	0.972	0.331
Productivity φ Nurra sub-sample	0.977	0.340

* p-value for t-test on mean difference between the two sub-samples: φ = 0.455.

On average, greater inefficiency was calculated for the provision of recreational services with respect to agricultural production. Because a double output frontier was estimated, the analysis permitted the calculation of efficiency related to each category of considered production in order to verify whether they were efficiently allocated, and, as a consequence, to measure the margin of increased value in cases with full ability to use the technical inputs at the farmers' disposability.

We estimated that the TE of farming production is significantly higher than the TE of recreational services, 0.851 and 0.712, respectively, as reported in Table 4.

Table 4. Optimal (fully efficient) outputs estimated by DEA.

Output	Observed Value	Specific TE	Optimal Value	Increase
Farming production (EUR'000)	52.8	0.851	62.0	+9.2
Recreational services (EUR'000)	134.5	0.712	188.8	+54.3

This difference means that farm resources are generally better used for farming practices than for the provision of agritourist services and that room for improving efficiency in the latter is sensitive (about 29%). In the case of full efficiency, farms would, on average, expand production by 9.2 M€ and 54 M€ for farming and recreational services outputs, respectively.

The scale efficiency (SE) was found, on average, to be equal to 0.907, implying that production could increase by about 10% if farms adjusted their production scale for efficient production (see the last column of Table 2). The farms in Nurra showed better SE values than the other sub-sample (0.910 vs. 0.871), although the difference was not highly significant ($\alpha = 0.05$)

Table 5 shows how scale affects efficiency according to the nature of returns to scale estimated. Applying the NIRS condition, about 46% of the farms revealed an optimal scale efficiency, whereas most scale-inefficient farms could improve their efficiency by reducing their production scale. Indeed, estimations suggest that about 38% of the observed agritourist farms operate under decreasing returns to scale, meaning that they are oversized with respect to production.

Table 5. Estimated returns to scale by DEA.

	CRS	IRS	DRS
Sample (n = 37)			
N.	17	6	14
%.	45.9	16.2	37.9
Montiferru sub-sample (n = 20)			
N.	9	3	8
%.	45.0	15.0	40.0
Nurra sub-sample (n = 17)			
N.	8	3	6
%.	47.0	17.7	35.3

CRS = constant returns to scale; IRS = increasing returns to scale; DRS = decreasing returns to scale.

This percentage is higher in the Montiferru sub-sample, and this finding might confirm the hypothesis about possible motivations reported above on the basis of the lower TE in this sub-sample (40.0% vs. 35.3%). In other terms, it might depend on the high level of some inputs (number of beds and places at the table *in primis*) that are increased more than output, contributing to enlarge the operation scale of the farms, because today they are not fully utilized due to insufficient tourist demand (low capacity utilization). It is clear that these factors can be more exploited in the future but today the scale of these farms appears oversized considering the value of production achieved.

On the contrary, a minority of farms reveal increasing returns to scale. This result suggests that they operate under a suboptimal scale, i.e., their output levels are lower than the optimal ones and they should be expanded in order to adequately increase productivity.

Even if an output-oriented approach were applied, the DEA model permits estimation of the role of each technical input in conditioning the technical efficiency. In other words, we are able to estimate the TE related to each input and the specific margin saved by each input to achieve full efficiency. It must be underlined that the output- and input-orientated measures will only provide equivalent measures of TE when constant returns to scale exist, but will be unequal when increasing or decreasing returns to scale are present [64]. However, the ranking of estimated scores is invariant with respect to the adopted approach.

Table 6 shows the estimated specific TE values and margins.

Table 6. Optimal (fully efficient) input use estimated by DEA.

Input	Observed Value	Specific TE	Optimal Value	Saving
Land area (Ha)	43.9	0.709	30.4	−12.5
Labour (EUR'000)	20.9	0.645	13.5	−7.4
Capital (EUR'000)	70.1	0.702	49.2	−20.9
Variable costs (EUR'000)	37.1	0.792	29.4	−7.7
Meals giving (N)	103.0	0.675	68.7	−33.0
Accommodation (N)	12.3	0.788	9.7	−2.6

The cost of labour and meal provision are variables associated with lower inefficiency (TE equal to 0.645 and 0.675, respectively). Concerning the "number of places at the table" variable that we used as a proxy for restaurant services provided, the low efficiency can be explained by the fact that meal provision is only fully exploited in particular periods (e.g., weekends, summertime), and even then, farm plant capacity is not ever fully used. Indeed, all farmers declared that they concentrate on the provision of meals during spring and summertime or in the weekends or following reservations. Using the number of meals/places at the table/year as an indicator of the annual capacity utilization of a restaurant, i.e., the number reflects the days per year of full exploitation of this service and it can be taken as a measure of the occupancy rate, we found that only 6% of the farms showed a value equal to or more than 100 (100 in 365 days corresponds to about 27% capacity utilization). This value was less than 20 in about 25% of farms (7% capacity utilization). On average, we found that the capacity utilization amounted to 10.2% (value of indicator equal to 37), and this value would largely explains the low estimated single-efficiency score related to this input.

However, as found by other researchers on recreational services—not provided by farms but by tourist structures such as hotels—confluence of tourist flow in given seasons is one of the factors that mainly affects efficiency [65]. Furthermore, the size of a restaurant is often a variable that poorly affects efficiency overall if it is calculated in monetary terms [66].

At the same time, we expected similar results for the accommodation input, but this was the second most efficient explanatory variable estimated (TE equal to 0.788). Most likely, the agritourist farmers are more cautious in supporting investments for accommodation than in providing places at the table, given the importance, on average, of this sort of investment from a financial point of view. Most farms studied (54.0%) could only accommodate up to 10–15 people, and only 18.7% of farmers stated that they have more than 20 beds at their disposal. Furthermore, 56.7% of the farms provide hospitality by reservation throughout the year. Furthermore, taking into account the number of spent nights/beds/year as an indicator of the capacity utilization of these facilities, we found that only 16.2% of the farmers fully utilize their capacity for more than 100 days each year, and this value is equal or less than 10 in about 19% of the farms. On average, the accommodation capacity is fully exploited for about 15% of the year—54 out of 365 days—but this rate is higher than the corresponding value of meal provision.

This finding means that accommodation services are more efficiently utilized—in terms of occupancy rate—than meal provision services and it explains the higher estimated single-input efficiency related to accommodation input compared to meal provision input.

Regarding the low labour efficiency, it must be underlined that the greatest part of the work carried out is implicit (hired) work. Furthermore, the same worker often divides his or her time between agricultural and agritourist practices. Therefore, this item could be overestimated with consequent implications for the technical efficiency estimation. Furthermore, a source of inefficiency related to labour might concern the requirement to ensure employment in farming rather than in recreational services. This result implies that farmers are not fully able to allocate labour on the basis of their own needs, so this constraint might affect efficiency. As reported above, increasing the efficiency of the recreational service output would lead farmers to gain up to 54,000 Euros; however, this might require a different allocation of workers, and this need cannot be fully satisfied due to the inherent nature of Italian agritourism.

The results provide evidence of the effects of recreational and multifunctional activities on farm outcomes. Application of the technical efficiency analysis allowed us to identify the most important criticism—the allocation of agritourist farm resources—and to estimate the margins for improving the value of production in the case of full efficiency of technical inputs use for each of the activities practiced. Among the most important implications that might be derived from these findings is that this study can support farmers, policy-makers and decision-makers in promoting adequate measures to take advantage of multi-functionality to improve farming income and to enhance recreational services related to farming.

From the farmers' perspective, agritourist entrepreneurs should improve their efficiency in the use of inputs related to recreational services production, specifically in terms of the number of places at the table, which was used in this analysis as a proxy for the potential supply of meal services provided to tourists. On the other hand, agritourism is often a seasonable activity, so the farm's services are organised considering the tourist flow in the summertime when the provision of these services is generally the highest. However, farmers should be able to take advantage of potential demand throughout the year, especially by exploiting the number of places at the table more efficiently. This ability could be promoted, for example, by enhancing the pluriactivity (with respect to farms) and multifunctionality (with respect to rural spaces) of farms by promoting school programming, increasing opportunities for visiting farms, involving local stakeholders and shareholders in cultural initiatives and, more generally, by creating conditions for increasing hospitality and the ability to create new value given a certain bundle of technical inputs.

From the decision-makers' point of view, rural and multifunctional policies can be supported by these results to individualise the main critical issues and to better foster programming in favour of Sardinian agritourism. For example, even with the seasonal nature of agritourism, we found that investment in accommodation structures does not increase inefficiency, while increasing the number of places at the table does. Furthermore, the operational scale is not an alarming source of inefficiency, although some of the farms appear to be oversized (operating under decreasing returns to scale).

Therefore, at least with reference to the Sardinian segment, this estimed result could be useful information to support investments and to allow better organisation and promotion of investments, given the normative constraints of agritourist activity. Most likely, policy measures should encourage a more equal relationship between (potential) places at the table and the economic dimension of farms to minimise inefficiency in this specific practice. However, as reported above, the presence of inefficiency is a common feature in tourist activities, and inefficiency might be an inherent characteristic of agritourism due to the fluctuating tourist demand during a given year.

5. Conclusions

The study is one of the first attempts in Europe to estimate technical efficiency in the agritourism sector. A double output frontier that separately involves products from farming and recreational services was applied to a sample of Sardinian agritourist farms. The findings suggest that efficiency can improve if technical inputs are adequately used, whereas the scale appears to be close enough to optimality. Furthermore, we found that efficiency was not homogeneous in the sample, because the group of farms located in the Nurra region were more efficient than the ones in the Montiferru region. However, all farms were shown to lie on the same technological frontier. Finally, the margin to improve efficiency is more significant for recreational services—even if normative constraints exist concerning labour allocation—and various factors have different magnitudes of contribution to efficiency.

The novelty of the study mainly concerns the use of technical efficiency analysis to evaluate agritourist farmers' ability to allocate technical resources at their disposal, taking into account both the objective of profit maximization—an output-oriented approach was used—and the normative constraint in ensuring the prevalence of agricultural practices with respect to agritourist ones. The estimated results could provide useful information for farmers and public decision-makers, especially if used with other evidence (e.g., balance sheet analysis).

However, being a first attempt, this study had some limitations that need to be overcome to provide more generalized findings. Firstly, the size of the sample influenced the choice of the method as DEA is particularly suitable for handling small sample sizes. Secondly, we focused on two geographical areas, and other areas should be investigated in order to corroborate our findings. Finally, comparison with realities characterized by higher capacity utilization of recreational services might be promoted to better understand the role of seasonality in conditioning efficiency.

In conclusion, more research must be done to better understand the relationship between the technical inputs introduced in agritourism and value of the outputs produced.

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