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Research article

Landscape management and economic evaluation of the ecosystem services of the vineyards

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Abstract: The contribution aims to highlight the relationship between the business economy applied to viticulture and the ecosystem. The concepts of ecosystem services and viticultural biodiversity are seen in order to provide a new perspective for the development of a more sustainable business management. The work contributes to enriching the economic literature by introducing the relationship between ecosystem and business. The new perspective helps to place the company within the wider ecological-social system, favoring a more consistent interpretation of the relationship of exchange (impact and dependence) of resources with nature. The work proposes a methodology for calculating the ecosystem service rendered by the vineyards cultivated in the Sicilian hills. The conceptual scheme and the methodology adopted highlight the value of the ecosystem service. Certainly, for the future, it is necessary to create business models where ecosystem services find a remuneration as the entrepreneur is led to adopt cultivation practices in this sense only if he finds a remuneration from the public or private sector. Ecosystem services are important to protect the landscape and the environment. The paper proposes a land management method that respects the environmental balance. This approach leads to long-term value creation at both the micro and macroeconomic levels.

Keywords: evaluation; ecosystem services; landscape; environmental risk

1. Introduction

Agricultural activity forms unique and unrepeatable landscapes such as the viticultural ones that in some cases have become a historical heritage of humanity. Viticulture shapes the environment and

contributes to the preservation of traditions and the prevention of landslides and landslides. The study of the relationship between economy and environmental protection is not new to the world of business economics. The exercise of the business activity takes place in close connection with the environment, it finds its strengths in it. At an international level, the issue of relations between companies and the environment has now become of constant interest on the part of many scholars [1]. In fact, the focus on concepts such as green economy, sustainable development, eco-efficiency, cleaner production has become part of the economic-managerial language [2–4]. Today there is greater attention to business choices and their impact on the environment. However, to date, the aspects related to environmental protection have not had the ability to effectively affect the development and growth trajectories of either high-income countries or emerging economies. Despite the importance of sustainability, the green economy, cleaner technologies, the vision of the relationship between production systems, businesses and ecosystems has not changed, and the idea that nature is a free and inexhaustible capital remained at the basis of the choices. economics and relations between business and the environment [5,6]. The criticality of production techniques that are not respectful of the environment were highlighted by the Millennium Ecosystem Assessment [7] which highlighted that about 2/3 of the ecosystems surveyed are damaged or seriously compromised (60% at no longer sustainable levels) due to growing anthropogenic pressure and the spread on a global scale of lifestyles strongly geared towards consumption. In order to propose environmentally friendly economic and production models, the relationship between business and the environment must be reviewed. It is also important to pay attention to the organization of organizational structures, the environmental and social sustainability of farms or ecosystem services [8,9]. Ecosystems, in fact, perform a series of functions that contribute to human well-being and health, either directly (think of a forest and the production of wood and food, or the purification of water), is indirect (for example, pollination, climate regulation, soil formation processes). The concept of ecosystem services represents the connection between the functions performed by nature and the benefits that humans, organizations and society obtain from the use of these functions. The protection of the territory begins with the recognition of its importance. Ecosystem services contribute to the permanence of man in the territory. The analysis of ecosystem services, and their measurement and evaluation, offers the business economy a new interpretative lens to read the relationship between organization and the environment and allows a clearer understanding of the development trajectories of companies that are respectful of the environment. In this paper, after analyzing the economic literature on ecosystem services, the ecosystem service of the arrangement of espalier vineyards in the hilly area of Sicily was evaluated, where viticulture boasts an ancient tradition. Viticulture helps to create production systems capable of making the territory grow and develop. Starting from the analysis of other papers [10] in this the novelty of this research is represented by the internalization of the ecosystem service in business strategies. This aspect is very relevant both for the entrepreneur as it reduces the management costs of the vineyard, but also at the macroeconomic level as proper management determines the conditions for development and economic growth.

The study is innovative on this aspect as the Common Agricultural Policy (CAP) should encourage entrepreneurs who adopt these principles through aid for the planting of vineyards.

2. Review of the economic literature on ecosystem services

The concept of ecosystem services has developed since the 1970s through a series of studies that have emphasized how the functions performed by ecosystems generate utility for human beings, for organizations and for society [11]. These studies highlight that our dependence on the availability and quality of these services, which are not - as a rule - intercepted by market mechanisms; they also highlight the issue of conservation of natural capital and biodiversity as an essential condition of our well-being [12]. This aspect is very important because the ecosystem service provided by agricultural crops and their arrangement is overlooked in the market valuations of land, which represents an added value for the natural environment and for the economic operators who find sustenance from it.

Ecosystem services can be identified in four types: of supply or procurement, which generate the actual goods, such as food, water, fibers, wood, fuel and other raw materials, genetic materials, etc.; regulation, such as the regulation of climate, tides, water quality (water purification), pollination and control of infestations, etc.; cultural, which include the use of nature for spiritual or aesthetic, recreational, and educational purposes; life support, including primary production, nutrient cycle, decomposition and soil formation.

All the types of ecosystem services identified contribute to generating well-being for individuals and value for companies, which use directly or indirectly the functions freely performed by nature. Think, for example, of the fishing sector and the exploitation of fish resources; the agri-food industry, and the use of processes such as pollination or climate regulation; we consider products such as wood, paper, rubber or the textile sector that directly benefit from the so-called supply eco-services for the supply of raw materials; again think of tourism and the value generated by forests, woods, sea coasts, beaches, coral reefs. We can say that ecosystem services make it possible to achieve Pareto-efficient conditions, as they improve the performance of an economic entity without worsening those of the others.

Ecosystem services are essential for the vitality and competitiveness of businesses. Over the years their benefits have been underestimated and attention has been paid only to the productive function of the business. The company is able to generate income, provided that it develops on a competitive vision. In this way, ecosystem services represent an intangible value that is part of the company's assets. Under the competitive aspect, they can offer a differentiating advantage, increase the productivity and profitability of the company itself. Indeed, variations in the availability of ecoservices, the effect of increasing pressure on natural and consumption capital higher than regeneration rates [13,14], can affect the operation of company to the point of putting the continuity of the business and its economic-financial sustainability at risk, requiring adequate responses at the management and organizational level. The new business economy has embraced the ecological challenge, giving birth to a new branch that studies the multiple relationships between organization and the natural environment. As a function of this environmental sensitivity, where it is taken into account that resources are not unlimited, new innovative conceptual models have been developed [15–17]. At the macro level, these scholars have explored the consequences of market failures for natural resources, analyzing the relationships between policy makers' actions, regulations, social movements, NGOs, and corporate activities [18]. At a strategic level and business competitiveness studies, several studies have examined whether and how environmental protection affects competitive advantage and business

performance [19], and have analyzed which resources, skills and mechanisms can lead to more efficient management of the natural environment through sustainable innovations [20]. In these studies, starting from environmental sustainability, competitive models are studied that lead to the economic sustainability of the company. Finally, multiple managerial disciplines such as marketing [21], supply chain management and production [22], accounting have deepened the operational implications deriving from the need to measure and manage the effects of polluting processes and products on ecosystems [23].

What appears surprising, however, is the scarce attention paid by this line of research to ecosystems, their functionality as complex adaptive systems, and their interdependence with firms and their behaviors [24].

By highlighting these initiatives, and drawing on recent theories developed in the ecological field, the ecosystem services approach allows us to reformulate the traditional vision of the relationship between business and nature, conceiving the existence of two systems, the economic-social one and the ecological one. , not only interconnected but also - and above all - interdependent; thus overcoming the concept of the environment as an external element independent of the organizational context, which provides resources and accommodates the different forms of pollution [25,26].

Businesses are integrated with natural ecosystems. In this way, on the one hand, the concept of ecosystem services, with its distinctive properties deriving from the nature of complex adaptive systems, is brought to the attention of business scholars; on the other hand, the concept of interdependence is introduced, breaking down the business-environment relationship into two main dimensions: the impact from and towards ecosystems, and dependence, a new category that allows us to grasp another dimension of the relationships between the elements of the socio-ecological system.

The term impact identifies the forms of use of ecosystems both as resources, or inputs for industrial processes (for example, inputs such as raw materials, energy, auxiliary materials), and as wells, to accommodate unwanted outputs deriving from the activities of transformation at the process or product level (for example, atmospheric emissions, waste, waste water, etc.). If the term impact identifies a dimension of the relationship that over the years has been the subject of a certain deepening also by the managerial and organizational disciplines, with the concept of dependence, on the other hand, a new element is introduced into the relationship between business and environment.

This concept places the emphasis on the interaction between the functionality of the company and the availability of the services generated by the ecological system, which in turn derives from the health of its processes. The growing fragility of ecosystems, the loss of biodiversity, the reduction of ecological resilience can affect companies and the technological-production chains that characterize them, generating new risks and requiring new strategic and operational solutions. The degradation of ecosystems can result in a loss of ecosystems with effects on business activity.

The conditions of increasing degradation of ecosystems determine the emergence of new risks and opportunities for businesses, and require: the adoption of suitable methodologies and tools to identify, measure and evaluate the conditions of impact and dependence on ecosystem services; operational strategies and solutions to face and manage these risks and seize the related opportunities. If the concept of impact has so far seen technological-productive skills and process / product innovation as the prevailing key to improving the business-environment relationship, recognizing the dependence on services produced by ecosystems can make deeper transformations necessary. ,

extended to the level of entire industrial sectors, involving very different stakeholders. This perspective, in fact, integrates the more traditional approach based on eco-efficiency and cleaner technologies, and pushes towards a complete re-design of the technological-production chains. Taking note of the fact that the sustainability of a company over time is linked to the availability of services generated by nature, and that these services are now at risk, should lead to the development of specific strategies, for example aimed at ensuring continuity in the availability of natural resources used in terms of desired quantity, quality, and price. This may mean not only re-discussing traditional procurement logics, but also developing ad hoc partnerships with raw material producers, with other communities that use eco-services, with local regulators and administrators, with competitors, at in order to identify more sustainable practices and solutions.

In the absence of a system of governance and protection of natural capital and biodiversity, however, the spontaneous initiative of businesses can only be limited in frequency, size and impact capacity. Indeed, ecosystem services are still perceived by those who use them as public goods with unlimited availability.

3. Methods

The replacement cost criterion can be applied to estimate the value of the ecosystem service to prevent the phenomenon of hydrogeological instability in hilly vineyards. Applying this criterion, a good or a service is assessed on the basis of the cost that the company would have to incur to replace it with another good or service capable of performing the same function within the farm. The replacement cost method is appropriate if the value of the service is estimated on a corporate or local scale, because the hypothesis that, in the partial adaptation assessment, the price system is independent of the alternative considered is sustainable [27].

In the case of hilly vineyards, thanks to the structure of the agro-environmental landscape, and to the peasant tradition, the arrangement of the rows on is able to mitigate the risk of hydrogeological instability. Peasant knowledge, which is handed down from generation to generation, therefore currently limits the need for interventions aimed at mitigating hydrogeological instability. However, if the vine producers of the Sicilian hills abandoned the arrangement of the rows as it happens in tradition, it would be necessary to intervene with works of land arrangement aimed at conveying the waters in order to avoid erosion and loss of soil fertility.

The Value of the ecosystem service (VS), rendered by the excellent arrangement of the vineyard, obtained as a replacement value, and given by the difference between the cost of planting the vineyard estimated in the hypothesis of absence of planting in respect of the orography of the land actually to which are added the annual management costs of the vineyard minus the costs of restoring it to its current conditions. All updated to date according to the anticipation coefficient.

$$VSt = (\left(Ct + \sum_{0}^{n} Cg \right) - \sum_{0}^{n} Cr) \frac{1}{(1+r)^{n}} \quad (1)$$

Where is it:

Ct = Total cost of planting the vineyard in the hypothesis that the orographic conditions of the land are not respected calculated at the end of year n;

Cg = annual management cost of the vineyard;

Cr = cost of restoring the vineyard;

n = economic life of the vineyard;

r = interest rate assessed by looking at alternative investments for equal time and risk.

After determining the total value of the ecosystem service calculated VSt with formula 1 (referring to the entire duration of the investment in the vineyard), we determined the annual value VSa:

$$VSa = VSt \frac{r}{(1+r)^{n} - 1} \quad (2)$$

The calculation method was applied to a case study in the hilly area of western Sicily where the viticultural activity boasts a centuries-old tradition. In order to choose the survey unit, it was decided to analyze a company specializing in the production of wine grapes with the entire company area covered with vines. The cultivar is Nero d'Avola, an indigenous Sicilian vine with a vineyard planting distance of 2.50 m x 0.90 with a density of 4,444 plants per hectare. The year of survey and estimate of costs and replacement value is 2020.

4. Results and discussions

The survey was carried out by going to the production facility. After having detected the technical data, the planting cost referred to the end of the second year was determined, which amounts to 14000 euros per hectare. From the direct investigation conducted, the failure to arrange land in the traditional form would require an intervention (leveling of the ground and arrangement of the poles and replanting of vines) of 1000 euros per hectare on an annual basis. The annual cost of managing the vineyard amounts to 2500 euros per hectare. The economic life of the vineyard from the information collected is 13 years. The interest rate applied is 3% and was obtained by asking the banking institutions in the area for the rate applied for an investment equal to the same amount of money and for the same investment period. By applying formula (1), then subtracting the cost actually incurred for restoring the soil conditions to its current conditions from the value of the vineyard planting cost service estimated in the hypothesis of absence of planting respecting the orography of the land and adding the annual management cost, the replacement value of the service rendered by traditional vineyards to the Sicilian territory is obtained which is equal to 26321.16 euros (VSt) in the hypothesis of an economic duration of 13 years. Applying formula (2) the VSa amounts to 1,416.07 euros for each year of the investment in the vineyard. Estimating the value of the ecosystem service is of particular importance considering that very often the excellent arrangement of the land is omitted in the replanting of vineyards. The lack of soil arrangement also causes a loss of soil fertility and therefore of its productivity and profitability. Furthermore, the landslides phenomena determine negative externalities to the companies that are located in the plains. Economic and market instruments can contribute to the enhancement of biodiversity and ecosystem services, favoring their measurement and quantification and encouraging conducts favorable to their protection. In such a context, the implementation of joint actions between public and private actors, with particular reference to companies, can allow the institutional and cultural legitimacy necessary to overcome some of the structural difficulties that characterize the protection of natural capital, contributing to the creation of a necessary model of

governance and protection of natural capital and biodiversity. Reference is made to a model in which companies can be encouraged to identify their dependence on ecosystem services and the potential damage resulting from their loss; and policy makers must encourage, through appropriate policies, the adoption of practices that are respectful of ecosystems. The notion of ecosystem services therefore offers a new construct for interpreting the relationship of interdependence (impact / dependence) between businesses and the natural environment. In the past, man and peasant knowledge had respect for the environment. In reality, people lived in "ecosystem" agriculture where the productive function was seen from a circular economy perspective. Agriculture and animal husbandry lived in close relationship. The phenomena of erosion and hydrogeological instability are the result of that agricultural model where the efficiency of production is enhanced. In reality, this does not mean that production efficiency should not be taken into account but that both ecosystems and businesses are complex adaptive systems [28,29]. The latter act, grow, transform within socio-ecological systems, with which they co-evolve along multiple space-time scales. A first line of research, therefore, could examine the different organizational theories (institutional theory, resource dependency, systemic approach, agency, etc.) to understand which ones are more suitable for reading the interdependence between businesses and nature, and which to provide the best interpretative tools to examine the implications induced by the conditions of scarcity and uncertainty of ecosystem services, and by the new concept of limit, introduced with planetary boundaries. Regulations and economic instruments. New tools economic and new forms of governance are intended to be adopted in the coming years to ensure the effective protection of natural assets, with obvious implications for the behavior of companies. Therefore, new spaces are opening up for research on the role of environmental policies and regulations as drivers of the adoption of sustainable behaviors, of new cleaner technologies, but above all for the creation of markets aimed at protecting natural capital. Strategic processes and managerial decisions. For those studying business management it becomes interesting to analyze how the dynamics of ecosystems influence strategic processes and managerial decisions. The theory of complexity and modern ecology have introduced the concepts of adaptation and resilience, where in the face of complex adaptive systems the reductionist logic, oriented to control and simplification, has proved not to work.

From what has been described so far, it is clear that it is necessary to bring out a new awareness in the business world, spreading a perspective that integrates dependence and impact into the business-ecosystem relationship. This article, therefore, offers managers a new interpretative key for reading the risks and opportunities associated with this relationship, and opens the way to new strategies that extend beyond traditional company boundaries: upstream, along the management of supply chains, up to the phase of interaction with the generation of ecosystem services; downstream, towards the closure of the production and consumption cycles.

In particular, the work provides managers with an innovative framework to analyze and monitor the impact-dependence relationship and, therefore, try to prevent the emergence of risks related to the properties of complex adaptive systems and the growing scarcity of ecosystems.

5. Conclusion

The recognition of ecosystem services makes it possible to protect the territory and maintain a long-term balance between man and environment. The awareness of depending on environmental services that risk being irreparably compromised is beginning to spread also in the business world; while policy makers, through the development of specific tools, have begun to shift the collective attention to the conservation of natural capital and biodiversity. Speaking of environmental protection no longer means dealing only with climate change but rather activating business models that are consonant with the environment. The issue of the loss of functionality of ecosystems represents one of the most important challenges, especially in this period where the Covid-19 pandemic requires a rethinking of growth and development models according to a vision of circular economy.

It is therefore of interest that the behavior of businesses and the management of organizational processes reflect the dynamics and adopt environmentally friendly practices. In doing so, in addition to respecting the environment, ecological and social systems are promoted and trying to develop new knowledge in tune with long-term development. This contribution wanted to propose a methodology for calculating the ecosystem service in hilly vineyards, a highly topical issue, with a view to offering public and private operators a tool to promote both environmental policy actions and agronomic practices that respect the environment. The public operator is called to create those conditions where the entrepreneur can be competitive and competitiveness must be done in respect of the ecosystem. In fact, the entrepreneur is set to adopt "ecosystem" practices provided that these services are remunerated either by the public sector (through specific policies) or provided that the consumer is willing to pay an extra price for the ecosystem service created by the company. To do this, the consumer should be careful in choosing products that derive from environmentally friendly practices. Most likely either this cost is borne by the public operator, or many consumers (especially those with low income) are unable to remunerate the ecosystem service produced by the farm. the correct management of the vineyard, with the right rules of governance, determine the conditions for the balanced development of the ecosystem. As demonstrated in the research, the value of the ecosystem service is at the basis of the governance and orientation of entrepreneurs who have a long-term vision.

Conflict of interest

The author declare no conflict of interest.

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