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Keynote article

## Valuing for sustainability: hidden costs and benefits in multidimensional agriculture

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**Abstract.** The concept of agriculture has changed over the years. Whereas it was once considered simply a “means” for the production of goods (food and non-food), today, its multifunctionality, understood as the ability to also provide environmental and social services, takes on greater importance. The concept of multifunctionality is intended to change the conception of the agricultural sector and make it more suitable for the historical period of transition we are currently experiencing, for which it is essential to abandon old paradigms in order to create new ones. An unresolved challenge is providing value for each of the multifunctional services. This article provides a brief review of studies dedicated to identifying the main market and extra-market effects of multidimensional agriculture and describes some approaches used to adopt (monetary) quantification of related and secondary activities to facilitate the adoption of more sustainable practices. Special attention is given to payments for ecosystem services, true cost accounting, and true price tools to analyse the positive and negative externalities of multifunctional agricultural systems.

**Keywords:** multifunctional agriculture, true cost accounting, true price, payments for ecosystem services, sustainable development.

**JEL codes:** Q11, Q15, Q57.

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### HIGHLIGHTS

- Multidimensional agriculture is a complex topic.
- Providing value for each externality is fundamental.
- Payments for ecosystem services can be used to support positive externalities.
- True cost accounting and true price are tools for assessing negative externalities.

### 1. INTRODUCTION

The agricultural economics research agenda is constantly evolving (Brunori, 2022; Malorgio, Marangon, 2021; von Braun, Sheryl, 2023). One of the issues that still attracts special attention, particularly in light of the sig-

nificant institutional implications that can be assumed, is identifying and quantifying the (monetary) effects of the related and secondary activities (market and non-market) of agro-zootechnical productions. The theme has been at the centre of analyses for a long time, according to different perspectives. Among these emerges the relationship between the social functions (sectorial contribution to collective well-being) and the multiple methods used by the public decision-maker for its support. In particular, in recent years, a significant debate has resumed around the justification of public policies for agriculture, especially the Common Agricultural Policy, as an intervention well-versed by a sort of “Public Money for Public Goods” (PMPG) principle (Kam *et al.*, 2023).

The image of a “multidimensional agriculture” that guides this contribution is linked to the path that emerged with strong and superior evidence in Europe starting from the 1980s (Marangon, 2008) – one from an agriculture intended for the production of goods (food and non-food) to one that has become a complex and multifunctional sector – capable of offering the community other goods and services aimed at increasing social welfare. This sphere of activities determines the articulated family of social functions of agriculture. The Italian agrarian economy tradition has long supported the primary sector’s ability to provide important social outputs. In recent times, however, we have been witnessing a process of rethinking the contents that this role assumes at the current juncture of socio-economic development (Corsi *et al.*, 2023; Malorgio, Marangon, 2021; Sivini, Vitale, 2023).

The theme of the social functions of agriculture has been addressed by economic analysis, mainly using the concept of market failure due to the existence of phenomena known as externalities (positive and negative) and public goods (OECD, 2001, 2003, 2005, 2008). Agricultural economists have tackled the problem in connection with the theme of the multifunctionality of agriculture and the instruments of public intervention support of the social functions recognised in the primary sector. The activities provided by “multidimensional agriculture” require economic assessment and incentive-based instruments in supporting public goods and providing positive externalities or reducing negative impacts. It is fundamental to have a good knowledge of the potential and dynamic connections between natural capital for production, its stock changes, and its capability to impact on human well-being that arise because of farming/agriculture and more in general agri-food value chain activities.

Van Huylenbroeck *et al.* (2007) examined the intricate connections within a farm system and presented a

fresh perspective on the role of agriculture in rural areas. They proposed the need to reconsider and redefine the concept of multifunctional agricultural production as well as the analytical frameworks used to study it. The re-evaluation of existing evidence on the various functions performed by farming is of importance, as previous research has shown that agriculture goes beyond producing marketable goods. It also provides non-market benefits that contribute to rural prosperity. These contributions can take different forms, such as directly increasing property values or generating economic advantages in sectors like tourism. Moreover, agriculture indirectly helps preserve the rural heritage and promote agroecological systems. The multifaceted nature of these contributions highlights the importance of understanding and assessing the multifunctionality of farming within rural contexts. Since multifunctionality could be a unifying principle to bring productive and non-productive functions into harmony, Van Huylenbroeck *et al.* (2007) pointed out that a fundamental intervention referred to how this multifunctional role of agriculture can be supported and incentivised, requiring the development of new institutional arrangements and a major change in policy incentives.

Compared to the past, today’s agricultural and food companies are even more involved in the processes that regulate the dynamics of the production system, within which they have the task of developing a strategy that keeps economic vitality and environmental and social sustainability unchanged (Malorgio, Marangon, 2021). Therefore, it is not simply a question of producing quality goods and with a level of differentiation capable of distinguishing them on the national and international markets but of providing services to individuals and the community. Furthermore, it is a matter of developing organisational and technological knowledge that guarantees an efficient relationship with partners in the supply chain and at the same time adopts sustainable production techniques for environmental protection, rational use of natural resources, protection of biodiversity and valorisation of local resources. Overall, all these positive impacts of multidimensional farming/agriculture are able to improve human well-being.

The aim of this paper is to provide a brief review of studies devoted to identifying the main market and non-market effects of multidimensional farming/agriculture with a description of some approaches used to adopt a (monetary) quantification of the related and secondary activities in order to facilitate the adoption of more sustainable practices. The paper is structured as follows. A brief introduction to the concept of the multifunctional role of agri-food systems is provided in the first section.

The main literature on multifunctionality and its presence and diffusion is described in Section 2. Section 3 presents the positive effects of multifunctionality and the role of payments for ecosystem services, while Section 4 analyses the negative impacts and the true cost and true price of food approaches. The final section offers some conclusions.

## 2. MARKET AND NON-MARKET AGRICULTURAL MULTIFUNCTIONALITY: THE CONCEPTUAL FRAMEWORK

The literature on the multifunctionality of agriculture is vast and detailed, as can be deduced at an international level from, for example, what was produced by the OECD in terms of documents (OECD, 2001, 2003, 2005, 2008). According to the OECD's perspective, multifunctional farming involves the production of commodity and non-commodity outputs, which may be both public goods and externalities.

Besides this definition, there are different interpretative approaches to multifunctionality (Sivini, Vitale, 2023). Agriculture can be considered a multifunctional activity since, as is known, it is capable of producing a complex set of products that go beyond satisfying the traditional demand for food and fibre (Aguglia *et al.*, 2008; Bonfiglio *et al.*, 2022; Henke, Vanni, 2017; Roep, van Der Ploeg, 2003; van Der Ploeg *et al.*, 2009; van Der Ploeg, Roep, 2003; Van Huylenbroeck *et al.*, 2007; Wilson, 2007, 2008). If these are the "primary" products of agriculture, providing a positive anthropic value, the "secondary" products can be characterised by both negative (e.g. all forms of pollution and natural resources depletion), and positive (in the case of landscape maintenance, biodiversity protection, environmental risk prevention, cultural heritage conservation, rural development, food safety and animal welfare) values (Van Huylenbroeck *et al.*, 2007).

According to Sivini and Vitale (2023), the above-mentioned positive values can be provided by farmers producing both social and environmental services (e.g. tourism, educational, recreational, and supporting environmental resources management). The focus of these approaches is mainly on the opportunity to gain by producing goods with a market, and, consequently, non-productive functions (i.e. non-marketable) are often undermined (Nowack *et al.*, 2022). Furthermore, the literature includes studies focusing on more integrative approaches to the analysis of multifunctional roles, with the aim of redefining the concept. According to what is called the "new" rural development paradigm, which

implies reconnecting agriculture with nature and society at large, van der Ploeg *et al.* (2003) pointed out three groups of strategies. "Deepening" strategies include all farm practices that can offer high value-added production, such as organic production or the development of local supply chains. "Broadening" strategies involve new services (e.g. tourism services or social farming) resulting from the creation of partnerships within the rural area. Lastly, "regrounding" strategies are organisational in nature and involve the mobilisation of internal resources in farm production.

Using this framework, and according to van der Ploeg *et al.* (2009) and Aguglia *et al.* (2008), the analysis of multifunctionality also refers to the creation of synergies between the different agricultural functions and the development of relationships between agriculture and society. Considering normative conceptualisations of multifunctionality, Wilson (2007, 2008) described farm-level multifunctional agricultural transitions. Adopting a productivist/non-productivist multifunctionality range, Wilson categorised a number of farm types and identified different farm-level transitional potentials from weak to strong multifunctionality between different categories and ownership types of farms. Strong multifunctionality was described as "characterized by strong social, economic, cultural, moral and environmental capital" (Wilson, 2008, p. 368). It includes farmers who are closely connected to the community in which they operate (hence, outside global capitalist networks), sensitive to environmental issues (hence, well predisposed to organic farming and the development of local supply chains), and aware of the importance of farm household knowledge.

Conversely, weak multifunctionality rises in productivist logic. Institutional support for multifunctionality warrants farmers' income diversification by capitalising on positive externalities provision (Potter, 2004). Moreover, Wilson (2007, 2008) conceptualised multifunctional transitional procedures at the farm system level over time. To better describe the complexity of multifunctionality, path dependency and decision-making processes were introduced. The decision-making procedure was assumed as groups of decision-making opportunities bounded by productivist and non-productivist action and thought, while path dependency suggested that system memory contributes to defining the likelihood of multifunctional activities, arguing that quick transitional breaks in transitional processes often characterise farm-level transitions.

More recently, a growing interest in agroecology has been observed as a model for multifunctional agriculture (Wezel *et al.*, 2009), as it is capable of fusing ecolog-

ical and biological principles/methods with sustainable agriculture design and management practices. Agroecology, in fact, requires a holistic, systems-level understanding of agri-food system sustainability (Gliessman, 2021). Due to specific local developments, a number of differences exist, but there is agreement in the conviction that agroecology combines scientific discipline, social movement and cultural practice that, together, can lead to the achievement of multifunctional agricultural practices. However, with the exception of France, which has good experience, the European Union (EU) has no clear strategy to support agroecological practices and action plans. In Italy, a number of initiatives were developed following the universal exhibition “EXPO 2015 Milan”, and the experience of the bio-districts helped the promotion of agroecological practices. According to Gargano *et al.* (2021), Italian multifunctional farms adopted a model that can be considered a precursor of this approach. The Italian farm diversification system effectively anticipated the European Green Deal strategy because of the simultaneous presence of key elements concerning both agricultural practices and ethical and social aspects. Their findings underscore the characteristics of farmers who enhance the agroecological orientation and put it into practice in a more conscious manner (i.e. educational level, economic sector of previous employment, and ability to create multi-actor and multi-level networks).

Finally, adopting a territorial approach can help identify a number of recent studies about multifunctionality that focus the analysis on more “traditional” geographical contexts in emerging areas. Indeed, attention to multifunctional agriculture seems to have recently shifted from the specifically European framework (Nowack *et al.*, 2022) and/or the OECD countries (OECD, 2001, 2003, 2005); recent studies now include other rural contexts, such as farming regions of China (Song, Robinson, 2020; Zhang *et al.*, 2023), with original insights into the role of primary activities in guaranteeing the well-being of local communities.

### 3. “UNINTENTIONAL” MULTIFUNCTIONALITY AND POSITIVE EXTERNALITIES

#### 3.1. The provision of ecosystem services

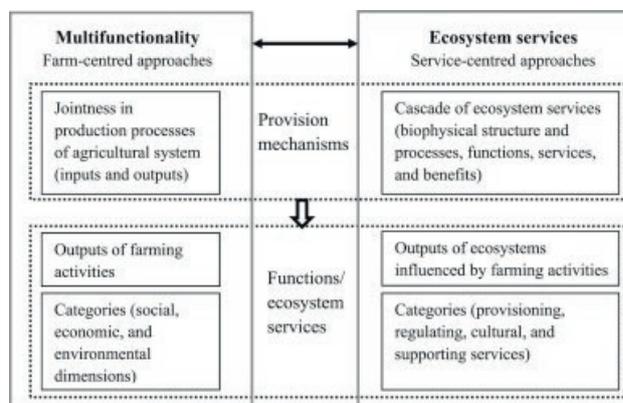
Agri-food systems have both positive and negative impacts on planetary health and human well-being (TEEB, 2018; Hendriks *et al.*, 2023; Michalke *et al.*, 2023; FAO *et al.*, 2022). According to Rovai and Andreoli (2016), the post-conflict period (which saw the emergence of agricultural multifunctionality and the provi-

sion of ecosystem services) was marked by an intense process of urbanisation, the abandonment of rural areas, and the concentration of agricultural practices on the most fertile lands, resulting in significant negative environmental and socio-economic impacts (Hendriks *et al.*, 2023; Michalke *et al.*, 2023). However, over time, there has been increasing knowledge and awareness of the opportunities and benefits associated with sustainable production methods and ecosystem services provided by farmers, for example, risk reduction from environmental disasters or extreme weather events. Huang *et al.* (2015) stated that, since being promoted by international programmes, multifunctional agriculture and ecosystem services are considered two important concepts for sustainable agricultural research and policy making. They provided a synthesis of the different interpretations of the relationship among the multifunctional role of agriculture, ecosystems, functions and ecosystem services provision (Figure 1).

Furthermore, Bernués *et al.* (2019) found that citizens prefer a multifunctional configuration of agricultural systems oriented towards a mix of quality products, landscape management, biodiversity conservation, and further improvement of ecosystem services. Consequently, interventions in favour of activities that produce positive benefits need to be enhanced (Eigenraam *et al.*, 2020).

A number of pragmatic and innovative projects have been implemented in diverse and heterogeneous areas, combining multifunctional agricultural diversification strategies with the provision of ecosystem services related to the environmental protection of land (Bretagnolle *et al.*, 2018; Tran *et al.*, 2023). For example, we know that the community can obtain better services by offering farmers custodianships in the territory.

**Figure 1.** Fundamental differences between multifunctional agriculture and ecosystem services in agricultural research.



Source: Huang *et al.*, (2015).

Such an approach generates significant benefits, such as lower costs for environmental prevention organisations, increased consumer appreciation/satisfaction and willingness to pay (Tempesta, Vecchiato, 2022), and increased chances of survival for local farms.

The mismanagement of environmental resources for agricultural economic development has also reduced the natural capacity of the ecosystem to provide ecosystem services. The opportunity to counteract this negative effect comes from the enforcement of the benefits produced by agricultural multifunctionality by adopting measures (e.g. restoration of carbon rich habitats, or conservation of biodiversity) that can play a crucial role in improving the provision of ecosystem services (Bernués *et al.*, 2019), building resilience to negative impacts derived from developing anthropic activities, and, more generally, potentially contributing to the United Nations' Sustainable Development Goals (SDGs) for 2030 (Boix-Fayos, de Vente, 2023). When these benefits are not marketable, it is essential to find other means of estimation and remuneration, except in the case of purely voluntary production strictly linked to more sustainable attitudes, which does not require any kind of incentives. The search for the best set of instruments to ensure a satisfactory level of ecosystem service provision is increasingly high on the political agenda.

To motivate land managers or owners to engage in the provision of socially valuable ecosystem services and make decisions based on social, environmental and economic aspects, it seems useful to employ incentive-based tools (Jack *et al.*, 2008). Indeed, Piñeiro *et al.* (2020), who analysed 17,936 studies, stated that farmers' decisions to adopt sustainable agricultural practices in response to incentive interventions depend on many factors; however, the researchers demonstrated that, given an appropriate design, incentive-based programmes are able to produce environmental benefits. According to White *et al.* (2022), schemes with sufficient levels of financial incentives could increase the provision of quality ecosystem services, at least among some types of farmers, since a number of them may continue to be more attracted by more conventional practices able to provide only provisioning ecosystem services. Tanaka *et al.* (2022) discussed the importance of adequately encouraging landowners and farmers to promote ecosystem service provision due to the complex context they have to manage (e.g. evolving socio-economic conditions, increasing risks and uncertainties). Further, Hayes *et al.* (2022) pointed out the need to counteract the incentive uncertainty linked to temporary financial supports used to promote the desired resource-use behaviours.

### 3.2. Payments for ecosystem services

Incentive-based tools can be classified into three categories: i) market-based instruments, providing incentives through market signals; ii) regulatory measures (e.g. certifications); and iii) cross-compliance financial supports (i.e. direct payments linked to basic environmental standards) (Marangon, Troiano, 2017). The first category offers adaptable adoption to incentivise particular behaviour changes; however, it needs to be planned and correspond to the intended crucial direction (Piñeiro *et al.*, 2020). Among market-based tools, payment for ecosystem services (PES) consists of a remuneration scheme for land managers or owners to embrace activities restoring, safeguarding, or enhancing ecosystem services and biodiversity (European Commission, 2021; Salzman *et al.*, 2018; Wünscher, Engel, 2012), including some farmers' multifunctional practices (Boix-Fayos, de Vente, 2023; Marangon, Troiano, 2017).

Although many different denominations (i.e. the Italian "Payments for Ecosystem and Environmental Services") and definitions for PES coexist (Yan *et al.*, 2022), an influential reference model is that of Wunder (2015). This model focuses on market mechanisms and conceives PES as «a voluntary transaction between service users and service providers that are conditional on agreed rules of natural resource management for generating offsite services» (Wunder, 2015, p. 241). According to this financing mechanism, the supplier has to be paid to provide a service. The beneficiaries (i.e. individuals, communities, businesses, or government acting on behalf of various parties) make the payment in favour of land managers or owners who supply the ecosystem service (Wunder *et al.*, 2008). With PES, a market is created, and prices are placed on non-market ecosystem services deriving, among others, from agricultural multifunctional practices (Rovai, Andreoli, 2016). Bringing them into the market potentially allows their value, which is typically not "visible", to be expressed in monetary terms. This internalisation of the positive externalities of land use decisions allows land managers or owners to assess the benefits derived from developing multifunctional activities and compare them with the value of the costs of their supply (Smith, Sullivan, 2014).

According to the literature following Wunder (2015), PES can be considered a market-based or market-like instrument created to internalise benefits, which are externalised, with the aim of bringing marginal costs into line with marginal benefits with the aim of increasing economic surpluses. Due to the difficulties in implementing PES in favour of certain ecosystem service provisions, some scholars have proposed alternative defini-

tions. For example, Farley and Costanza (2010) proposed an original approach to PES that differentiates ecosystem goods as stock-flow resources and ecosystem services as fund services and provides a definition of ecosystems as a special configuration of stock-flow resources able to supply a flow of services. Consequently, PES schemes paying for land uses linked to generating ecosystem services are payments for ecosystem funds. Given the complexity of ecosystems and the flow of services they generate, Farley and Costanza (2010) stated that payments for a group of not-strictly defined services are more likely to maximise social benefits than a market-like payment for a well-identified ecosystem service.

Neoclassical environmental economics provides a conceptual framework for the PES instrument. According to Engel *et al.* (2008), its essential idea is linked to the Coase theorem, which assumes that, given certain conditions, the problem related to the existence of external effects can be directly surmounted through private transactions negotiated between the affected parties without considering the initial allocation of property rights. Moreover, the results will lead to enhanced economic efficiency, as stated by Pascual *et al.* (2010). The idea of developing private market negotiations, providing direct compensation to multifunctional farmers, and influencing the supply of ecosystem services presents probable great cost-effectiveness gains (Engel *et al.*, 2008). Farmers with higher marginal costs for providing ecosystem services will be included to provide fewer services than farmers with lower costs. However, the presence of large transaction costs, power imbalances, or poorly identified property rights could hinder the adoption of this kind of Coasean solution (White *et al.*, 2022). Consequently, the planning of PES tools, which are potentially also adaptable and cost effective, is not a simple task and requires a jointly run effort and good information to estimate ecosystem services (Havinga *et al.*, 2020). Furthermore, the analysis of all contextual conditions as conditioning factors is fundamental (Haile *et al.*, 2019).

PES tools have been used in many areas of the world with varying degrees of acceptance. A number of PES developed to encourage the supply of ecosystem services provided through the multifunctional role of agriculture can be identified. One of the well-known examples is the Vittel PES (Perrot-Maitre, 2006), localised in north-eastern France, where a water bottling firm paid local farmers to adopt sustainable production methods able to provide ecosystem services. Similarly, in Italy, some PESs linked to agricultural multifunctional practices can be identified, and their positive effects have been pointed out (Gaglio *et al.*, 2023; Schirpke *et al.*, 2018).

An analysis of different PES case studies reveals certain types of institutional intervention schemes in favour of multifunctional agricultural practices included among PES as PES-like mechanisms, which are more similar to the Pigouvian environmental instruments used to correct negative or enhance positive externalities (Troiano, Marangon, 2011). Indeed, some governmental payment programmes that offer payments to farmers deciding to adopt sustainable production activities on a voluntary basis could be identified as the Pigouvian concept of PES (Gaglio *et al.*, 2023; Schomers *et al.*, 2021). Agri-environmental schemes that compensate farmers for the provision of non-commodity outputs could also be included in this concept.

Both Coasean and Pigouvian types of PES are useful for quantifying, in monetary terms, the effects produced by the multifunctional role of agriculture. However, in Coasean-type PES, there is a private negotiation between the beneficiary, who pays directly and on an exclusively voluntary basis, and the service provider. Instead, in the Pigouvian approach of PES, governmental interventions may focus on either paying or making others pay on behalf of the direct beneficiary to spur ecosystem services provision. Although both have pros and cons, Pigouvian PES schemes have often been criticised for their low level of effectiveness (Galler *et al.*, 2016). Moreover, the development and implementation of Pigouvian PES programmes usually depends on complex governance structures involving several diverse actors; nonetheless, they keep transaction costs reasonably low (Schomers *et al.*, 2021). Furthermore, they prove to act better with benefits produced on a large scale and beneficiaries that are not directly and easily identifiable. However, the opportunity offered by Coasean-type PES approaches to directly involve the actors who benefit and perceive the value of the provided ecosystem services increases the probability of using a well-functioning incentive mechanism (Marangon, Troiano, 2013). Beneficiaries can also directly observe whether the service is delivered, eventually taking into consideration a renegotiation or conclusion of the transaction.

At the international level, most PES programmes follow the Pigouvian approach, and several studies have described and analysed the Pigouvian PES scheme, which is effectively the most diffused approach (Schomers, Matzdorf, 2013). However, the Coasean-type PES seems to be promising, considering the need to adopt innovative sustainable business models to support multifunctionality in order to help revitalise rural areas, according to the European Union Green Deal (Boix-Fayos, de Vente, 2023). Furthermore, the failure of indirect mechanisms adopted during the 1980s and 1990s

to incentivise land managers to adopt environmentally sustainable practices suggests that incentive approaches require the implementation of innovative tools to support the multifunctional role of agriculture, and Coasean-type PES is suited to achieve that purpose.

Nonetheless, PES tools are only one of the solutions for market failure linked to the undersupply of ecosystem services, as the creation of markets is not possible in certain circumstances, and other economic incentives may be necessary to support an adequate provision of these benefits (e.g. financial incentives given to areas with natural handicaps to maintain agricultural activities and guarantee environmental and social benefits).

#### 4. NEGATIVE EXTERNALITIES AND TRUE VALUES OF FOOD

##### 4.1. Hidden costs of agri-food systems

Currently, the need to provide food according to sustainability is a priority identified by all institutions. Moreover, the importance of identifying, assessing and managing negative externalities is fundamental to reduce tomorrow's business risk (TEEB, 2018). On the one hand, unhealthy food consumption habits are responsible for a number of negative social and environmental impacts produced along the agri-food supply chain (World Health Organization, 2019). On the other, developing sustainable agri-food systems would ensure that all people have access to healthy and affordable food while respecting planetary and social boundaries (Hendriks *et al.*, 2023).

To move towards more sustainable food provision, an ecological transition is needed (Bertossi *et al.*, 2023). According to some estimations (Food and Land Use Coalition, 2019; Steiner *et al.*, 2020), the transformation of these systems by 2030 would cost more than USD 300 billion per year. These investments would be divided in detail into 10 key aspects: promoting healthy diets, supporting productive and regenerative agriculture, protecting and restoring nature, ensuring healthy and productive oceans, diversifying the protein supply, reducing food loss and waste, fostering local loops and linkages, harnessing the digital revolution, promoting stronger rural livelihoods, and addressing gender and demography (Food and Land Use Coalition, 2019). To support this kind of transformation, it is necessary to understand the hidden costs and benefits of agri-food systems, which is an essential step forward towards the kind of new policies, practices, science and community engagement necessary to achieve SDGs.

Current agri-food systems have huge and invisible externalities that are usually not revealed in market prices

(von Braun, Sheryl, 2023). The “hidden costs” of global food and land use systems are estimated to be US\$19.8 trillion per year: \$7 trillion of environmental costs and \$12 trillion of health costs (TEEB, 2018). Furthermore, many hidden benefits, such as healthy and nutritious food, are also not accounted for. However, this type of benefit seems to be somewhat challenging to appraise (Clark *et al.*, 2022). These statistics provide a rough evaluation of the global investment needed to transform agri-food systems into resilient and sustainable entities, taking into account the challenges posed by climate change and other environmental risks. While these estimates act as a driving force for urgently required action, it is important to highlight some important findings from Thornton *et al.* (2023), who estimated the annual cost of implementing 11 essential measures required for the restructuring of food systems (e.g. ensure zero agricultural land expansion in high-carbon landscapes, or enable markets and public-sector actions to incentivise climate-resilient low emission practices) to be approximately US\$ 1.3 ± 0.1 trillion (accounting for less than 7 percent of the negative externalities produced annually by existing food systems).

##### 4.2. True cost accounting and true price approaches

To support the ecological transition among agri-food systems, an adequate framework and a systemic approach to change the instruments used to measure and value the environmental, social, health and economic impacts of food systems is an immediate way to take action and promote human, animal and planetary health.

Since the launch of the TEEBAgriFood Scientific and Economics Foundations report in 2018 (TEEB, 2018), the TEEBAgriFood Framework has become a reference for the true cost accounting (TCA) framework in agri-food systems. The concept emerges from increasing awareness of the negative externalities of agri-food systems (Hendriks *et al.*, 2023), which form a significant barrier to the transition of these systems (Galgani *et al.*, 2021). The consensus among scientists is that current agri-food systems are not sustainable because they use a lot of resources, contribute greatly to global emissions, and cause a significant loss of biodiversity. Additionally, these systems put a lot of pressure on Earth's planetary boundaries, as von Braun and Sheryl (2023) have pointed out. These systems, in which the erosion of natural capital, breaches of human rights, and unhealthy food are permissible and strongly incentivised, were increasingly considered conflicting with policies aiming to foster sustainable agri-food systems. Furthermore, the food

products that are lowest in price come at the highest cost to human health and the environment (Aspenson, 2020).

According to a report by Von Braun and Sheryl (2023), the global external costs related to the health and environmental impacts of agri-food systems are estimated to be roughly twice the value of food products in terms of market prices. Specifically, these externalities are valued at around US\$ 20 trillion, while the market value of food products is estimated at US\$ 9 trillion. To address these externalities, the first step involves disclosing and redefining the value attributed to food. This can be achieved through the use of true cost assessment (TCA), a tool that systematically measures and evaluates the environmental, social, health and economic costs and benefits associated with food production. A study conducted by Baker *et al.* (2020) emphasised the crucial role of TCA in transforming policies, products, organisations, farms and investments. In fact, there is a call for the agri-food system to further advance the research agenda on TCA by identifying practical approaches to internalise a portion of the significant externalities generated by the system. However, a successful transition towards internalising externalities requires the involvement of multiple stakeholders, as it necessitates collective support and collaboration.

A number of case studies have been conducted and analysed, and a growing and diverse community including several heterogeneous stakeholders has been seeking to improve, strengthen and mainstream the adoption of TEEB<sub>AgriFood</sub>. The Global Alliance for the Future of Food supported the development of this overarching reference method to ensure consistency and coherence across TEEB<sub>AgriFood</sub> applications.

The TCA framework allows different types of impacts to be assessed, including different aspects of the matrix that make up the food system (Minotti *et al.*, 2022). It could be considered a useful instrument to help the global community better understand the impacts of food systems, address the practices producing negative effects, and find new positive pathways to follow. TCA is the process of creating a framework that differs from the current conventional framework. In transforming agri-food systems' externalities into monetary terms, institutional decision makers cloud the capitalist politics they seek to remedy by suggesting that, once a better assessment is adopted, turning numbers into action will become the responsibility of other actors.

Under the framework of the TCA, different methods and tools have been developed with the aim of spreading a systemic and multilateral approach to reach transparency and participation, achieve transformative governance, and redirect structural power towards food

sovereignty and agri-ecological principles (Hendriks *et al.*, 2023a, 2023b). TCA can be considered a structured methodology from an ideological and visionary point of view. This innovative framework was born to be transparent, participatory, democratic, with a multi-criteria perspective, and able to assess the externalities of an alternative reference system in all the dimensions considered. Although economic accounting is important, as it conventionally assigns a common unit of measurement to several variables, TCA aims to assess all impacts, both market and non-market effects, including among the conventional economic aspects and social and political perspectives.

Despite its innovation and usefulness, the TCA approach also has some weaknesses. Indeed, it contains a vast range of methods, tools and calculators that are difficult to summarise or replicate in different contexts (Minotti *et al.*, 2022). In addition, this kind of internalisation of food systems' externalities carries economic and political risks (Patel, 2021). Its complexity lies mainly in the inclusion of indicators other than the exclusively economic ones that touch all those parts of the food system that are difficult to quantify. Furthermore, it is difficult to use data of a different nature within a single reference system, which presents very different units of measurement, and needs to find methodological compromises with the risk of invalidating the findings of the study itself. These difficulties have created a misuse of TCA, and some case studies have identified "greenwashing" activities. A leakage problem can also be created by assigning an economic value to a non-economic externality and moving the problem from one unit to another without actually solving or reducing the problem or risk in the system.

The Accelerator of True Cost Accounting, a community of practice born within the "Global Alliance for the Future of Food", was developed to address the lack of principles, frameworks, parameters and coherent operational guidelines of TCA. This community is enhancing the dissemination of the TCA approach in shaping all decision-making processes underpinning the transformation of agri-food systems. Although the role of decision makers in agri-food systems, both public and private, is relevant, the demand side proves to be fundamental. Economic theory posits that food prices are determined by supply and demand equilibrium. However, failing to account for negative external effects often results in prices that do not accurately reflect "true costs". To rectify this situation, enhancing transparency by incorporating TCA is fundamental (von Braun, Sheryl, 2023). The study by Michalke *et al.* (2023) is quite important in this context. By combining Life Cycle Assessment (LCA) meth-

odology with TCA, the authors translated the environmental damage associated with conventional and organic production into economic terms. The results showed that, on average, production generates more negative externalities per kg for conventional products than for organic products. Nevertheless, this environmental impact does not translate into a price increase.

One challenge, among others, to support TCA is consumers' acceptance, which can be promoted by practitioners. However, consumers' acceptance of true-price (TP) food products is still scarcely explored. A recent empirical study by Taufik *et al.* (2023) demonstrated that Dutch consumers' trust in true pricing characteristics and the actors implementing this pricing approach, along with their intention to purchase true price food goods, increased when they perceived value in terms of social status and positive environmental impact. In other words, appealing to social and environmental values enhanced by true pricing can encourage consumers to buy such products for which externalities are internalised. Similar results were obtained by Michalke *et al.* (2022) regarding animal-based foodstuffs.

However, the TCA and TP innovative approaches require more research. According to von Braun and Sheryl (2023), agricultural economics will need to accompany its adoption with scrutiny in terms of the efficiency, welfare, ecological and distributional effects of institutional interventions. In the implementation of TCA and TP and their acceptance among consumers, the role of transparency and just distribution of wealth is perceived as fundamental, proving that measures that are socially cautious and backed by relevant legal framework conditions are relevant to adopting and accepting a polluter pays context with a clear assignment of responsibilities among stakeholders.

## 5. CONCLUDING REMARKS

The opportunity to assign a price to each cost and benefit produced by an agri-food system is still one of the main challenges that agricultural economics has to tackle. This paper discusses the multifunctional role that agriculture can develop through its multidimensional activities and its capability to provide society with a number of ecosystem services. By considering non-market goods and services provided by agriculture, the opportunity to enhance their provision with devoted tools emerges. Non-market goods can be rewarded using incentive instruments.

The role of "pricing" seems to be profitable (Galgani *et al.*, 2021, 2023), but it presents a number of conditions

to be implemented and accepted among stakeholders. Different approaches and instruments could be adopted to provide compensation in favour of the benefits' provision and identify "true prices". This paper discussed PES, TCA and TP tools for analysing the positive and negative externalities of multifunctional agricultural systems. Despite their role in economic analysis, each of these tools presents both strengths and weaknesses, highlighting the need for additional studies to improve their knowledge and support implementation.

One of the main limitations of this paper is linked to its aim, which is only to stimulate scholars. It underscores enhancing opportunities to enforce the multifunctional role of agriculture by adopting different market-based instruments and economic tools, which seem to still be "innovative" approaches or only attempts to support multifunctionality. Future research studies could use this review as a starting point for the development of more detailed economic analyses capable of exploring the dynamics governing the use of one instrument rather than another.

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