ECONOMIC AND ENVIRONMENTAL SUSTAINABILITY IN AGRICULTURE: THE RESULTS GENERATED BY BIODEGRADABLE PRODUCTIVE MEANS

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ABSTRACT
Agriculture is recognized as one of the major production sectors responsible for polluting atmospheric emissions, especially when the related intensive production systems are to be considered, within which the "ortho-floricultural-nursery" sector into a protected environment prevails. This is a sector represented by production processes with a high degree of intensification of cultivation that put the attention of operators to the maintenance of an adequate level of economic and environmental sustainability; i.e. satisfactory levels of income and rational management of resources and control of company waste. In this context, this paper focuses on non-hazardous special agricultural waste by developing simulations of how total economic welfare (producer and consumer) can be maintained, or minimally modified, with the economic amount of equilibrium that aforementioned negative externalities tend to reduce.

KEYWORDS
Economic environmental; Sustainability; Biodegradable, Technological spillover.

INTRODUCTION

The paper reports on the opening economic-agrarian knowledges for carrying out the research - with financial resources of the University of Catania (Di3a) - from the theme "Sostenibilità economica delle Colture floro- ornamentali mediterranee. Soluzioni innovative sostenibili in sistemi di coltivazione senza suolo: il caso dei substrati di coltivazione di piante ornamentali in vaso".

The aim of the environmental improvement and the maintenance of total economic well-being can be achieved by introducing technological innovations into production activities, as long as they are compatible with the organizational and economic needs of business management. Some activities impose decisions that give impetus to innovation to counteract, above all, phenomena of obsolescence of polluting productive means, with the substitution of technically more refined and more competitive means (Pardey et al., 2010), which at the same time act on the containment of production costs due to the increase of labour productivity (Allegra et al., 2015). In agriculture, there is the orientation towards innovation in many production sectors (Zarbà et al., 2016), in some of these it is represented by the speed and acceleration of changes with a change in production techniques that seems to proceed at previously unknown pace (Allegra et al., 2017). In the horticultural, floricultural and the nursery sectors, innovation manifests itself in particular in the well-known traits of variety and variability, to which can be added a growing selectivity and sophistication in the expression of the needs of increasingly attentive consumers (Zarbà et al., 2015). Elements that accumulate the same sub-funds in a productive whole with the same qualitative purposes, even though they produce food products the other produces voluptuous products. In high terms, not only do the horticultural firms require products more personalized and with greater performance, services, and which are healthy and safe, but also they require products realized by production processes compatible with the environment (Bran et al., 2014). The guidelines are often the result of different business philosophies, dependent on long-term assets proportional to production capacity, with corresponding jobs and uses of materials on which short-term social costs depend (Zarbà et al., 2017). The environmental social costs do not fall within the budgets of the polluter; therefore, the damages, produced by the various activities to third parties, become external environmental diseconomies turning into a social problem that environmental policies must face (Conti, 1991). Over the last few decades, the debate on methods for assessing environmental costs and on how they can be brought again into the polluter's economic balance (ie to internalize diseconomies in production costs) has been rather heated. Even today, the quantification of environmental accounts must overcome many obstacles including the identification of methodologies for defining environmental impacts or the application of monetary valuation to sectors that are decisive for the environment; as for example the production of energy and its greenhouse effect (Bonazzi and Cagnoli, 2013). However, these are arguments, which are of considerable cognitive importance, are not the main object of this work; instead, they become important for our study when negative externality (polluting emissions) occurs, it is a matter of establishing the socially efficient level of production (Li, 2018), that is when according to the dictates of economic principles the equality between social marginal cost and social marginal benefit is identified (price). In the "ortho-floricultural-nursery" sector there are numerous productive means, above all in the economic category of circulating capital (short period) which give rise to negative externalities if not subjected to disposal, above all if they are plastic materials[1]. Equally numerous, can be the possibilities of some of these circulating means to neutralize the relative environmental social costs, such as the case of biodegradable means, many of which comply with the European standard EN13432 (2000). In agriculture the use of these last means of production is in continuous growth due to the direct effects on the agronomic production process with the corresponding environmental and economic repercussions (Giuffrida and Michel, 2010). Among the most recent biodegradable means of "simple fecundity" we mention "mulching film for the soil", "environmentally friendly substrates", as well as "ecological and environmentally friendly technical containers" for seedbeds and for cultivation of plants and vegetables. In this last context, the biodegradable plastic, being an organic material, is decomposed in situ in a short time without releasing toxic material; in fact, it is transformed into water and carbon dioxide. Growing substrates are an increasingly important factor in production, because

[1] In the "ortho-floricultural-nursery" farms, plastic is used in addition to film for mulching in many ways such as cover for greenhouses, irrigation pipes, hoses, fertilizer bags, anti-hail nets, rolling stock. While in other agricultural sectors, it is used for livestock disinfectant containers, silage hay roofing sheet, grape transport sheet.

they allow combining the need to optimize the efficiency of the used resources with the need to contain the environmental impact typical of intensive agricultural systems (Giuffrida et al., 2017). In fact, crops on substrates allow achieving greater control of telluric plant diseases, irrigation water and fertilizers. However, the use of substrates highlights the question of the reuse or disposal of the material that differs according to the category (Table 1) or the mixtures made. The choice of material may also depend on the interested production addresses, i.e. horticulture, reproduction nursery, floriculture, ornamental nursery, mushroom cultivation.

Table 1. Physical, chemical and mechanical characters of the substrates in "ortho-floricultural-nursery" sector

MAIN SUBSTRATES	PHYSICAL, CHEMICAL AND MECHANICAL CHARACTERS
PERLITE	Obtained from the transformation of an aluminum silicate of volcanic origin. Foam material, light colored, inert, ph neutral. High draining power, used in mixture with other organic substrates (peat, coconut fiber).
EXPANDED CLAY	Obtained by heating the clay at high temperatures. Used alone or in addition to other sustrates, it determines the increase in porosity, resulting in aeration and drainage.
ROCK WOOL	Obtained from the fusion of aluminum slicets, calcium, magnesium and carbon coke. High porosity, inert.
PUMICE	Aluminum silicate of volcanic origin containing potassium, sodium, traces of calcium, magnesium, iron. It decomposes easily by exchanging ions in solution. Very light porous material. Used alone or in mixture with other substrates.
VULCANIC LAPILLO	Volcanic origin. Used alone or with other substrates.
PEAT	Obtained from different materials of plant origin decomposed in anaerobic environment. They are extracted from deposits called peat bogs with chemical-physical character as a function of the botanical composition. Good ability to retain and release water, good porosity for the aeration of the substrate Used alone or in mixture with other substrates.
COCONUT FIBER	Obtained from cocoa processing waste. High porosity, good water retention capacity. Used alone or in mixture with other materials.
GRAPE MARC	Origin of fraction of grapes. Good porosity and good water retention and high content in microelements. Very suitable for the formation of substrates.
POLYSTYRENE	Obtained through specific industrial processes. Very light, has no water retention capacity, increases aeration, does not chemically interfere with the substrate and does not decompose. Used alone or added with other substrates.

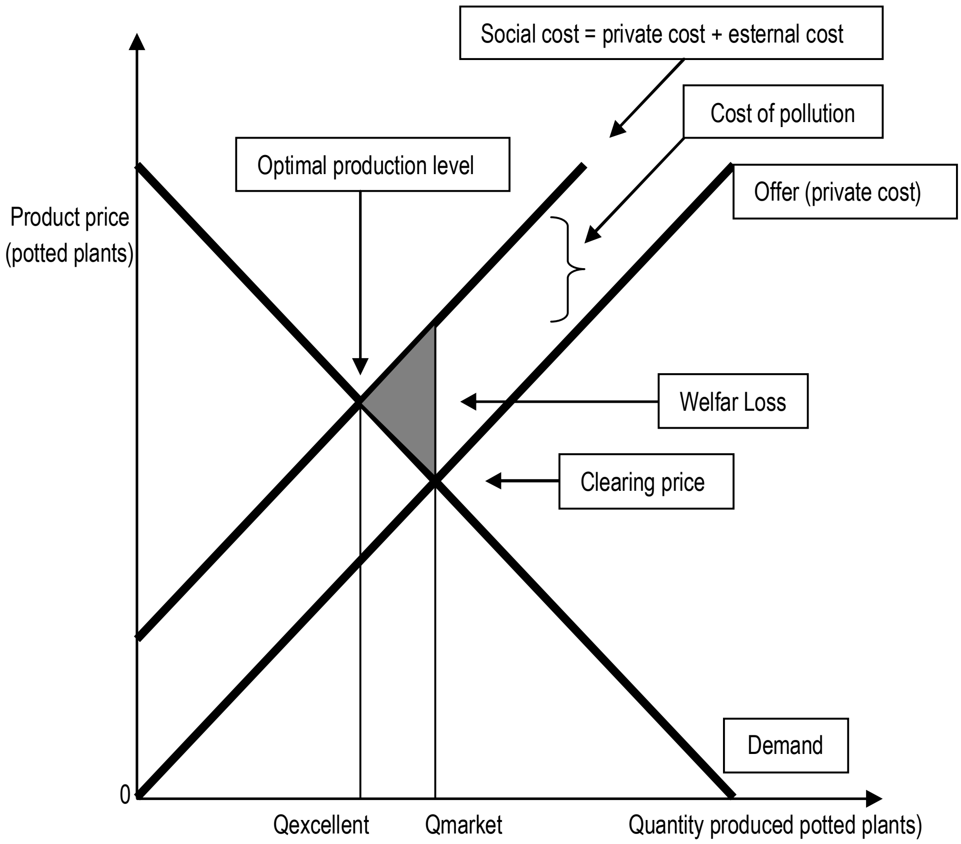
(Source: AIPSA- Italy, 2013)

1. METHODOLOGY

To establish the weight of the operating cost in relation to the type of technological innovation used, the comparison with a similar productive process ex ante innovation seems to be opportune (environmental disadvantages avoided). Therefore, it is necessary to establish the correct identification and imputation of the expense items of the cultivation technique operating cost with and without technological innovation (Noseleit, 2018). This last measure is very important since it could be indicative of the identification of positive externalities (*technological spillover*). It is important to pay attention on the context of indirect costs or imputed costs (overheads, amortization, etc.) with reference to the production process with the proposed innovation. The most important issue concerns the criterion of the imputation of indirect costs, or the search for the cause that gave rise to them (causal attribution) to establish the allocation criteria, in order to contain approximate evaluations. The allocation criteria that can be adapted to the companies are based on the "use of the new technology" (degree of use) and on the capacity of the production basis (utilized area, number of plants). The complexity shows up when we need to consider the effects of the new technology on some categories of expenditure attributable to the product affected by the innovative economic phenomenon. Thus, first of all there are the indirect costs to production (overheads production), since they vary with the entity of the total company production (maintenance, consumption of energy, water, etc.) and therefore they are difficult to ascribe to the reference product. Then there are the general non-production expenses (overheads of the period) concerning the organization of the company (costs for employees, managers, technicians, costs for paying interest on the loans obtained, etc.) attributed to the entire production business and difficult to attribute to the considered product (Mankiw Gregory et.al., 2015). Furthermore, it is important to remind the component of the opportunity costs for the risk of the activity and for the tasks performed by the entrepreneur, for the financial charges of the invested capital (calculation interest), etc. Another category of indirect costs that the company shall bear is the transaction costs for any purchases arrangements of direct and / or indirect factors pertaining to production, or for relations with various institutions. However, whatever it is the type of common, numerical, figurative and nominal cost to consider, it is necessary to maintain a certain prudence, especially if the new technology affects only a small part of the production activity and the related business management.

2. RESULTS

Whatever it is the detection method, the new technology probably involves a decrease in the historical private cost ex ante: among the main items of elementary costs would be those due to lower employment, to the efficient use of productive means (of fertilizers, herbicides, pesticides) and irrigation water, to the lowest internal and external transaction costs (indeed, net of those for the acquisition of new technologies), as well as to other less important economic loads depending on the type of biodegradable production medium employed in the production process. However, for the purposes of technical-economic comparability related to the various innovations indicated in this study, the opportunity to equal the sustained private cost for the purchase of one or more innovative productive means (since this is a current expenditure, ie operating disbursement) to the supposed economies realized with the new technology, in order to avoid, for every innovation introduced in the company a sequence of curves with its own slope in a graphical representation. It is an offer (marginal cost) of a level equal to the production condition without innovation. In a traditional ortho-horticultural production situation where pollution costs emerge (external cost), the cost of each unit of product realized assumes the connotation of social cost. This last one inclusive of the cost of private production (farms) and that incurred by third parties damaged by the negative externality (external cost). Therefore, the optimal quantity of product (or the number of potted plants) is realized in the intersection of the social cost curve with the demand curve, as shown in Figure 1; the amount corresponding to the market equilibrium condition is lower than of the socially optimal production condition.

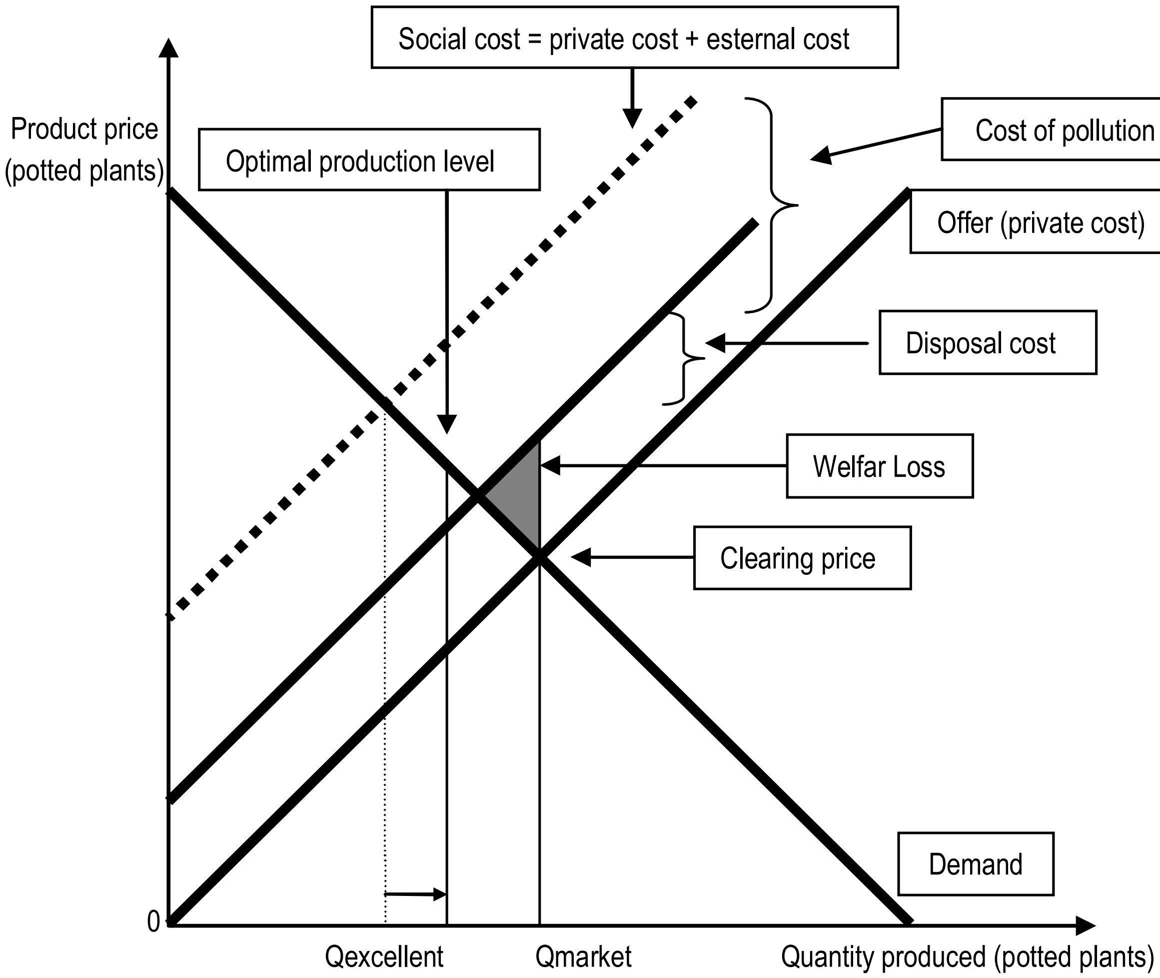


Negative externalities involve a higher social cost than the private cost and a reduction of the optimal quantity compared to the amount of equilibrium (clearing price). The curve is moved upwards following an imposition (tax per unit of product) that forces producers to bear the social cost. Basically, the externality is internalized, the agricultural company is required to bear the cost of pollution and to decide the quantity offered on the market, taking into account that the consumer also suffers the weight of the externality negative.

(Source: Our adaptation Mankiw Gregory et.al.,.2015)

Figure 1. Pollution and social optimum

This latter situation would indeed occur even if the farm uses special waste disposal[2], but with a minor gap considering the almost total reduction of the cost the negative externality borne by third parties (Figure 2).

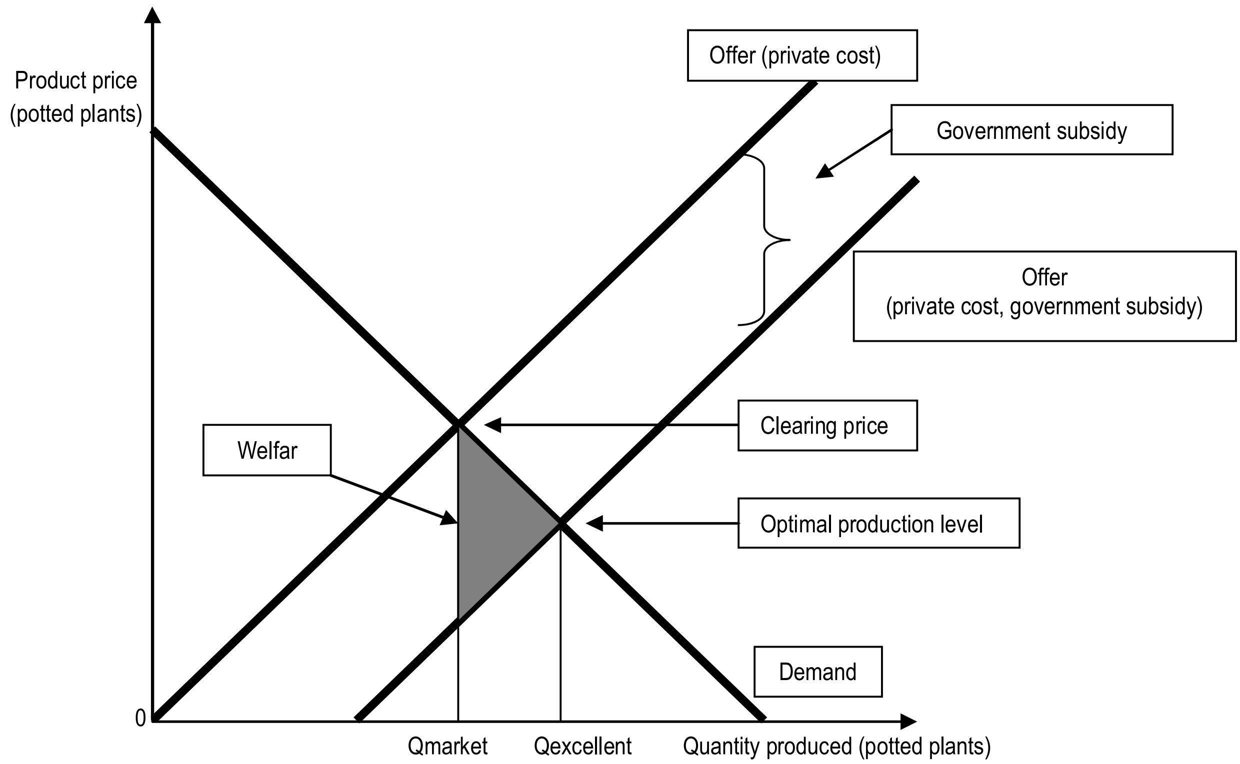


Reduction of the social cost, while the optimal quantity is slightly less than the amount of equilibrium (clearing price). If the firm bears the disposal of pollutants costs, internalize the externalities but with a smaller loss of benefits. The producers of the goods in question are only less able to discharge the external cost to consumers in the form of higher consumer prices. The reduction in profits for producers is not at a level that would rather lead to a loss from the market high.

(Source: Our elaborations)
Figure 2. Disposal and social optimum

On the other hand, considering the case of utilization in production process of biodegradable productive resources that hinder the formation of pollution costs, the social costs are lower than the private cost of production; therefore, it is a benefit for third parties. These knowledge can be shared in a social network for the development of new technology with sustainable function. In essence, a *technological spillover* resulting from the positive externalities that innovation would trigger.
So an innovation which benefits not only the farms that has resorted to biodegradable production facilities, but the "ortho-floricultural-nursery" sector as a whole. Innovation becomes part of the technological knowledge of the "ortho-floricultural-nursery" sector (technological diffusion). For the farm that has used the biodegradable production factor, the optimal condition of production is less than the amount of market equilibrium, while the socially desirable quantity is greater than the quantity that the market produces (Figure 3).

[2]In Italy, the disposal service provides for a fixed and a variable rate in addition to the transport rental rate, depending on the amount involved. Agricultural companies, with an income of less than 8,000 euros, are exempt from the disposal service, and do not produce special hazardous waste (engine oil, hydraulic oil, batteries) for which they are allowed to burn a small amount of waste off the waste system made by the company and aimed at their re-use as fertilizers or soil improvers. Agricultural enterprises with an annual business volume above the aforementioned threshold are obliged to submit the Single Environmental Declaration Model (MUD).



The farm can also take advantage of subsidies as the externality could be internalized by the state. In this situation the supply curve moves downwards corresponding to the amount of the subsidy. The subsidy helps to make innovation become part of the technological knowledge of agricultural society (technological diffusion). With the introduction of biodegradable productive means, an innovation is created which the company benefits from. Consumers also benefit because they can not bear higher prices and can have a larger quantity of the good.

(Source: Our elaborations)
Figure 3. Spillover technological and industrial police

CONCLUSION

The technical-economic simulation proposed in the present study would highlight rather interesting economic and environmental sustainability conditions with biodegradable production resources used in intensive agricultural production activities, in particular in the horticultural field. In fact, we are witnessing agricultural activities that produce polluting emissions that impose costs on third parties, which producers may not take into account because they are only interested in the quantity of equilibrium. With the use of short-term biodegrading productive means, we could escape the imposition of internalising the externalities, and the "loss of well-being". At the base of the evaluation system, there is an economic sustainability, which is complementary to the environmental one. In other words, by rationalizing decisions about innovative resources, it emerges an efficiency in the way of combining innovative productive resources in order to maximize a certain production level in the short term or to minimize the resources in order to produce the same product; while, at the same time, it emerges an effectiveness that is a measure of the entire social and economic well-being, even if it can not always be quantifiable.

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