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***PROCEEDINGS OF
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FOOD, AGRICULTURE
AND THE ENVIRONMENT***

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Introduction

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The cultural exchanges between the agricultural economists of the Universities of Minnesota and Padova, initiated in the 1960's, have become systematic since 1988 with the signing of a collaboration agreement between the two Universities, subsequently extended to other Universities and Research Centres in Italy and the U.S.A. The agreement, as well as facilitating seminars and stages for the academic staff and researchers, includes a biannual conference where subjects of common interest are tackled. In particular, since the very first meeting, three subject areas of particular importance for the development of the primary sector have been given emphasis: agricultural policies, relationships between agriculture and the environment, the land market. In recent years the problems related to the marketing of agricultural products and the evaluation of environmental goods have been added to these. More than ten years after the first meeting the farsightedness can certainly be applauded of the choice of areas for scientific exchange. The sudden changes in the international political and economic scenarios have in fact greatly accelerated the processes of globalisation that were already underway, also in research and scientific information. While there are still big differences in the agricultural systems and territorial structure, there has been an increasing convergence of the problems of agricultural and environmental policies in the two countries. In particular, awareness has increased of the substantial and strong interdependence between environmental problems (sustainability) and choices of agricultural policies and commercial phenomenon, undoubtedly accelerated by the increasing globalisation of the world economy.

1. Agro-environmental policies and economic globalisation

International trade in all sectors has developed markedly in recent years, due to technological changes, the altered world political scene and international agreements. With the fall of the Berlin wall it became clear that a market economy would be the only economic system compatible with democracy and the respect of civil rights and able to guarantee prospects for development, including social. In this new context¹, however, the progressive opening up of the markets poses some different problems from those of the past, due:

- a) to processes of globalisation and redistribution around the world of the centres and people who make decisions;
- b) to the impact of the opening up of the markets on the sustainability of the production processes in agriculture in both developed and developing countries;
- c) to the emergence of new forms of protectionism.

The debate between supporters of the opening up of the markets and supporters of forms of protectionism has been going on since the birth of economic policy, at times involving various schools of thought. In general, behind the theoretical considerations is the empirical observation that periods of strong growth of GDP at an international level go hand in hand with increasing international trade.

While it is therefore unquestionable that the opening up of the markets constitutes a central point for economic growth, it cannot be ignored that new problems can arise of the economic, social and environmental type, that must be taken into consideration when defining

¹ The use of fertilisers depends mainly on the type of crop practised and much less on the reduction in use on a single crop. For example, the substitution of maize with that of soybean or alfalfa sometimes reduces the nitrogen distribution by 100%, while the adoption of low environmental impact techniques cannot determine reductions higher than 60-70%.

agricultural policies aimed at greater sustainability. The lessening of the ideological components that influenced the debate on economic systems in the past (in particular between capitalism and communism) also means that the problems connected to the growth of the market economy worldwide can once again be tackled, and with greater liberty.

As well as the growth of the international markets, a second element that characterises the world economy towards the end of the century is the increasing importance of the financial component of the economy.

Globalisation of the financial markets will have strong repercussions on the economic balance of the nations and will influence and condition the effectiveness of the economic agents. In a scenario of strong opening up to the international markets, the individual countries will have less autonomy and decision-making capacity in the economic and environmental sector, as the exchange rates and the prices of many primary goods will modify the internal price system. The speed with which large sums of money can be transferred worldwide has the potential to destabilise some production systems, causing effects on the environment that are still little understood. The discrepancy between the evolving of the economic system and the environmental scene could result as even less accentuated within this framework than in substantially closed economic systems. Regarding this it can be stated that the longer the process takes from the decision of the businessman to its effect on the environment, the more complex it will be to adopt agro-environmental policies. There will be an analogous problem with an increase of things that can directly or indirectly influence the environmental impact of the economic activities. An example is the case of nitrate pollution in agriculture. This depends mainly on crop rotation and, in second place, on cropping methods². When the farmer works in a system of substantially stable prices, the choices of crop rotation, cropping methods and the use of input factors will be relatively constant and pollution control will be simpler. In this case the public official will have sufficient time to define the best tool for resolving the problem and to translate this into agro-environmental policy.

³On the contrary, if a case is supposed where the international market wholly determines the costs of the products and production factors, the farmer will face more competition and will therefore tend to more quickly modify his techniques and crop rotations. The way in which he does this will obviously be difficult to forecast and, given the times necessary for the adoption of environmental policies on the public side, these can easily result as misplaced and therefore ineffectual in changing events.

The reduced protectionism in the farming sector, accompanied by the globalisation phenomena underway, do not require just a more efficient agriculture, but also a revision of the methods the public official uses to organise his own intervention for guaranteeing a better sustainability in agro-livestock production. For example, the actions carried out in this sector by the EU have been revealed as fairly muddled, complex at a bureaucratic level and not very elastic, with the result that they have scarce efficacy.

Another set of problems in the environmental sector can derive from the methods with which a capitalist economy tends to change and to evolve. The factor that has decreed the establishment and spread of the system of capitalist production can in substance be traced to its strong vitality². All the more or less catastrophic forecasts made in the past by the different schools of thought have been revealed as unfounded and this appears to lead back to the very

² The use of fertilisers depends mainly on the type of crop practised and much less on the reduction in use on a single crop. For example, the substitution of maize with that of soybean or alfalfa sometimes reduces the nitrogen distribution by 100%, while the adoption of low environmental impact techniques cannot determine reductions higher than 60-70%.

³ In 1996/97 the exportation of cereals from the exporting countries to Africa and Asia was 207.7 million tonnes and corresponded to 71% of the total quantity exported worldwide. On the contrary the U.S.A. and Canada export 54% of cereals marketed at an international level (INEA, 1998).

essence of capitalism, i.e. the competitive mechanism that tends to annul profit in the medium-long term. In order to resist this a businessman can take different routes such as:

- a) set up process innovations (intervening on the business organisation and on technology)
- b) introduce profit innovations
- c) modify the function of demand (e.g. through publicity)
- d) widen the markets
- e) initiate strategies to compete on the market, acquiring a growing monopolistic power
- f) put pressure on the governing bodies with the aim of changing the regulations
- g) exploit the production factors (natural resources and labour), also by interacting with the political powers.
- h) operate illegally (e.g. polluting, evading taxes, corrupting public administrators etc.).

The first strategies ("a" and "b") perform a crucial action in favouring the economic growth of nations, favouring an increase in the productivity of the resources and determining the invention of products than can improve quality of life for the consumers. On the contrary, strategies "f", "g" and "h" are harmful behaviour that tend to manifest themselves especially in the nations where democracy does not have a solid base or has developed recently. An example is what has happened recently in the countries of the ex-Soviet Union or in some Far Eastern countries where the growth in a capitalist sense is often accompanied by widespread corruption and exploitation of labour and natural resources. This could trigger forms of unfair competition at an international level. A producer who operates in a country that imposes very low environmental standards on the production processes or that favours forms of labour exploitation, could be more competitive than a producer who is restricted by high environmental standards and workers' rights, as well as by paying adequate wages. In this way what Daly calls a depletion of moral capital can be verified, a factor that in the long-term could limit the development itself (Daly, 1993).

The elimination of customs barriers and growth of international trade could encourage increased pollution as well as the exploitation of labour and natural resources worldwide. According to the theory of compared advantage the more advanced nations could specialise in types of production with lower environmental impact and low labour requirements while the developing countries could specialise in highly polluting or labour-intensive ones. This could be encouraged by the big multinationals that have already shown a tendency to move some phases of the production cycle away from the industrialised countries. This is merely a hypothesis that could however be supported by the extreme mobility of funds and by the reduction in transport costs of the goods and especially, of know-how.

It should be understood, however, that even the positive elements (points "a", "b" and "d") can have not negligible effects on the environment and on the global sustainability of the production processes. Both process and production innovations have effects on the social organisation of the countries involved, as well as on the cultural level of the population. Consumption is, in fact, just like the organisation of production, a reflection of the cultural level of a nation and constitutes a very relevant aspect. The progressive opening up of the international market could encourage a prospective cultural and productive uniformity worldwide. This could be negligible, as many civilisations have evolved and then disappeared in the past, sometimes leaving only faint traces. In the current situation it is felt that a loss of cultural identity could cause unforeseeable environmental imbalances. On the contrary to what happens in other species, human evolution is cultural as well as biological. In many traditional societies individual behaviour is influenced by a set of behavioural norms that tend to put precise limits on the use of natural resources. In this way the question of common goods received in the past, and still receives in some local communities, extremely efficient responses from the point of view of sustainability. The emergence of co-operative behaviour

patterns to the detriment of individualist attitudes can in some cases allow management solutions to be defined that maximise society well being in the long-term. Behaviour of the prevalently utilitarian type (the basis of a capitalist economy) certainly wins in terms of favouring the growth of the economy. It cannot however be excluded that a correct response to environmental problems must originate from the spread of attitudes of the solidarity type that are translated into limits on the operating of the single economic agents. It follows, lastly, that a loss of cultural identity could aggravate the environmental problems. From this point of view, the processes of globalisation, that are closely connected to the tendency to recreate adequate profit margins, can accentuate environmental degradation at a world level. The loss of culture of the territory and the environment must be considered a negative externality generated by economic and production development and adequate policies to tackle the problem must therefore be identified.

2. Agricultural and territorial policies

From what has been pointed out, both agricultural and environmental policies must in the future tackle new problems and equip themselves with different tools of intervention from those used up to now.

It is accepted that the abolition of trade barriers is a process that must necessarily be general and cannot regard only some product sectors. The opening up of the markets for industrial products and for services is also increasingly involving agriculture. The abolition of customs barriers and the direct forms of prices support of the agricultural products poses, however, important problems and has forced agricultural economists to tackle new subject areas.

Up until a few years ago the majority of economists had a very similar attitude to that of the farming trade unions. The main problem that was central to discussions was the effect of an agricultural policy on the farmers' income in this country or in that region, or of a change of the guaranteed subsidy to one crop rather than to another. For years it was almost totally ignored that the aim of the economist must also be that of supplying appropriate information to improve the overall affluence of a nation and not that of a specific category.

The strong and incomprehensible distortions that are still found today in EU agricultural policy are due also to the support that agricultural economists have given to the claims of the farming trade unions. It is difficult for any economist to find a plausible justification for the agricultural policies of developed nations being centred on welfarism and the systematic illusions that the market indications gave through the prices system. The agricultural policies have for years systematically distorted the acquisitions of economic policy to the benefit of a social group and to the detriment of consumers as a whole. The agricultural policy was for decades centred on the abolition of the market substituted by a non-existent system of policy prices, on the introduction of forms of state-owned monopoly aimed at controlling production to raise the price. Some of the motivations for these choices could be agreed with if they referred to agriculture in the postwar period. The primary sector was the source of work for a great many people who had much lower incomes than those working in other sectors. Guaranteeing high prices could have had positive re-distributive effects to the benefit of a clearly disadvantaged category.

Besides, agriculture is essentially a price taker while those who provide the production factors and who buy the products are generally price makers. Because of this, the farmer suffers from the power of monopoly of the businesses that come before and after his production process and so obtains a systematically lower profit than that of the other sectors. Given the nature of the markets of many agricultural products (but not all) that prevents the starting up of different forms of market from free competition, agriculture will be structurally disadvantaged from this point of view. Agriculture also faces strong competition in the use of production

factors such as land and labour, the cost of which is often heavily influenced by demand from other producing sectors.

Especially in the 1980's it was maintained that agricultural price support was motivated by the necessity that farmers would continue to produce some positive "externalities" such as the protection of the territory, maintenance of the secondary water system, care of the landscape, etc.

It can be clearly seen that many of the motivations put forward will sometimes have become less important or ultimately, been revealed as completely unfounded. Moreover, past experience has shown that the guaranteeing of high prices, far from promoting the positive externalities, has encouraged the degradation of the environment and the landscape.

This means that in order to balance the lesser market weight of the farms, systems of incentives should be introduced that can reduce the cost of production factors and improve organisation of the production and marketing, while the positive externalities should be remunerated directly.

The policies adopted have also had the detrimental effect of slowing down reorganisation processes in the sector, so affecting the total economic efficiency. This has favoured the spread of strong phenomena of rent to the benefit of farms (for example part-time) that certainly had no problems of income support.

Lastly price support has inevitably ended up in diverting resources from uses that would certainly have been more profitable from the social point of view, such as experimentation, farm re-structuring, improvement of the environment etc.

One fact that is generally ignored in the current debate on sustainability is that, in order to be sustainable, agriculture must also be efficient. Only in this way can the first knot be tackled and resolved of sustainability on a global scale: the need to feed a still rapidly increasing population. It is unthinkable at the current state that this can be pursued by increasing the producing capabilities of developing countries alone (at least in the medium-long term)³. Obviously the agriculture of the developed countries should be able to accomplish this task at the lowest possible cost and offering the products at international prices. This does not mean that production efficiency must be pursued to the detriment of environmental quality in the exporting nations. The concept of sustainability should be seen from a world perspective and refer to the complexity of the problems that humanity must face in the next millenium⁴. For example, the irreversible degradation caused by excessive exploitation of the land (desertification, rainforest destruction, etc.)⁵ must surely be considered more serious than reversible modifications due to the excessive use of fertilisers in temperate zones. This is because the latter problem can be resolved or alleviated in various ways that do not necessarily imply lowering production and use of chemical inputs⁶. Agriculture in developed nations also has a comparative advantage in the adoption of technical innovations due to the higher level of education of the farmers, their greater availability of capital and higher propensity for the risk connected to the new techniques⁷. It is therefore probable that the biotechnological innovations will make their positive effects felt on the crops in the developed countries and will be adopted only secondly in those still developing, and only if

⁴ The population is currently circa 5 billion 950 million people that, according to the considered scenario, will become 8, 10 or 12 billion in 2050. According to the FAO, to tackle the demographic increase and at least partly reduce the problem of hunger, the supply of agricultural products must double between now and 2050.

⁵ According to FAO estimates, in the 1980's the rainforest reduced by 7.8%, from 1.91 to 1.76 million hectares.

⁶ The problem of quality of the waters is destined to increase markedly in the future. FAO estimates indicate that 58 countries will have problems of water supply in 2050, a phenomenon that will affect 5 billion people and could trigger heavy conflicts on both a local and international scale.

⁷ The risk of adopting new technologies is certainly much higher in developing countries or for farms with fewer assets. In these cases an error in the strategies could lead to hunger or the failure of the farm, whereas on the big farms it is translated into a temporary loss of profit.

they are compatible with the economic and environmental situation of the farms operating there. It can also be supposed that this technological gap could widen in the future because of the system of research in the fields of agriculture and biology. Given the importance of the huge multinationals that operate in this sector, it is obvious that the research will be aimed at technology for which ample potential market outlets exist. From this point of view technological hope does not appear to exist for the marginal areas, as the marginality generally also involves the incapacity to express a technological demand (both for problems of a cultural nature and for the scarce availability of capital to buy the innovation).

A farming system that is as efficient as possible and able to operate at contained levels of environmental impact is consequently a strategic aim for agriculture in the industrialised nations.

The recent CAP reform has not contributed in many ways to resolve the problems indicated. The mechanism of decoupling adopted is so partial as to not be considered a form of decoupling in the strict sense of the term (Marangon, 1988). The strong differentiation of the premium guaranteed to the various crops has indeed favoured some productions at the cost of the others. This has ended paradoxically by encouraging the growing of crops with a high environmental impact (e.g. maize) to the detriment of other less polluting ones (permanent meadow and alfalfa). The extension of the support to all producers has impeded forms of restructuring and reorganisation in the sector, keeping alive farms with scarce efficiency.

Lastly, especially in the first years that the MacSharry reform was in operation, the lack of co-ordination with the so-called agro-environmental measures thwarted the efficacy of the latter, so that the subsidies allocated became hidden forms of income support with scarce or no positive effects on the environment. Essentially the recent CAP reform has preserved its welfarism nature entirely and has not begun to solve the important problems that agriculture in the EU must tackle in view of a possible further opening up of the markets.

A new agricultural policy should be based on such principles as:

- a) wide freeing of the markets and progressive abolition of prices support
- b) adoption of measures of solidarity that safeguard the income of the farmers from possible negative price fluctuations on the international markets, tending however to guarantee returns for the work and not the profitability of the land
- c) interventions that allow a reorganisation of the sector to make it more efficient and therefore able to withstand competition on the international markets.
- d) identification of forms of incentive for the productions that generate positive external effects and deterrents for those that generate negative externalities
- e) adoption of policies of protecting the rural territory that reduce the spread of urban rent on farmland
- f) setting up of substantial policies of rural development that benefit "truly" marginal areas⁸.

It is worth repeating that this does not mean the total abandonment of forms of support for agriculture, that is still of strategic importance internationally. The farmer is much more subject to variations in price due to unpredictable weather factors worldwide. Funds for aid and solidarity must always be available, however, mainly taking on the nature of insurance (co-consortiums that insure against hailstone damage or other atmospheric calamities), abandoning the systematic aid that by its very nature infers permanent distortions.

Lastly, a question could arise about the EU. In this context would keeping the common agricultural policy as it has been put into practice up to now still make sense? Would its operating structures still make sense? Or must it completely change nature and equip itself with regional systems able to operate in closer contact with the farmer.

⁸ Although seemingly paradoxical, many parts of the Veneto plain, that are among the richest and most developed in the world, have benefited and in part continue to benefit, from EU funds for rural development.

It is obvious that the organisation of a system must relate closely to the aims that it intends to pursue. The shift from policies of prices support or land rents towards policies aimed at the re-structuring and reorganising of the farms, to improve the capacity of penetration on the markets etc., obviously implies the availability of both totally different tools and a very different bureaucratic organisation to that at present.

The same can be said for the actions aimed at improving the environment, that require a strong capacity of analysis and planning of the actions in the territory. Moreover, if these latter actions were to predominate over those more literally of the market, would the current mechanism of EU spending still make sense?

As long as EU spending is of a general nature and is managed directly by the EU, the transfer of contributions from member states to the EU has significance. But if the major part of the funds must once again be redistributed to these same member states to finance the actions, what significance would the initial payment into the coffers of the EU have? What's more, the policy being that subsidies are forbidden that can alter competition between the EU countries, once full competitiveness has been guaranteed, why not subsidise actions at a local level, especially in the field of socio-economic development or environmental upgrading?

The primary sector could in the future be regarded by the same standards as the other producing sectors for which no special legislation exists but just general and specific regulations to guarantee transparency and avoid forms of unfair competition. Within this context the EU regulative power could have particular importance in defining standards of quality for agro-food products and dictating rules, because a policy of safeguarding the quality of the productions could be effectively set up, leaving to the member states the duty to implement it.

In the environmental sector the need for greater autonomy of action at a regional level is even more marked. It being necessary that some minimum standards are respected throughout the EU, each state should be able to decide the entity and adapt the actions in the territory in accordance with the principle that who pollutes (and who benefits) pays. The principle being that every citizen of the EU has a right to a minimum level of quality in whichever EU state he is in, nothing should prevent that he would be guaranteed a higher quality when he was willing to contribute towards it.

3. Environmental policies

Research in the field of environmental economics has seen a strong boost in the past thirty years. The numerous textbooks available and also the large number of journals that tackle these subjects are witness to the increasing scientific output in this sector. Two schools of thought have been formed: that of environmental economics that follows neo-classical thought implicitly and that of ecological economics that has less orthodox attitudes towards the analysis of the relations between the environment and economics.

The numerous contributions from the first approach have led to substantial progress in the management of environmental problems. An example is the fundamental contribution of Coase (1960), that first showed the possibility of resolving some environmental problems through negotiation between private individuals without the direct state intervention. Or the idea of pollution permits (Dales, 1968) as an efficient tool for reducing some types of pollutants.

Especially in recent years, there has been an increasing trend towards studies that have a much more rigorous formal and mathematical approach, but along the way they seem to have forgotten the theoretical, cultural and sometimes ideological assumptions that should be the basis of the elaborated models. This is even more serious when it is considered that economics is a discipline that not only tries to interpret the reality, but that can profoundly

influence change and evolution. In other words, the results of economic research often constitute the support for the ways in which the public decision-maker intervenes in the economy.

In the environmental sector, forgetting the assumptions on which the analytical models proposed are based could have worrying results. For example, the idea of environmental taxation as proposed by Pigou is implicitly based on assumptions that are totally unrealistic. In particular, because an environmental tax could lead to a Pareto-efficient allocation of resources, it is necessary that the function of marginal damage is monotonic. If this does not happen it could be that not one, but rather a variety of environmental taxes are valid (Dasgupta and Heal, 1979, 79-92). Regarding this, fig. 1 illustrates the optimal equilibrium in the pollution level if the environmental damage has a logistic trend. The function of marginal damage (Md) will first be increasing, and after a maximum point, decreasing. As can be seen, as the curve of the marginal cost of cleaning up has a decreasing trend (a plausible hypothesis being problems of a technical nature), the possible points of equilibrium will be both P_1 and P_2 . This is therefore a quite different situation from that reported in fig. 2 that shows the equilibrium between pollution and cleaning up generally considered in the textbooks of environmental economics. Obviously, reality is much more complex because of the existence of retroaction phenomena and the complexity of the ecosystems. It would therefore be very difficult to identify functions of damage that can be fully expressed through mathematical formulae or even to simply outline their form.

It follows that the hypothesis of an optimal tax is completely unfounded although the textbooks of economics still discuss it as an efficient tool of environmental policy and it is still seen by many economists as a better tool than the imposition of a standard (command and control).

Baumol and Oates (1988, pp. 110-118) have clearly argued that just the presence of negative externalities would render the existence of optimal levels of pollution impossible (first best) because of the phenomena of non-convexity in the transformation curve that they derive from. In this context any tool of environmental policy becomes theoretically acceptable and in principle, one tool better than another could exist. On the contrary the complexity of the environmental and behavioural situations would suggest studying a variety of tools in a variety of contexts. In this case it would with every probability be extremely difficult to identify "recipes" applicable anywhere, but a greater theoretical dignity would surely be guaranteed to solutions coming from the usual procedures of environmental resource management of many public bodies.

Another case where the simplification introduced by the economists results as being particularly obvious is that of the so-called bio-economic models proposed to analyse the relationships between economics and renewable natural resources (Pearce and Turner, 1989). Some of the results the model arrives at would probably be of great surprise to a biologist or an ecologist. In particular, it is stated that a renewable resource (for example a species of animal) will be destined to extinction when discount rates are used that are higher than the earnings of the renewable resource itself. In other words, when the businessman, in outlining his production strategies, faces interest rates (determined by the capital market) higher than the rate of the earnings of the species, this will be destined to disappear in a market economy and in the absence of any form of regulation. What the management and regulative implications of this theoretical acquisition could be is difficult to say, but the suspicion is that the model tends to indicate on the one hand a certain capacity for self-control of the market (all species with a sufficiently high marginal rate of reproduction do not run the risk of extinction), or else that operating appropriately on a financial variable it will be possible to perform a function of protection of the reproducible natural resources. In both cases the results would have an important practical relevance.

Unfortunately, from a biological point of view, the model is fundamentally flawed as, by the admission of the authors themselves, it is based on the behaviour of a single species whose development over time has a logistic trend, ignoring all the systemic effects induced by the gathering of the renewable resource⁹. Effects that are generally unknown given the complexity of the ecological research in this sector. It is however highly probable that the disappearance of a species involves a comprehensive alteration to the ecosystem that will presumably be all the greater the lower is the position occupied by that species on the trophic scale.

In elaborating interpretative models, economics, like other sciences, introduces simplifications limiting the field of vision systematically to only some of the variables in play. It is, however, indispensable that the *ceteris paribus* introduced into the models is always kept in mind when describing the results. When this is not done (as increasingly happens) economic research can take on an ideological and not scientific nature because, by opportunely modifying the basic assumptions, a model can provide the responses expected by the economist.

An obvious case of this is the debate on the so-called "tragedy of common goods". According to the theoretical model proposed by Gordon (1954) and extended by Scott (1955), common goods¹⁰ will be subject to overuse when their properties are not attributed to private citizens or to the State. In other words, for these goods, the absence of access barriers would lead to an irrational use from the economic and, in many ways, also environmental point of view. This is a solution that could have important implications regarding the attribution of property rights on the use of these categories of environmental goods. Considering the total inefficiency of public experience in the field of economics, the only acceptable solution for a socially adequate use of common goods would come from their privatisation. Other forms of management would be excluded.

The analytical model, while being extremely correct from the formal point of view is, however, profoundly faulty as careful verification reveals that the assumptions on which it is based are questionable (Feeny et al., 1996). In particular the model is based on the following assumptions:

- a) the firms are all the same and have the single aim of maximising profit;
- b) access to the resource is entirely free from start to finish;
- c) the resource belongs to who gathers it;
- d) the firms do not interact with one another nor try to adopt common management strategies.

It is clear that, given the basic assumptions, the results could not be anything other than those achieved. In particular, the exclusion of the possibility that co-operative behaviour exists and that individuals can agree management methods that would safeguard the common interest can only lead to an overuse of the resource. In this case it is clear that the results are implicit in the theoretical presuppositions: the use of a renewable natural resource by firms that aim to maximise profit leads to its degradation when it is left to individual choices without any regulation. But the businessman provided for by the model is a selfish and basically stupid person for, in outlining his strategies he persists in not seeing what his neighbour does. Both past and present experience suggests on the contrary that private, co-operative and totally

⁹ In tackling the subject of the use of mathematical models to describe the behaviour of populations and ecosystems, Smith states that "their utility consists mainly in the analysis of particular cases" as "the ecosystems that exist in nature contain too many interacting species [...] for the simulation to be a valid approach" (Smith, 1975). This definition is a completely different from the economic one that often attempts to identify general rules from particular cases.

¹⁰ By common goods is intended those goods for which rivalry exists in the use but no bar in access to the use (Feeny et al., 1996).

public forms of management have had both successes and failures in the use of common goods. The reason for this can probably be found in motivations that are difficult to generalise and which the economist often takes no interest in (culture of the population involved, nature of the resource, economic situation of the users, etc.).

If the cultural and social motivations were important it could easily be hypothesised that it is an opening up of the market and the asserting of individualist over co-operative behaviour that favours the overuse of the renewable resource and the tendency to its degradation.

It is therefore worthwhile to stress once again that the results obtained are in many ways implicit in the basic assumptions and consequently of little use for any purpose.

At this point we should ask ourselves if a businessman really exists like the one to whom implicit reference is made in many of the models proposed using the neo-classical approach in environment economics. On the other hand, the reference to a "decision-maker" as a sort of demiurge capable of intervening from outside to recreate the ideal conditions of paradise lost, the Paretan optimum, is also somewhat arguable if not paradoxical.

This approach ignores the fact that, with the aim of maximising profits, the businessman can pursue many different strategies, some legal and others not, amongst which the possibility of influencing the choices of the public decision-maker appears to be important. Apart from the factors on which the choices of the latter are based, in any case choices in the environmental field will be asymmetric because of transaction costs. For example, the following situation can be considered. There is a factory that damages many individuals (n) by its pollution. The individual benefit arising from the adoption of policies of pollution control are bi and ti are the costs necessary for those individuals who have been polluted to get together and put pressure on the decision-maker so that a law is adopted that forces the polluter to reduce the pollution. Obviously the transaction costs will be all the higher the greater is the number of those polluted as it becomes increasingly onerous to involve many people in putting pressure on the decision-maker. In this way $ti=f(n)$. Assuming that reaching the optimal level of pollution (defined by the standard conditions of equilibrium between marginal damage and marginal cost of cleaning up) involves a cost equal to C for the polluter and a total benefit equal to B for those polluted, with $B=\sum bi$.

If $B>C$ the adoption of the control policy will be desirable from the social point of view. However the single individual will have an interest in participating in putting pressure on the decision-maker only if $bi>ti$ while, on the contrary, the polluter will try in any case to avoid the adoption of the policy that will force him to pay the costs of cleaning up. It can be assumed that the polluter must also pay the transaction costs (tp) for influencing the choices of the government, but obviously these will be much lower than those of the individuals polluted. It follows that, while it is probable that the latter will do everything to avoid the imposition of the new regulation if $bi<ti$ for all the n individuals, none of those polluted would put any intervention into practice. The decision-maker will only be under pressure from the polluter and will not adopt any control measures.

The example could be considered as a worst case and its implications would be better studied and explored further. However it demonstrates the existence of a sort of "social entropy" consequent on the different distribution between individuals of the costs and benefits due to the adoption of some environmental policies. In particular it can be inferred that when the latter involve modest benefits to the advantage of many individuals, they will have little probability of being adopted if they involve costs that hit a few individuals hard. Within this context an important role is played by the information that can accentuate or reduce the decisional asymmetry. Especially when the damage is slight, individual perception will weigh on the choices more than its correct quantification.

Figure 1

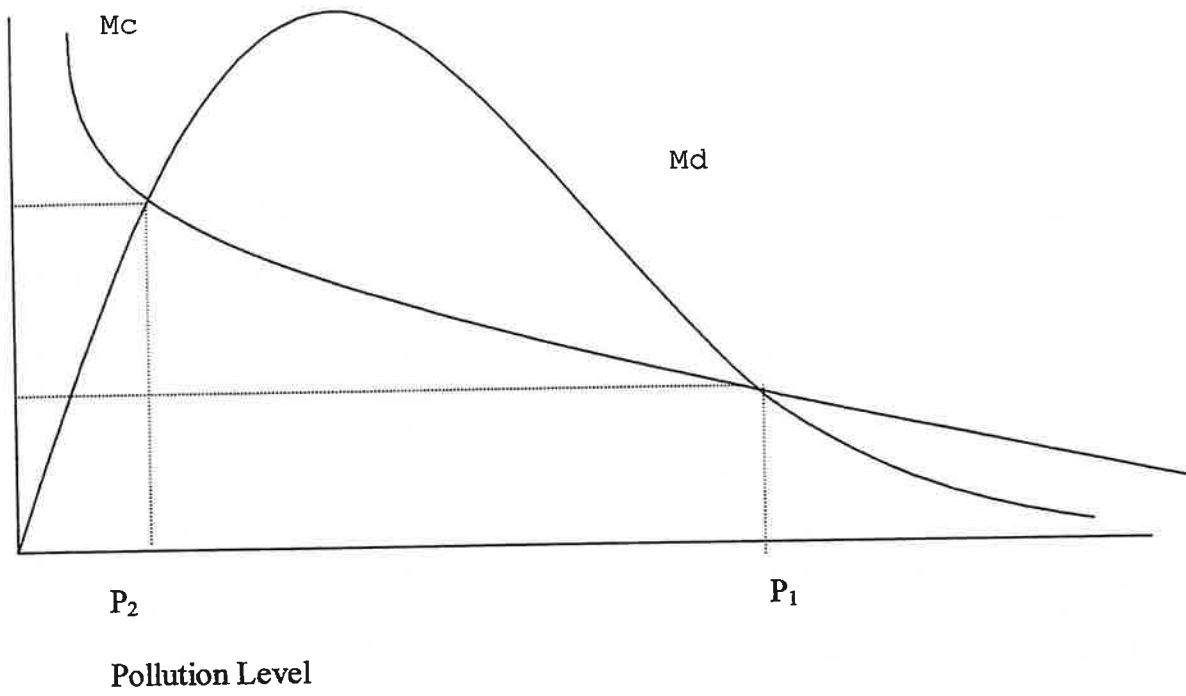
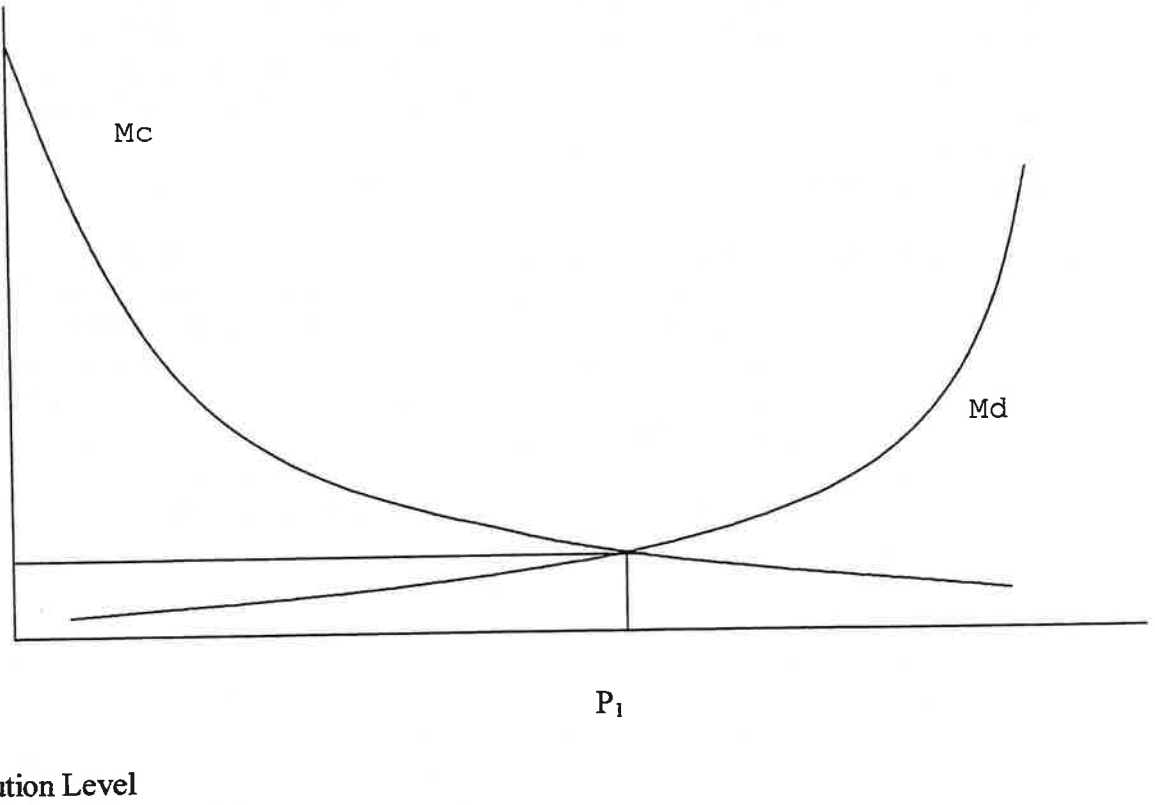


Figure 2



The subject, as can be seen, deserves further study but emphasises that in analysing environmental policies, the factors that influence and determine the public choices cannot be forgotten and, maybe even more, the attitude of the society towards environmental problems. In an advanced society such as ours, to ignore these problems simply means not to tackle them. The environmental, social, regulative, cultural and informational context cannot be considered as external variables as happens in many models. The fact that these variables are not easily mathematically formalised does not mean that they should be considered secondary or unimportant.

What conclusions can be drawn from what has been said about the aims of outlining a policy in the agro-environmental sector?

First of all, once the field has been cleared of the ambiguity of the existence of a social optimum (Paretan), it is clear that the prerequisite for the realisation of policies in the agro-environmental field will always be the definition of the standard of quality of the resources (Romano, 1998). The definition of a given level of environmental quality will with every probability be the result of scientific knowledge and of a compromise between the various social groups involved and, maybe even more so, of political choices.

The next question will be that of the most suitable tool to guarantee the reaching of the objective. Also in this case it will be appropriate to abandon the misunderstanding of the superiority of a financial tool over those of the command and control type. A particularly important role in this will be played by the characteristics of the general public and public administration. An optimal tool on paper could be opposed by society and be totally ineffective. It might equally be completely alien to the culture and level of education of the public administration, which would involve notable delays in the adoption of the policies and make them inefficient, if not dangerous.

The different types of tool also have fairly different levels of effectiveness and efficiency. Taxes on the inputs or on the end products will be relatively easy to implement, generally within the existing tax system. If the flexibility were high enough they would be very efficient and allow rapid improvement of the environment. However, they have the disadvantage of not being specifically territorial and environmental and it is very difficult to quantify their effects. Decidedly better targeted and more efficient is the imposition of samples at the expense of all the activities that require the release of government permits (hunting, fishing, mining activities, etc.).

The command and control rules are very effective if it is a case of banning the use of highly noxious products but, as with the taxes, they pose important problems if they refer to emissions. It is well known that the quantification of emissions in the farming sector is extremely difficult, if not impossible. Respecting a standard of process can be likewise shown to be very expensive for many arable crops. It could therefore be more useful to define actions that induce the farmer to grow different crops rather than alter the technique used. For example the re-introduction of rotations, or the presence of soybean or meadow in the rotation, can give a greater reduction in the use of fertilisers than that obtained with the best agronomic practices in maize.

Lastly the need must be cited again for coherence between agricultural and environmental policies. Agricultural policies can strongly influence the production choices of the farmers, thus rendering environmental measures unworkable. For example it is completely useless to provide incentives for a reduction in the use of fertilisers if higher earnings are then guaranteed for crops that require large amounts of them.

It is also clear that, in this context, to hypothesise the adoption of measures of a general nature capable of operating on a wide scale could make any harmonisation very complex. It follows that while it is desirable that the public official abstains as much as possible from influencing the choices of the businessman, substituting himself for the market, it is equally desirable that

he can act with extreme liberty when it is a case of improving the quality of the environment. The type of action to take, the tool to use and the financial cost of the transactions in the agro-environmental sector must as far as possible be defined at a local level in an attempt to balance and distribute as fairly as possible the costs and benefits of the intervention.

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