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ENVIRONMENT, INNOVATION AND REORGANISATION OF INDUSTRIAL SPACE. A THEORETICAL FRAMEWORK

1. TOWARDS THE «ECO-RESTRUCTURING» OF THE ECONOMY.

As it is well known, the «Earth Summit», the United Nations Conference on the Environment and Development held in Rio de Janeiro in 1992, through Agenda 21, assumes the environmental problem as a global one, giving a strong impulse to the application of the idea of sustainability to the various geographical scales, from the world scale to urban and regional ones.

We are thus entering a historical phase in which the impulses represented by sustainable development (in the form of policies, actions and principles) generated at the global level are gradually spreading, above all in the post-industrial economies. The industrial systems of these economies, and some sectors in particular, thus appear stimulated by the evolution of regulations and by the growing pressure of increasingly large bodies of opinion to undertake a process of «eco-restructuring» with decision, aimed at pursuing greater ecological efficiency, in terms of the consumption of natural resources and the release of pollutants into the ecosystem.

The territorial result of these dynamics is still to be explored: alongside the presumable strengthening of some «strong» areas, that have begun processes of environmental reconversion before others, new possibilities of development could arise for some areas that have been marginal up to now, among these most of the manufacturing systems around the Mediterranean basin. From the sectorial point of view, the environmental quality of the product becomes a crucial competitive factor on the international markets for some sectors. The process of ecological modernisation of the advanced

(*) Although the paper is the result of a collective reflection, first, second and fourth paragraphs are mainly the work of E. Dansero, while third paragraph is mainly by S. Conti and F. Sforzi.

economies is thus becoming a structural fact, which the individual national and local economies must take into account.

These very general considerations suffice to highlight how the environmental problem is appearing unmistakably in the terms of the global/local dialectic, where representations and meanings of a general nature are overlapping, potentially in conflict, with local representations and meanings. There are, for example, some environmental emergencies which can be dealt with effectively only through a global political approach (greenhouse effect, ozone hole), but the implementation of which can be particularly problematic at the level of local systems. At the same time, the stimuli to elaborate global policies often come from significant experiences at the local level (such as, for example, the collection and recycling of waste, biological agriculture and other more complex strategies of environmental and territorial reconversion).

It thus becomes essential to identify the local situations from where the impulses to «eco-territorial innovation» start. This poses the need for a regional study of the forms of interaction between the local societies and the (local and global) ecosystem and of the changes which these relations have encountered in relation to the environmental policies implemented. Unless one feels that there is a single road to sustainability to be pursued at the world level, it is in fact necessary to think about the possibilities of activating strategies of sustainable development, identifying the possibility of transforming the different local contexts towards greater sustainability.

2. TWO ENVIRONMENTS TO «EXPLORE».

For the construction of a territorial approach to the analysis of the environment-industrial development relationship, it is necessary, in our opinion, to compare two different approaches to the problem, which must be recomposed theoretically and empirically. These are different approaches based on two different meanings attributed to the concept of environment: as a (local) socio-cultural environment (as well as economic) in the first case, and as a physical environment (or better, ecosystem) in the second. They thus appear as two different ways in which attempts have been made to integrate the concept of environment within reflections on industrial growth.

1. The first – which we shall define as *environment-industry* – conceives the environment essentially in the physical sense and as an ecosystem, and points out on the consequences of the processes of industrial growth in terms of the exploitation of natural resources, the deterioration and the risk of the natural ecosystems. In this light, the analysis of the environment-development relationship is understood as the study of the evolution and of the different meanings that the environment – in its physical nature and systemic complexity – has assumed in the processes of industrial development.

2. The second approach – which we shall define *industry-environment* – is located in the line of studies on local development (Becattini, 1989, 1990; Coffey and Polèse, 1985; Conti and Julien, 1989) which has brought

the gradual discovery of the importance of local socio-cultural components in the interpretation of development processes. The intuitions derived from this have had great significance on the epistemological level, and in particular have demonstrated the centrality of the study of *the local* in the understanding and interpretation of the real processes of socio-economic transformation.

The path we intend to tread is thus the following: after having examined separately the two perspectives introduced above, we shall attempt to integrate them so as to construct a territorial approach. A theoretical proposal arises from this that acknowledges the need for the integration between natural sciences and social sciences expressed by the debate on the concept of sustainable development and above all on the instruments to trigger strategies of sustainable development on the different geographical scales.

2.1. *Environment-industry*. – The first perspective thus proceeds from recognising the state of deterioration of the natural ecosystems to identification of the various forms of pressure. Among the latter, industrial growth undoubtedly occupies a central position among the typologies and levels of pressure and impact on the ecosystems (1).

Partly in response to «external» pressures (environmental legislation, public opinion), the first attitude of the industrial world towards the environmental question has been a defensive and aggressive one. When they were not ignored, environmental problems were regularly minimised, in the attempt to limit the responsibility of enterprise and in the conviction that over (and above) the «invisible hand» of the market there was the «public hand».

This type of position has undergone an evolution common to almost all industrialised countries. On the one hand, measuring the aspects of environmental damage, a perception began to emerge that the direct impact of industrial production is in some cases lower than others (in agriculture among others) and that in many cases the deterioration of the environment derives more from consumption choices than ones of production. On the other hand, the industrial world is recording a slow but constant change in attitude. The environmental question has now come to represent an inevitable cost which entrepreneurs have to take into account, and as such must be tackled systematically and structurally with the appropriate management and decision-making tools that are adopted in dealing with the other issues that characterise the life of an enterprise. In broad terms, the evolution towards a management of enterprise that is sensitive to environmental factors (*environmental management*) has occurred in three successive stages:

(1) This is substantially the perspective followed in the reflections on the environmental damage to the Mediterranean, and in particular in the «Blue Plan» studies formulated in the framework of the Mediterranean Action Plan (MAP) adopted in Barcelona in 1975 within the UNEP's *Regional Seas Programme*. Perhaps the most fitting example is the Blue Plan file on industry, in which the predictable evolution of the environmental impact of various industrial sectors (mining, steel, cement, organic and inorganic chemicals, agro-industry, tanning, paper etc.) is analysed (Giri, 1991).

passive ecology in which the environment represents exclusively a constraint, to be respected so as not to incur penalties of various types (economic, legal, image etc.); *active ecology*, in which the potential advantages represented by environmental constraints (opportunity for new markets, new products, competitive advantage etc.) can be seen; *integrated ecology* in which the environment is assumed at the level of a strategic variable, on a par with so many other key factors in company management (purchasing, personnel, technology etc.) (Schmidt di Friedberg, 1992).

The perspective. First of all, it must be underlined that it is anything but homogeneous. Within it, in fact, very different approaches clash over methodology, ends and, above all, underlying ideology: from explicitly techno-centric positions to the more markedly eco- (or bio-) centric ones (O'Riordan, 1989; Pepper, 1984; Adams, 1990; Bartelmus, 1994). Beyond the different positions expressed, this approach – which we can define as *environmentalist* – has had the merit of having drawn attention since the late 1960s to the consequences of industrial growth in terms of the deterioration of the quantitative and qualitative state of the ecosystems.

However, in our opinion, this perspective presents a great limit in having excessively simplified the phenomenon of industry, not enquiring in depth into its essence as a variously organised activity which maintains both tighter or looser links with a local context and activates growing processes of globalisation. This is, in a sense, a reductionist perspective in that it neglects industry as an organised phenomenon, guided by its internal dynamic or logic.

In effect, the different positions share the consideration of industry as a factor of pressure on the environment, to study its levels, typologies and, possibly, geographical distribution, so as to control and reduce the effects on the environment. It is interpreted, therefore, as a factor to be controlled and regulated differently according to the diverse positions and temporal evolution of environmental policies: from protection against pollution to the conservation of the natural heritage, resource management and, finally, sustainable development (Colby, 1991) (2).

In the field of environmental policy and local environmental planning, this is all translated into a typical approach in coping with problems deriving from the industry-environment conflict: the factors of pressure are identified abstractly (individual companies or sectors), then projected on to a land area differentiated only physically (the physical environment and, at the most, the built environment) and the simple and cumulative territorial articulation is analysed in relation to the ecosystems involved.

(2) Since the official launch of MAP (1975) this sort of shift in the objectives followed can also be seen in environmental policy on the Mediterranean: from the fight against industrial pollution, to which priority attention was given, to the conservation and protection of the environment, finally reaching sustainable development with Agenda 21 for the Mediterranean (Med Agenda 21) and the design of the Mediterranean Commission on Sustainable Development (Vallega, 1995).

It should be underlined that the geographical distribution of production activities is in itself a constituent element in the relations that the various production sectors and technologies weave with the ecosystem. These relations assume full meaning only in connection to this: a negative impact, such as any pollution of the air or water, becomes such only in relation to a specific portion of the earth's surface, in other words in relation to the characteristics (the stability, resilience, vulnerability) of the ecosystems directly involved. It is not only the quality of the impact that can vary regionally, but also the scale on which the impact can have an effect. The same impact can activate local, regional or even global effects in relation to local characteristics. A simple example is that of the different effect that atmospheric emissions can have according to the direction of local winds and their position in global circulation.

Together with space, the time factor is essential, as is evident in the case of irreversible changes, where an anthropic pressure, even if only slight, but persistent and cumulative in time, or a sudden shock, can overcome the resilience of the ecosystem and shift it to a completely new state.

However, to emphasise fully how the local (regional) system is a founding element in the definition of environmental problems, it is not enough to project the distribution of production sectors onto a physical map of the territory, but it is necessary to consider how industrial production is organised spatially and ask what relations it maintains with local society. It is not sufficient, in other words, to represent the territory as a simple overlapping of layers, each expressing a function, on a physical support; it is instead necessary to assume it as the historical expression of horizontal and vertical social relations that link the human community with a natural environment that is not a mere physical support, but an (eco) system, a highly complex living being.

In this sense, as we shall see in the second perspective we examine, the explicit introduction of the category of the «territorial production system» (or *industrial district*) in the industry-environment relationship does not have the sole meaning of describing environmental problems in a particular local context, but constitutes a fundamental key of interpretation for the understanding, explanation and correction of the problematic relations between society and the ecosystem. These are relations, perceived and evaluated in different ways, whose attribution of meaning is particularly significant on a local scale, where the territory and environmental quality are at stake for a range of actors.

One might ask why the consideration of industry as an organised and organisational phenomenon has remained in the background. It is important to underline the anti-industrial attitude that has characterised a fair part of the contributions in the environmentalist approach (in the more eco-centric and radical positions), while the techno-centric positions have long barricaded themselves behind minimalisation of industry's environmental responsibility. Furthermore, the fact that this has been cultivated largely by

researchers from the field of the natural sciences and from technologies with a rather «hard» approach has had its weight. Social scientists are strongly influenced by the neo-classical approach that has dominated the new branch of the economy of the environment, substantially concentrated on a perspective of a micro-economic type and incapable of grasping the organisational complexity of industry.

From analysis to policy. These interpretative weaknesses are the mirror of the failure of traditional environmental policies. They have revealed themselves to be essentially *regulatory* («command and control»), implemented through typical standards (emissions, process and product) of limits and bans (Pearce and Turner, 1990). These policies tackled environmental problems in a sectorial manner, generally coinciding with the differing environmental elements: air, water, earth (waste), noise. This type of policy has unveiled great limitations in terms of flexibility and adaptability over time, causing, among other effects, a serious burden for the public authority entrusted with controlling the situation. In addition, they do not stimulate the introduction of cleaner technologies or less polluting products, as they demand only observance of a standard – something that is difficult to define.

Towards the end of the 1980s, a new generation of environmental policy tools began to emerge, of various forms but explicitly aimed at the prevention of environmental damage and which find a fundamental point of reference, for example, in the Fifth Environmental Action Programme of EU. The characteristics common to these instruments are: *a*) growing integration between environmental and other policies; *b*) the shift from policies based on environmental sectors to integrated ones focused on the production-distribution-consumption-disposal cycle; *c*) the extension of greater responsibility to both producers and consumers; *d*) the regulation of enterprise's environmental management in the framework of increasing collaboration between public authorities, enterprise and citizen-consumers. These are instruments of a pro-active nature, i.e. intended to promote a new entrepreneurial approach to the environment, aiming to anticipate norms so as to gain a competitive advantage over companies that will have to step into line later (Bresso, 1993). In brief, they induce industry to become an active party in the process of eco-restructuring the economy.

In effect, the progressive passage to instruments of an interactive type has allowed the reductionism with which the environmentalist approach appears imbued to be overcome at least in part. The business world, but more in general the private objects of environmental policies, are assumed as complex entities, whose environmental performance cannot be regulated entirely exogenously. This could appear, for example, from some fields of experimentation. Among the innovative instruments are the so-called *voluntary agreements*: these are a sort of contract between a company, a group of companies or an entire industrial sector and the national or regional authority. In this case, the enterprises undertake to reach certain envi-

ronmental objectives (both in terms of quality and quantity) in a pre-set period; for its part, the authority abstains from regulating the question until the company shows that it has observed the agreements made (Campiglio, 1994; Glachant, 1994).

2.2 Industry-environment. – While in the first perspective industry is considered a factor of environmental deterioration, and consequently its activity must be subjected to regulation, in this second perspective, the environment represents a set of constraints and potentials that provide the context for industrial activity and constitute a privatised resource that can be modified temporarily or irreversibly. The privatisation consists in the self-interested and often damaging use of public property, in this case the environment.

An industrial plant that discharges dangerous emissions into the atmosphere, despite the availability of technology capable of controlling the problem, reduces its production costs and, presumably, the price of its products for customers. This type of behaviour is irreprehensible from the point of view of individual economic rationality, even if the consequence is the destruction of the environment.

Put in these terms, the problem of the industry-environment relationship resembles, upturned, the environment-industry illustrated above. Economic reasons and environmentalist needs do not correspond, and the way out is represented by the recourse to the sanctions of protection measures.

For industry, the introduction of more and more severe and pervasive standards represents an obstacle to its competitive capacity, as there is no guarantee of the simultaneous application of the norms to all the companies competing for the same item on the same markets. And even when this is possible, there is no certainty that enterprises located in the industrialised countries – which, being the most sensitive to environmental problems, apply the norms with greatest severity – will not decentralise the dirtiest manufacturing stages beyond national borders to other countries where the norms either do not exist or are applied more tolerantly (Leonard, 1988). In this way, the disparity between enterprises in the same industry is reproduced, and it is for this reason that enterprises consider the introduction of environmental control measures (aimed at regulating the privatisation of the environment) as an interference by public institutions in private initiative and the free market.

These are the classic terms of the industry-environment relationship; or better, these are the traditional ways through which the industry-environment has been approached analytically.

From the individual enterprise to the local system. At the root of this analytical approach is the identification of the individual company as the unit of enquiry of industrial economics and, more generally, of economic development.

In Italy, in the decade between the late 1970s and the early 1980s, the

theoretical reflection on industrial development underwent profound change because the enterprise was gradually replaced by the local system as the unit of enquiry of development. In this way, a territorial interpretation of development was reached, as the local system was configured as the local (territorially concentrated) mutual penetration of enterprises and the population that worked in them. While the enterprise is an a-territorial concept without a social dimension, the local system is a socio-economic territorial concept.

Shifting attention from the individual enterprise to the local system means recognising that the economy of the enterprise system is integrated with, and is fed by, its environment. Thus, producing does not only mean transforming a set of raw materials into a finished product according to certain technical procedures within a certain time span, but also means reproducing the material and human pre-requisites on which the production process itself depends. The production of goods includes the social reproduction of the production organism: a truly «complete» production process must co-produce (together with goods) the values, knowledge, institutions and natural environment that help to reproduce it without compromising its future development.

Defined in these terms, the local system includes within it most of the flows between enterprises in a single production process with reference to raw materials, finished and semi-finished products, production phases, people, capital, services, information and knowledge. The local system's distinguishing feature as an open system allows similar flows to occur across its boundaries both during the production process and at the end of it, when it is necessary to place the finished products on the final market. The globalisation of the economy and of the society also derives from similar processes that act on the internal configuration of the individual local systems through the growth in number and frequency of their local/global relations, and sometimes also refashions the boundaries themselves.

Finally, the identification of the local system as the unit of enquiry allows an interpretation of development that unites economic and socio-cultural growth, as phenomena which are both naturally localised, and the local/global dynamic as the dimensions which mutually penetrate each other in the explanation of development phenomena.

This approach to industrial development gave rise to a new current of thought on local development, which owes much to the theoretical reflection on the industrial district and to the empirical analyses that followed, and in many ways can be said to represent a direct branch of it.

Scholars belonging to this current of thought have not yet tackled explicitly the relationship between industry and the environment, although the theoretical scheme of local development has all the pre-requisites for this relationship to be dealt with through interpretative solutions capable of harmonising environmental and economic development needs and at the same time of encouraging practical effects on the definition of effective policies to contain the environmental impact of industrial production.

One of the main obstacles that hinders convergence, above all on the

analytical level, between the points of view of those tackling the problem of the industry-environment relationship from the side of industrial growth and those who tackle it from the side of conservation of the environment derives exactly from the nature of the unit of enquiry.

The identification of the unit of enquiry with the individual enterprise in fact influences the ways of assessing environmental costs. These are considered indirect costs of the production process, in that they are undesired effects of industrial activity, and external to the enterprise, as the territorial projection of the production process, which have to be dealt with only when there are environmental standards to be respected.

The fact that environmental costs are external to the enterprise, but internal to the local system where the enterprise is located, can be considered in a different light only in the event of there being social sanctions by the local community or that the entrepreneurs live in the same local system where the enterprises they own are located. Thus, the economic disinterest they show for the physical environment as entrepreneurs becomes social interest as citizens of the local system, with the contradictions that this duality generates.

Vice versa, in the theoretical framework of local development, the identification of the unit of enquiry with the local system has the effect that environmental costs become internal to the enterprise system located in it, as the local system is identified with the various production processes that occur within it.

This reclassification of environmental costs from external to the individual enterprise to being internal to enterprises, considered as a whole, depends on the shift in the unit of enquiry into the production system that has gone from the individual enterprise to the local system, as a territorially located complex of enterprises.

The local production system, or localised industry as it is also known, represents the theoretical assumption typical of local development that allows the internalisation of the physical environment in the industrial production process, and thus make it become *ab initio* an integral part of the economic process.

The approach to the problem of the industry-environment relationship according to the theoretical scheme of local development generates consequences that are of considerable importance from the point of view of environmental policies. In fact, environmental costs become comparable for the individual enterprises of local industry to the costs they have to sustain to maintain efficient the other key elements in the production process: machinery and plant.

In this way, the control and conservation of the environment, which was first a problem of environmental impact (external to production, concerning the respect of regulations and the definition of standards) now become a problem of environmental maintenance (internal to production, concerning the maintenance in efficient conditions of the elements of the production process).

3. TOWARDS A SYNTHESIS.

The assertion of a *territorial logic* in the description and interpretation of economic processes leads to an explicitly geographical approach to the industry-environment relationship, shifting from an abstract perspective to one of analysis in terms of the relations that are established between the local industrial system and the ecosystem. More in particular, as the environmental question stems from the relations that exist between socio-economic processes and natural processes, the territorial perspective assumes a central significance, in that:

1) the comprehension of real social and economic phenomena requires analysis of the territorial diversification of the economy, which is a constituent element of them;

2) environmental problems themselves, including the global ones, cannot be defined abstractly. The territorial diversification of the ecosystems, their characteristics and the inter-relations between anthropic and natural components is instead indispensable to the analysis of the causes of environmental impact.

Both the structure and the evolution of the global economic system and that of the planetary ecosystem depend on what happens at the local level (and vice versa) and thus appears as a typical *global/local relationship*.

The problem is that of giving intelligibility to highly complex processes which, as such, definitively challenge the reductionist (and mechanistic) tradition which has dominated social sciences over the past decades. To this end, some insights of an epistemological type must be opened: we believe, in fact, that much of our efforts of analysis – including empirical work – are futile if we do not insert our reasoning in the framework of the broader debate on the nature of the epistemological and ethical transition underway in contemporary science. Only thus can the problems of the industry-environment and global-local dialectic acquire full significance.

3.1 *The perspectives of complexity.* – To avoid getting into interminable epistemological discussions, we shall assume the metaphor that best illustrates the paradigmatic leap in progress in contemporary science. According to the felicitous intuition of von Foerster (1981), recent decades have seen the passage from a vision of reality understood as a *banal machine*, the expression of the mechanistic-structuralist paradigm, to that of the *non-banal machine*, the manifestation of the new paradigm that is being formed.

The first represents the world as an immutable set of elements and of relations between the elements, so the machine always gives the same response to the same impulse. It is its behaviour that demonstrates that the machine is: *a) analytically determinable*, because if one analyses it, its functioning can be understood; *b) independent of history*, because it always behaves in the same way over time, laying bare its invariant nature; *c) predictable*, as we can know what its behaviour will be over time (Vallega, 1995). The mechanistic ideal, aimed at imposing a «simple» vision of the

world, i.e. based on a linear logic of causality, could not but see space in the simplest and most abstract way possible: a passive support (a geometric one, in the most radical vision) in which the local territorial diversities were considered as irrelevant for the purposes of the explanation.

The *non-banal machine* has different, even conflicting, properties. It possesses an *internal state* capable of determining what the machine does. Consequently, in the presence of the same impulse, repeated over time, the machine gives different responses. It follows that the machine: *a) cannot be determined analytically*, because one cannot understand how different responses are given to the same impulse; *b) it is dependent on history*, because its behaviour changes over time; *c) its behaviour is not predictable*.

This is obviously a metaphor, yet capable of illustrating facts that have undermined the foundations of conventional knowledge and the principles on which it was grounded (evidence, reductionism, causality, exhaustiveness) (3). In great synthesis, the «cultural revolution» underway in the contemporary sciences stems from some inter-connected phenomena:

a) The establishment of ecology as the foundation of a new epistemology. We refer here not to ecology understood as a science that merely integrates different disciplines for the study of ecological systems, but as the bringer of a «new», «macroscopic» and holistic ethic and methodology for the study both of social systems and of phenomena of interaction between society and the environment. Ecology, as an integrating category, is a systemic concept and thus expresses the explosion of systemism in the field of knowledge. To comprehend (from the Latin *comprehendo*, to embrace, envelop) the mechanisms and the functioning [of an ecosystem] means accepting its fundamental character, which is its systemic character. This marks the irreversible crisis of mechanistic determinism.

b) The principle of reciprocal interaction between the whole and its parts is a foundation of the systems approach: this expresses the character of non-reducibility *between different disciplinary knowledge*, on the one hand, and, on the other, between the whole and the parts of any phenomenon. If assumed in isolation, a system can also be quantified, but in this way one fails to grasp the holistic quality, in that its dynamic and behaviour is inexplicable if isolated from the whole.

If different disciplines cannot be separated (although they are non-reducible), nor a hierarchy be made of them, no system can be separated from the whole of which it is a part, nor from the parts which make it up. In this light, ecology and systemism represent the capacity to describe and understand the set of mechanisms and chains (*networks*, we would now say) which bind every system to others (from the infinitely small to the infinitely large): from this descends the heuristic character of a co-evolutive perspective

(3) We refer here to the contrast, explained by Le Moigne (1990), between the precepts of the «classical» (or Cartesian) modern scientific method and the precepts of the «new» science taking shape. The principle of *evidence* is opposed to that of *pertinence*, *reductionism* to *globalism*, *causality* to *teleology*, and *exhaustiveness* to *aggregativity*.

and the *reciprocal non-reducibility between the local and global*. This reintroduces the global-local relation into every action of everyday life.

c) This ecological, systemic and evolutive knowledge is the foundation of a true culture of complexity. It expresses the fundamental passage from the principle of *evidence* typical of mechanistic knowledge and its presumed scientific nature to the principle of *pertinence*, i.e. to the implicit or explicit intention of the researcher, endowed with his own cognitive structures.

The study of the phenomenon does not occur from a detached and abstract point of view, but from an angle imposed by the pursuit of one's own (the researcher's, the discipline's) ends. Complexity, as is well known, more than a property of reality, is a *way of describing it* that introduces elements of subjectivity into it.

3.2 *Time, space, subjectivity*. – In short, we find ourselves faced with a triangle whose corners – time, space, subjectivity – correspond to the three great founding ideas of contemporary science: *a) time* expresses evolution, obviously not in terms of a trend towards equilibrium, but of irreversibility and unpredictability; *b) space* refers to a composite object, in which the whole (global) cannot be broken down into parts, nor the parts be re-assembled into the whole; *c) subjectivity*, finally, refers to the essential characteristic of the objects to be described, *whose property stems from the value attributed to them by the autonomous action of the actors*.

It follows that space (or better, spaces) has characteristics that do *not* stem from the «general laws» of the (global) economy, but from its own organisational principles (in particular, the autonomous action of local actors). And here the geographical perspective comes decidedly into play: «space is differentiated also and above all because of the long-term natural and historical processes and because of a time that is *neither reversible nor linear* in that it is an expression of unpredictable historical contingencies» (Dematteis, 1995, p. 4).

These contingencies constitute the substratum on which the organisational component of the territorially embedded actors can play, transforming local potential into values that can be exported in the global circuits (Conti and Dematteis, 1995).

The local autonomy of the individual phenomena reintroduces the idea of the *contextualisation of the action of the actors* (Suchman, 1990) and, what counts the most, leads to the reinterpretation of both global and local systems, in terms of *self-organisation*: i.e. in terms of systems that are open and at the same time closed operatively, between which, thanks to the logics of the functioning of complex and autopoietic systems, *structural coupling* is accomplished (4). The first, the global, is a space of flows which tie together different and changing local systems: it is, therefore, a *transterrito-*

(4) According to the theory of autonomous systems (Wiener, 1965; Atlan, 1979; von Foerster, 1981; Maturana and Varela, 1985), the system is seen in a continuous state of dynamism, where the relations of reciprocal interaction with the environment (with other active systems) are defined in terms of *structural coupling*. This coupling occurs when the system, organisatio-

rial system. The second is instead a territorially closed system rooted in a specific *milieu* and its main function is to produce goods and services. The geographical perspective is that of giving meaning to the actors' action, in other words to the *embeddedness* in the values and local environmental endowments, whose evolution cannot be separated from the global dynamic of the system.

The *principles* recalled here do obviously not exhaust the vast range of epistemological transition in progress in contemporary science. By rethinking scientific knowledge, they appear capable, however, of giving full pertinence to the idea of the non separation between the economy and the environment. More in particular, they allow the highlighting of some fundamental questions of a conceptual and theoretical nature:

a) The overcoming of the «hierarchical» interpretation of the relationship between man and the environment (both the anthropocentric type and its opposite, the ecocentric kind) in preference for a relationship defined by a multitude of connections and which, as Bateson (1979) states, assumes a «critical relationship» of man with the environment, the expression of the dynamic character of natural and social equilibriums.

b) The assumption of the dynamics of the man-nature relationship as a bi-modular systemic relationship is in antinomy to both mechanistic reductionism and even to von Bertalanffy's vision of open systems, and indeed to the socio-centred interpretation (*à la* Luhmann, 1989) which reduces the environment to a factor of disturbance and «echo» in society.

c) The challenge of environmental knowledge cannot be simplified through the traditional categories of analysis nor through the juxtaposition of concepts taken from different disciplines. It does not, in fact, involve only problems of a philosophical nature, but of an *epistemological* one: in this light, the recourse to a *generalist* approach is not methodological reductionism, but the expression of interdisciplinary dialogue, which imposes itself when faced with a subject of multidimensional knowledge (Comeliau, 1994). It implies the limitation of each cognitive strategy (and paradigm), offering in contrast the complementarity between different and at the same time non-reducible conceptual systems, each one bearing its own theoretical and methodological baggage. In this sense, the role of disciplines such as geography is strengthened; for a long time their limit had seemed to be that of not managing to be a specialist discipline.

d) The re-affirmation of the ethical dimension in cognitive strategies cannot be isolated from the crisis of formalising and quantifying culture. The

nally closed, selects the perturbations from the outside, modifying its own structure continuously. This process of adaptation which guarantees the invariance of the organisation is *autopoietic*, i.e. a circular process that reproduces the elements and the relations between the elements (i.e. the structure), modifying them. Paraphrasing Piaget, the concept of aperture therefore refers to the structure, and that of closure to the organisation, which remains constant precisely because of the transformation of its components.

very debate on sustainable development has produced the resurgence of two great groups of ethical problems: that of the relationship between man and nature, and that of the relationship of rights and equality between people and between generations: what Laszlo (1981) defines in terms of *universally human values*.

3.3 *Three levels of intelligibility*. The range of concepts illustrated above can now be recomposed into *three levels of intelligibility*. They cannot be separated from each other, and neither can they be put in a hierarchy; on the contrary, they are part of a single, inseparable articulation (fig. 1).

1. At a first logical level we can assume as an image of reference the *biosphere system*, a «complex organism» which has relations with the external environment – given by the sun as the source of heat – and its two modules: the socio-cultural system and the ecosystem. Thanks to the energy supplied by the sun, there is an articulated series of interacting feedbacks between them which bind the evolutionary dynamic of society to that of the eco-system.

This is thus *a society-environment bi-modular system*, where both the sub-systems, as non banal machines, assume behaviour that is neither determined nor predictable (Vallega, 1995). The relations between the two modules (and the phenomena of change which follow) cannot be assumed without taking into account the scale: they involve simultaneously the global and the local scales, even if there are different *forms of contextualisation* on each scale. Think, for example, of a micro-process of air pollution (a micro event in the sense described above) which produces unpredictable repercussions on a vaster scale. In contrast, a process of change induced in the global eco-system (such as, for example, the variations in temperature at the global level) inevitably influence the local eco-systems (again in ways that cannot be determined a priori).

2. It follows that the dynamic that directs the evolution of the system implies that each of its modules is open to the other, while each obeys its own logic of transformation.

The image that one perceives is thus one of great complexity: the local contextualisation of a socio-economic phenomenon, for example, does not respond merely to the structural logics of its own system of reference (which do however act to a decisive extent). This image cannot occur, however, without the simultaneous activation of the relations of interdependence with the environmental system. A micro economic event will thus act at the same time on the modification (evolution) of the structure of the socio-economic system, on the specific *social and environmental milieu*, and on the global environmental system (as is seen, for instance, in the phenomena of the «export» of pollution).

3. It would obviously be reductive (and mechanistic, in the end) to think that whatever process of contextualisation follows an identical dynamic and produces analogous evolutionary effects (globally and locally). The specific diversities of each milieu (whether environmental, economic, social, politi-

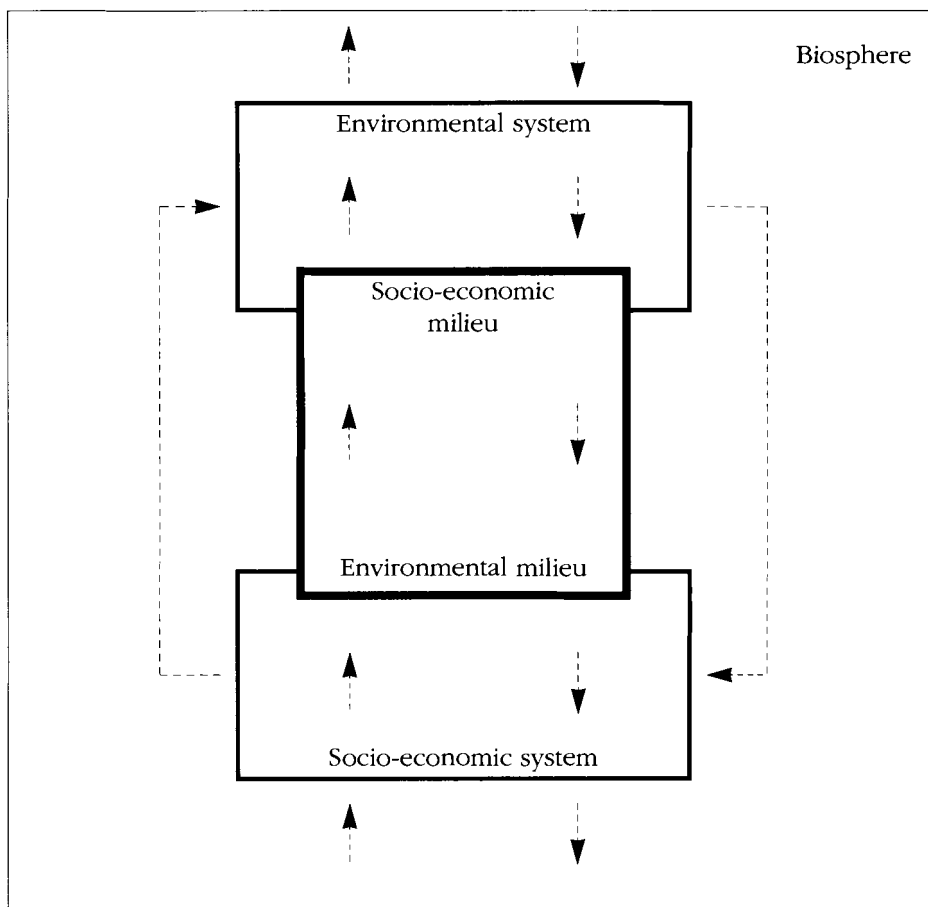


FIG. 1 – CONTEXTUALISATION OF THE CO-EVOLUTIVE DYNAMIC.

Source: Conti and Dansero, 1995.

cal etc.) are, on the contrary, the founding element of a world which has nothing in common with the Newtonian image of a repetitive universe.

Environment, economy, society, culture, ethics, etc. are all interdependent dimensions which define a multidimensional scenario, *different forms of environmental interaction* and therefore *different paths to sustainability*. In this light, the *local* dimension, in the sense of an individual (and unrepeatable) combination of social and ecological relations, asserts itself. The environmental question, in other words, cannot be isolated from the social (and therefore ethical, cultural etc.) conditions in which it occurs.

3.4 The socio-environmental relations. – We must therefore consider a territorial system as a bimodular system composed of two sub-systems (an

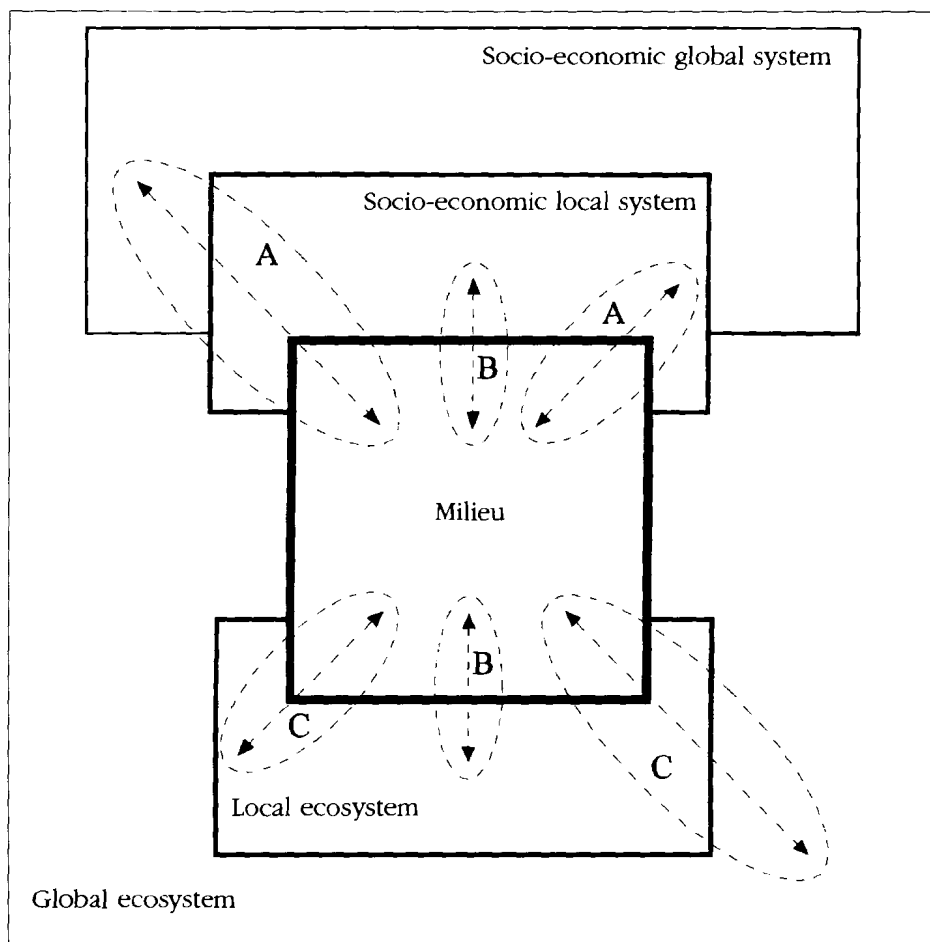


FIG. 2 – SIGNIFICATIVE SOCIO-ENVIRONMENTAL RELATIONS.

Legend: A) indirect environmental relations; B) direct environmental relations; C) environment-environment relations.

anthropic system and an ecosystem), «zipped» together by the local *milieu*. As the human community sub-system cannot survive except by preserving the integrity of the other sub-system, it follows that the ecosystem occupies a privileged position. The study of the local system becomes enormously more complex, in that the interesting relations become those that develop within the two sub-systems, those between the two sub-systems, as well as those that each sub-system activates with the outside world. In addition, the application to the social sciences of concepts developed within ecology induces study of the territorial system as an ecosystem characterised by a

varying degree of artificiality, which is extremely high in an industrial-type context. It is thus necessary to re-read the relations within the local system, and between it and the outside, making them much more complex.

Firstly, the traditional relations of a socio-economic type must be reinterpreted. They are configured, in fact, as *indirect environmental relations*. All exchanges of goods, every import or export, just as traffic goods or passenger flows, are in reality exchanges of sustainability with the outside (fig. 2). Each exchange between different local systems, which involves material elements, means bringing different ecosystems into contact. These are, therefore, co-operative-competitive relations to take possession of the resources belonging to a different *milieu*.

A second type of relations is that of the *direct man-environment type*, within the local system and mediated by the local system. This is the most classic and clearly identifiable form of environmental relations, in the form of inputs and outputs (air, water, energy, soil, waste).

A third type of relations to consider is the *environment-environment type*, which occurs within the local ecosystem, but can also involve other ecosystems, even non-contiguous ones (for example, the phenomenon of acid rain). They are the result of the functioning of the earth's ecosystems and occur according to the great cycles of nature. These are highly complex relations, partly due to the alterations made by man to the functioning of the earth's ecosystem. In a socio-centric perspective, they can also be interpreted as social relations mediated by the ecosystem (as is the case of the «export» of water pollution which, in a hydrographic basin on which many local communities depend, has effects downstream).

In the representations of a functionalist kind, the local system is defined while ignoring the physical environment, or at the most incorporating some of its characteristics (from a deposit/withdrawal standpoint). The problem is instead that of including the physical environment, in its systemic complexity, in the organisation of the local system. If by organisation of the system one means the set of relations between the internal components that must remain invariant so as not to compromise its identity and even survival, then one can wonder if sustainable development, with reference to a single local system, is compatible with the system's identity, in other words whether it comes within the variability of the structure of the system itself.

4. CONCLUSIONS: POSSIBILITIES AND LIMITS OF SUSTAINABLE LOCAL DEVELOPMENT.

The representation of the relations that the local system has with the outside thus highlights the importance of internal (self-referential) representations to the local system, with regard to the environmental question. Indeed, these become a fundamental aspect of the social system itself, which reworks the stimuli from outside (such as environmental standards, or imported pollution incorporated in materials or finished products) and from the ecosystem, on the basis of its internal representations.

By this, we do certainly not want to deny the evidence of global envi-

ronmental problems (such as the greenhouse effect or the ozone hole), which must necessarily be tackled with a global approach. One crucial problem is instead that of the scale on which sustainable development must be planned, designed and, above all, practised. The concept of sustainable development, as defined in the Brundtland Report and developed by a continually growing literature, seems far from the conceptions of local development: the reference to the «local» happens when the desire is expressed for the community's shared support for the enlightened projects of sustainable development, rather than emphasising the need for support from the outside for the *self-sustainable* projects of development of the community itself (Friedmann, 1992).

The question of whether there is any sense in a local analysis of sustainable development is thus posed on two reciprocally connected levels:

a) on the *analytical-operational* level. The local level is introduced as it is locally that it is necessary to implement the strategies of sustainable development. If we consider, for example, the lines of action defined by the 5th Programme of the EC (*For lasting and sustainable development*), they affect the aspects of the management of resources, mobility, production and services that can be applied concretely only at the local level. In particular, Agenda 21, the environmental programme for the 21st century drawn up at Rio, articulates its action on different levels: global; regional (understood as the large space); national and sub-national;

b) on the *epistemological* level. The local level is not introduced only for analytical purposes, but as an inseparable level for the understanding of real phenomena. This is, in the end, the lesson from the studies of local development, which have the merit of having brought back to the centre what had remained on the sidelines of economic analysis, i.e. the concept of environment, considered above all in its socio-cultural components. In this way, the field of studies is extended, including also the other environments of which the local system is composed, and thus the physical environment. This theoretical approach has important implications on the operational plane, where the local does not constitute merely the partition of an administrative activity, but is a structured whole with often conflicting significance and attributions of meanings. The understanding of the concept of local development in terms of sustainability accentuates strongly, as we have seen, the regulatory-political character, reproposing the top-down or bottom-up dilemma which has characterised three decades of development policy. The perspective followed above is part of this dilemma, highlighting the limits intrinsic to the conception of the planning of local development as a linear process that can be regulated from the outside, instead of the outcome of a complex dynamic between systems with their own rationale and logic. In this context, the viewpoint of sustainability forces us to search for that set of possible relations with the ecosystem that do not mean destructuring the entire bimodular system.

It is thus possible to state that the concept of sustainability must, sub-

stantially, be defined within global compatibilities, in relation to a given environment. The sustainability of development is an objective that should be territorialised in order to be pursued in practice, in that the carrying capacities and potential vary in each local context (Bresso, 1993). But in this sense, it must be admitted that a number of local sustainability models will exist, feasible through the reformulation of development on the basis of the specific characteristics of the local territory and ecosystems.

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