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**PRECAUTION AND PROTECTION POLICIES OF URBAN ECOSYSTEM
IN THE IBLEA NORTH EASTERN COAST OF SICILY¹**

Paper 139

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PRECAUTION AND PROTECTION POLICIES OF URBAN ECOSYSTEM IN THE IBLEA NORTH EASTERN COAST OF SICILY²

1. Sustainable planning related to management of the coastline

Geomorphologic as well as historical-economic reconstruction that has determined origin and evolution of the coastline, offers up-to-date reflections.

The irreversible damage of a large part of coastal resources as well as the awareness of environmental resources depletion led to an accurate evaluation of the eco-systems and their protection. A correct management of coastal areas must be founded on the comprehension of dynamics as well as coastal natural processes, without clashing interests.

It is then imposed, precaution and protection policies that begins from the study of the environment and may lead to the awareness and prevention of risk through corrected information.

A sustainable management of the complicated coast system require particular attention to factors, meaningfully affecting coasts dynamics, also taking into account the mentioned areas composed by two components, earth and sea, which are in mutual relation with human and physical processes, due to every type of initiative must include both³ (Vallega, 1999; Belfiore, 2001).

From a logical point of view, planning should precede management, despite spontaneous environmental management has been operated for many years. Only after, complication of network has created clashing relations, and environmental impact has reached high pick of risk, the community needs to control the behaviour through planning activities, introducing environmental quality control systems in relation to land transformation projects (Vallega, 1990).

The growing awareness needs more careful environmental management introducing the concept of *sustainable development*, attempting to conciliate environmental and economic problems in order to achieve technological progress while monitoring its impact on the environment. The operation of this concept is limited by today's technological know-how, and by social and economic organisation related to the use of environmental resources and by biosphere capacity to engross the effects of human activities.

Planning means project a sustainable region in which the well-being of the population is reached without damaging environmental resources, saving the ecosystems and reducing as much as possible not renewable resources consumption.

In order to achieve such management it is necessary to introduce the concept of "shared planning", mainly relating to the integration of opinions and different point of views of actors in planning and programming processes, through a co-operational involvement, which aims to create shared engagements and responsibilities, ensuring the singling out of real matters as well as feasible solutions, eliminating the possible conflicts related to "management".

Even if the mentioned bottom-up shared approach it is considered important in relation to the environmental management, it is necessary that national and regional policies establish the goals as

² The paper is a partial result of a research project financed by MIUR (ex 40%) and titled "Sustainable development and quality of life in urban areas of eastern Sicily" while "Urban ecosystem: the good practises for the governance of urban sustainability and consistent development" is the national research project coordinated by Tullio D'Aponte, University of Naples "Federico II".

³ The position of the coast, for its nature, is subjected to variations, mainly caused by erosion and sediment accumulation. It characterise coastal dynamics and must be taken into account when planning coastal installation.

well as investments plans and strategies related to the usage of the coast and their natural resources (Cirelli, Mercatanti and Porto, 2003).

2. The Iblea North Eastern coast of Sicily

The Sicilian coastal environment, as well as many other areas in the Mediterranean, has undergone deep changes that heavily influenced the environmental alteration. Drainage intervention, intensive cultivation, demographic concentration caused by not regulated urbanisation, development of road infrastructures, concentration of highly polluted industrial areas, and a more recent development of tourist infrastructures, have determined unsustainable impact.

The uses of the environment, very often contrasting one another, have lead to a general impoverishment of the environment as well as an enormous risk for the population health, damaging their quality of life (Calabrò, 1957; Barilaro, 1992).

A pivotal role in the impoverishment of the environment has to be ascribed to the development of industrial areas in many peculiar and appealing bays and landscapes of the island. The industrial areas of Porto Empedocle, Gela, Milazzo and Priolo Gargallo, born in the second half of the XX century and based on the model of the *growth pole theory* of François Perroux (1955), have deeply transformed the landscape characteristics as well as the social-economic structures existing in the areas (Ruggiero, 1972; Scrofani, 1998). From a certain point of view spreading of industrial plants in the southern part of Italy is the direct result of equivocal and contradictory compromises between politician urgency to run away from the backwardness of the country and the necessity of private investors to strategically localise industrial plants (Cristaudo, 1981).

Even if in southern Italy the industrialisation represents one of the most important phenomenon of the post-war period, having brightened the economy, the absence of adequate planning led to problems that the areas were not able to sustain. Nowadays industrial areas are under accusation of contributing to the creation of the “refuse society”, mainly caused by impoverishment of the environment, defilement of water, pollution of land and air.

A clear understanding of the situation can be verified in the coastal tract going from the river St. Leonardo (natural border between Syracuse and Catania) to Syracuse.

A problematical area represents the region of major concentration of industrial establishment in Sicily, adding to the unsustainable load the seismic vulnerability of the area, many times epicentre of ruinous earthquake and tidal waves⁴ (Di Blasi, 2000).

The industrial plants have been set in line in a long tract, the Piana of Megara, on the coastline going from the gulf of Augusta to Capo St. Panagia. In the Megarese coast the settling down of large refinery and chemical, petrochemical, thermo-electrical and construction plants have determined substantial alteration of the landscape. The view results surrealistic, made of pipes, boilers, tanks, spherical and cylindrical, iron towers of refineries, smoke stack of chemical plants and large landing-stage (Pecora, 1974, pp. 344-349). The landscape was completely different from the one described by Giuseppe Tomasi di Lampedusa in his tale “La Sirena”, in which the salt-flats come forward in the Augusta bay “... in quel golfettino interno, più in su di Punta Izzo [...] è il più bel posto della Sicilia. La costa è selvaggia [...] completamente deserta, non si vede neppure una casa; il mare è colore dei pavoni; e proprio di fronte, al di là di queste onde cangianti, sale l’Etna; da nessun altro posto è bello come da lì, calmo, possente, davvero divino” (Tomasi di Lampedusa, 1961).

The land presents its own geomorphologic characteristics with a tract of coast presenting steep cliffs (Capo St. Panagia, north of Syracuse and Capo Murro di Porco, south of Syracuse), little peninsulas (such as the Augusta ones, Thapsos and Ortigia), with ramification of fiords, beside

⁴ The Malteo Iblese fault plane causes strongly earthquakes in this area.

shining sandy shores, creating gulfs and bays, succeeding each other⁵ (Cirelli, Mercatanti and Porto, 2003).

Proceeding towards the inland part, marine wharf have been created where superficial ideography, constructed from the erosion evolve caves, parallel to the coast line, with a wavelike form pushed up against the inner part of the Ibleo plateau⁶.

Natural characteristics as well as the historical and economical events in this land justify population settling down and permanence in the past decades (Ruggiero, 1975).

The coastal areas, until the first half of the last century, has been characterized by diffuse agriculture (mainly related to citrus, almonds and grapes growing); later large alteration of use have been experienced, caused by the intense coastal urbanization related to the fast growing phenomenon of the second home, as well as the consequent illegal constructions and the concentration of industrial plants, mainly developed in the coastline going from Augusta to Syracuse for approximately 30 Km.

The site choice, has influenced by favourable harbour orography as well as the strategic position given by the route of the materials through the Mediterranean, public funds have also had a pivotal role helping large enterprises (Pireddu, 1994).

The industrialization process, started in this area in 1949 with the major installation of the first plant of the Ra.Si.O.M. (Raffineria Siciliana Olii Minerali) processing raw materials, even if it opened eastern Sicily to renewal after the second world war while revising the economy and infrastructures, that has caused environmental damage in most cases not reversible⁷ (Maiorca, 2001).

The industrial area has become in a few years the most important in Sicily, and one of the most important in Italy. Plants which were first only located in the coastal area were expanding towards the inland of the country, designing the so-called *industrial triangle*⁸ Augusta-Melilli-Priolo Gargallo. The immediate and tangible effects of the industrial boom, which was enormous and not planned at all, have been environmental transformation, modification of the population life style as well as demographic growth of the nearby areas. As a consequence the employees migration, resulted in decline of primary activities. New industrial plants have favoured the permanent movement of employees and their families in the plants nearby, also creating the phenomenon of commuters (Ruggiero, 1975, pp. 34-35).

The Megara industrial plant has awaken not only Syracuse but also nearby towns such as Augusta, Priolo Gargallo, Melilli, Sortino and Floridia. The marine traffic created by the industrial plants has transformed Augusta from a little commercial port and military base to one of the most important trade port of the Mediterranean (Ruggiero, 1972). The major demographic increase was experienced in Priolo Gargallo, a little town between Augusta and Syracuse, which became the principal centre of industrialization. From 1951 to 1981, Priolo Gargallo has experienced a demographic growth of the 139% (Barilaro, 1992) becoming in 1979 an independent municipality⁹.

⁵ From a geologic and morphologic point of view the examined area is localised in the Iblean site, which constitutes a wise stable area, it was not strained from the orogenesis and involved in many systems of normal fault oriented NE-SW; to the west Scoglitti-Agnone ones and to the north Sigona Grande-Reitano ones (Cosentino *et alii*, 1982, pp. 180-181). Parallely those faults has developed a system of *horst and graben*, major importance has the Sigona Grande-Reitano and Agnone horst and the Scordia-Lentini graben. On the mentioned fault system have been created barrier reef (so-called "falesie"), that, destructed from erosion, nowadays moved subsided from the sea, resulting in the most relevant morphologic element of the costal areas. Unbroken slope of a calcareus nature are founded in the nearby of Villasmundo toward the southern part of Monti Climiti through Melilli e behind Priolo Gargallo (Carbone *et alii*, 1982).

⁶ A vast number of caves have been adapted to habitation from prehistory times or used as necropolis, the most famous is the one of the city of Pantalica (Pecora, 1974, p.26).

⁷ Angelo Moratti built the Ra.Si.O.M. in Augusta. The choice of Augusta was determined by the fact that the area was flat, on the route Suez-Gibilterra where the major traffic of raw material was recorded, mainly coming from Russia and the Middle east, by the presence of the natural harbour and the copiousness of low cost labours as well as the possibilities of utilising the subterranean reservoirs and the Navy wharf, employed during the second world war.

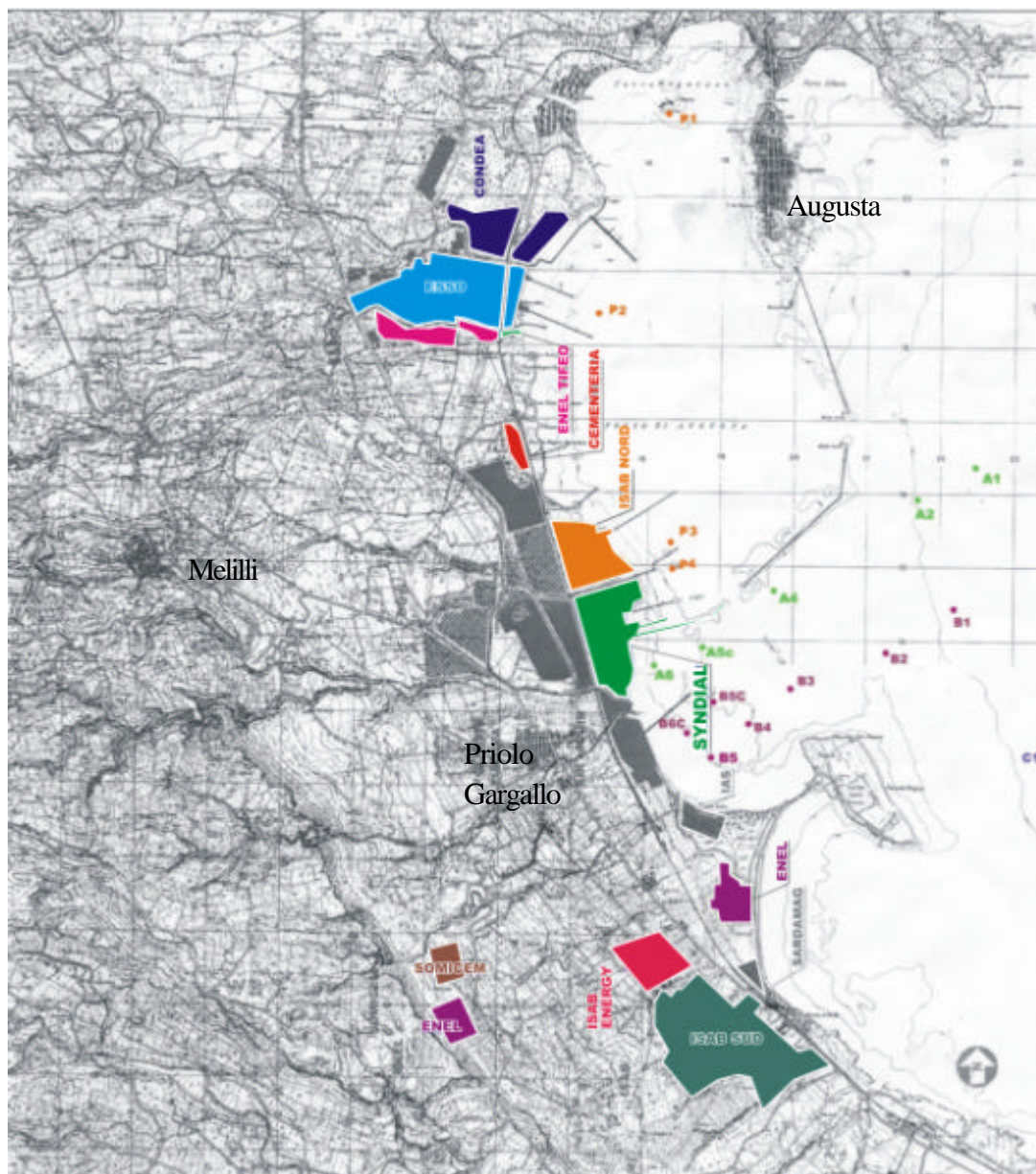
⁸ Today called *dammned triangle* due to its high percentage of neoplastic pathologies and congenital birth defects verified in the area. For further deepening Sciacca *et alii*, 2003.

⁹ While the results of 1991 and 2001 ISTAT census of population indicate stationariness.

The harbour complex, composed by the Augusta, Priolo Gargallo and St. Panagia calls, moves raw materials and tankers for the 20% of the national share (more than 46 thousands of tons of oil and more than 2.700 oil tankers) (Scrofani, 1998).

The Megara industrial area occupy a surface of 44 Km², and is composed by eight agglomerates, hosting 70 enterprises (figure 1). The typology of the plants (oil refineries, production of combusted, detergent) focus on the aim of creating an integrated industrial complex. Probably the strong integration has been the main obstacle to the development and consolidation of endogenous entrepreneur initiatives.

Fig. 1 - The “industrial triangle”

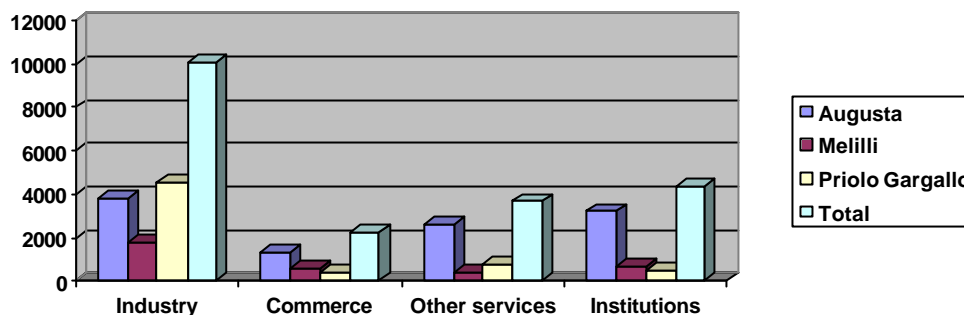


Font: Our elaboration on IGM¹⁰ map

¹⁰ Istituto Geografico Militare (Military Survey Office).

Despite the continuous loss of labour, up to today the industrial sector still represents a pivotal role, employing approximately 10.000 people, on the other hand data relating to institutional services are quite worrying, providing that the value results greater if compared to other services, meaning not balanced expansion of the tertiary industry as well as representing an index of “non development” (figure 2).

Fig. 2 - Sector employees “industrial triangle” (absolute value)



Font: Our elaboration based on 8th Industry Census, ISTAT¹¹ 2001

The phenomenon can be observed in the three towns examined, in Augusta the not equal expansion has a large growth (3.700 employees in the industrial sector, more than 3.000 employees in public administration and about 2.500 in the other services), Priolo Gargallo has been affected less than the other towns presenting a ratio of 1 to 7 between employees in the other services and industrial sector, still being an “industrial city”; even if Melilli presents a balance that is not equal between industrial sector and other services, it still maintains its agricultural vocation. In the last year they localised their large commercial distribution.

Even if it presents beautiful beaches and very peculiar sites, the smoke stacks present on the horizon, the pungent smell of the air caused by the industrial plants and water defilement do not allow the usage of the coast; perhaps in the future, when the whole area will be degraded, the archaeological industrial will be upgraded.

In November 1990 the area has been declared an environmental “high risk zone”, in particular the industrial zone of Priolo Gargallo and Augusta, ENEL¹² power plant have been listed among 50 national sites of the national programme that should undergo drainage and renewal for the environment, made by the Ministry of the Environment¹³.

The situation of the south coast is completely different. Sites such as Ognina, Eloro, Vendicari, Marzamemi, Portopalo and the isle of Capo Passero are not contaminated at all, presenting crystal clear waters and peculiar landscapes. In these areas, there are many sites of immense environmental value, i.e. protected areas. Ten in the city of Syracuse (table 1) six (written in script) located on the coast or on the coast nearby. Provided that “prendendo atto dell’obiettivo di contribuire con un migliore ambiente alla qualità della vita..., di garantire l’uso plurimo delle risorse e lo sviluppo sostenibile e di valutare gli effetti diretti ed indiretti sull’uomo..., sulle acque di superficie e sotterranee..., sul paesaggio e sull’interazione di detti fattori, sui beni materiali e sul patrimonio culturale ed ambientale” (Dpr 12/04/96) it is evident that location of plants should be decided according to environmental needs.

¹¹ Istituto Centrale di Statistica (Central Statistics Institute).

¹² Ente Nazionale per l’Energia Elettrica (National Electricity Board).

¹³ Today the industrialised area of Priolo Gargallo is one of the 50 national sites of the National Plan of reclamation issued by the Ministry of Environment.

Tab. 1 - Protected areas in the city of Syracuse

<i>Name</i>	<i>Site</i>	<i>Surface (hectares)</i>
<i>Cava Grande of Cassibile</i>	Avola, Syracuse, Noto	2.696,49
Speleological complex Villasmundo-Sant' Alfio	Melilli	71,66
<i>River Ciane and saltpan of Syracuse</i>	Syracuse	316,68
Cave "Monello"	Syracuse	59,16
Cave "Palombara"	Melilli	11,25
<i>Isle of Correnti</i>	Portopalo di Capo Passero	64,37
<i>Isle of Capo Passero</i>	Portopalo di Capo Passero	35,63
<i>Faunistic oasis of Vendicari</i>	Noto	1.512,00
Pantalica and Valle of Anapo	Sortino, Ferla, Cassaro, Buscemi	3.712,07
<i>Saltpan of Priolo Gargallo</i>	Priolo Gargallo	54,50
Total	Province of Syracuse	8.806,81

Font: Azienda Foreste Demaniali of Syracuse, 2003

In the examined sites, in order to give adequate value to the resources, sustainable tourism become a necessity. It is well known that sustainable developments, even if representing a global problem, can be pursued as an objective if only it is localized, provided that intervention must be adapted to resources as well as potential and geographical context (Cencini, 1999; Porto, 2002).

3. Systematic vulnerability connected by natural risk in the "industrial triangle"

The particular geologic and geomorphologic structure of the soil results in high environmental risks, for instance seismic and hydro-geologic risk. The mentioned risks are completely ignored by environmental management, also favouring the anthropologization of the area with the localization of petrochemicals and the consequent growth of urban cities, exceeding their population capacity.

Provided that plants cannot exist without *risk factors*, they must be developed coexisting with natural and anthropic disaster. The limits of acceptable risk are regulated by *laws* and by population *habits*, as a consequence, even if the risks are not deeply understood, they must be included and considered in environmental planning.

Risk, is composed by two factors: *danger* and *damage*. Obviously there is no risk without damage, being strictly related to men and their activities. Even the so-called "natural risks", are not really natural, being related and generated from men (Villari, 1997). Summarising, natural risk exist because the happening of natural phenomenon (earthquakes, volcano eruptions, floods, landslides...) cause damages to people and structures made by men in a specific geographic area.

Evaluate risk means taking into account the *functional* characteristics that the social-economic system has developed in the specific area during many years; as a consequence it must be taken into account the urban structure as well as the social-cultural relations, with the main aim of restarting the system after the phenomenon in the shortest period possible.

In order to completely examine the risk of a specific system the vulnerability must be considered (deriving from the Latin word *vulnus*, which means "wound"), it means the incapacity of the system to withhold the exterior stress exceeding a certain level, called "soglia di vulnerabilità/ level of vulnerability" (Santojanni, 1996). The first aim for cautious environmental planning is to understand the factors which may influence the level of vulnerability; those factors

present five aspects: density and distribution of population, display of goods, economic structure, social organization and planning choices.

The analysis of vulnerability do not have to be limited to one single element that can be damaged by the phenomenon but have to be defined by all the effects, provoked by the single element damage, on the systems they belong to. Vulnerability is then the sum of *direct vulnerability* (tendency of physical elements to be damaged: wharf, road, building...), *indirect* (state of crisis experienced by a system in case of its elements are damaged: transportation, information and networks has been blocked) and *postponed vulnerability* (blocking or slowing down of activities in the medium and long term after the phenomenon, causing negative effects on the population: unemployment, reduction of salaries...) (Pinna, 2002).

Vulnerability will be less in those risky areas in which citizen are aware of the consequences of the problems, thus resulting in an adequate policy of safeguarding of the environment, based on the evaluation of costs and benefits, and the importance of protecting human lives and environment.

Assuming it is an initial hypothesis that the society considers urgent to decrease risk, many strategies are feasible.

The first strategy aims to maximise the level of risk reduction, accounting on technology and disposable funds, the high exploitation of resources results in a non feasible solution for a global planning dedicated to the public security.

The second strategy assumes that certain level of risk are acceptable in society, it is then important to determine which risks are acceptable, to equalize the exploitation of private and public resources, reaching a high level of risk reduction in order to make them acceptable for the population.

The third strategy tries to stabilize the acceptable level of risk for every unit of marginal expense. Expenses stop when the increasing reduction of risk is smaller that there is no further expenses. In this case, it is important to evaluate the danger, in terms of possible effects, on the basis of the costs necessary for their reduction.

The fourth strategy, is based on the existing proportion between tolerance of loss and benefits achieved by activities related to the risk (Alexander, 1990).

Summarising, the *seismic risk* is the connection between the natural phenomenon "earthquake" and the economic parameter related to the value of the inhabited environment. In other words, risky areas without inhabited towns or important investments (from an economic point of view) have a seismic risk which is zero, while low risk areas with an high density of population have high seismic risk.

The above considerations allow a complete vision of the concept of risk, enabling considerations on the Ibleo environment, which resulted complex in terms of level of risk, economic, social and cultural structure. The seismic origin of the Iblean area is the result of the interaction between the border of the north African and the Eurasiatic one (Cosentino *et alii*, 1982, pp. 180-181); when the tension accumulated between rocks arises above their resistance, producing a fault and causing a slide of two blocks along the fault plane, the enormous amount of energy first kept is rapidly liberated as seismic waves, through the earth crust reaching the surface. The starting point of a fault enucleation is called *ipocentre* and its projection on the surface is the *epicentre*¹⁴.

¹⁴ The strength of earthquakes is evaluated according to two different criteria: *seismic intensity* and *magnitude*.

Intensity is evaluated on the basis of a descriptive scale which is measuring the degree of damage of the structures, soil disorder and animals reaction; it does not depend on soil movement but on observation of effects on the epicentral area. This is a qualitative observation, considered important because in certain large seismic areas do not exist seismograph able to measure violent movement in addition the history of earthquake is mainly based on this kind of description. The measurement scale commonly used are Mercalli - Cancani - Sieberg (MCS) and Medvedev - Sponheuer - Karnik (MKS), with degrees going from 1 to 12.

If we intend to measure the greatness of earthquakes in any part of the world, it is necessary to use type of measurement not depending on density of population or typology of constructions; it will then be necessary to use a quantitative scale, that can be used in both inhabited and isolated places. The criteria, studied by Charles Richter, is magnitude, which gives the right dimension of earthquake energy liberated at the ipocentre.

In the examined area the seismic factor is the result of the activity of the tectonic alignment of the Ibleo-Maltese slope, situated off the Ionic coast, it is characterised by a seismic style presenting phenomenon of huge magnitude ($M > 7$) and deep ipocentre; the phenomenon are widely diffuse and occur after long period of scarce seismic activity (the return time is hundreds years).

It is well known the earthquake of the 11th of January 1693, in Val di Noto (X degree of the Mercalli scale), affecting the south eastern side of the island as well as the earthquake of December 1990 (so-called “earthquake of St. Lucia”) with the epicentre in the Augusta area (table 2).

Moreover in 1693 15 metres waves destroyed ships and vessels in the port of Augusta. Even if dealing with small fishing boats and vessels, this shows that in the area tidal waves (the Japanese *tsunami*) exist, it is an earthquake with its ipocentre in the sea that generates waves with massive length and height (tens and hundreds of kilometres). The wave of tidal waves can travel at a speed of 700/800 km/h for thousands of km without modifying their energy, smashing very violently the coastline, even if it is very far from the origin. The *tsunami* waves, closed to the coastline, decrease the speed at the same time increasing the height, reaching heights of tens of metres when smashing on the coastline, and when the waves backwash take along with them what encountered¹⁵.

Tab. 2 -Tidal waves in Sicily from 1169 to today

Site	Year
Stromboli	2001
Augusta	1990
Stromboli	1954
Eolie	1944
Stromboli	1930
Salina (Eolie)	1926
Stromboli	1919
Stromboli	1916
Messina – Reggio Calabria	1908
Cefalù	1823
Catania	1818
Sciacca	1817
Straits of Messina	1784
Sciacca	1727
Palermo	1726
Augusta (11 th January)	1693
Augusta (9 th January)	1693
Messina	1649
Naso (Messina)	1613
East coast	1329
Messina	1169

Font: Procenzano, 2005, p. 100; our elaboration

The industrial plants presence, in particular the petrochemical, as well as the huge urbanization, as a result of an exponential demographic growth, have increased the possibilities of risk connected to further natural phenomenon, such as flood.

The hydro-graphic system is not well regulated, few rivers are torrent-like rivers with little seasonal floods, mainly in autumn and winter. Rivers are Marcellino, Mulinello, Cantera; of smallest importance Cava Mostroingiano, Cava Sorciara and Porcaria.

Floods are related to the characteristics of torrent-like rivers, which vary from shallow water to floods, with strong intensity and lasting for a limited amount of time, also emphasized by human

¹⁵ Nowadays the port of Augusta hosts naval ship as well as oil tankers, and fishing boat. There is an industrial zone in the coastline. Not very many people are aware that in November 2002 a ‘marigraph’ has been placed on the sea floor 15 miles off Augusta, it should advise possible occurring tidal wave. How could we be advised provided that there is no alarm system?

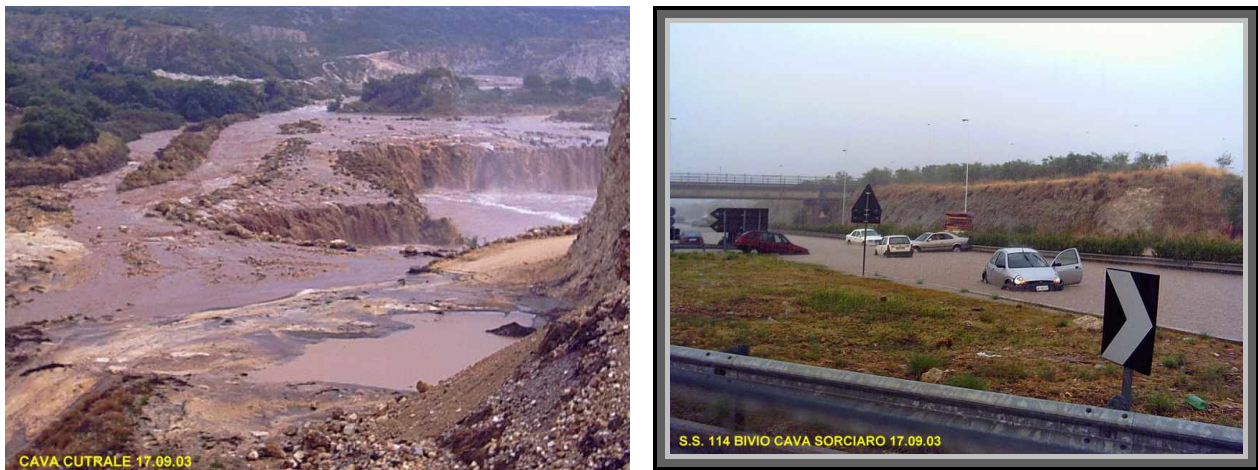
actions: deforestation, excessive loading, scarce maintenance of canals, cementation of river-beds due to construction expansion. The latter disorder the hydro-geological balance of the fluvial environment, and the brook waters are diverted from canals.

Even if the time of catastrophic floods return in the area are evaluated in a 100 years, they can be observed as phenomenon of a certain importance, possibly they will not present catastrophic dimensions, but surely have occurred very frequently in the last 50 years, for instance the cloudburst of the 17th September 2003 (figure 3). A prevention planning should achieve a free zone between canals and men activities.

The carbonate rocks of the Ibleo plateau for their peculiar hydro-geological characteristics, permeability and storing capacity, constitutes an important water layer, necessary for the community.

The large underground catchment basin, in the town halls of Augusta, Priolo Gargallo and Melilli, is composed by many water wells for domestic uses, whereas the main exploitation of the basin derives from industrial activities. In a few years the quantity has been worn out being that the uses exceeded supplies, diminishing water level;

Fig. 3 - Flood 17th September 2003



Font: www.comune.priologargallo.it

Between Augusta and Priolo Gargallo, the water decreases more than 100 metres. The worn out process along the coastline not only has impoverished the water layer but has also increased the amount of seawater (saline intrusion) with the consequent deterioration of the quality of potable water.

The bwering of water has been listed as one of the fundamental problem of the area at risk of Augusta-Priolo Gargallo-Melilli, which is already included in the triennial plan of the Ministry of the Environment approved by the *Committee of Ministers for Economic Planning* the 3rd of August 1990.

A further natural phenomenon that would strongly increase the vulnerability of the restricted area is strictly related to the exploitation of the water layer, it is called *subsidence*, which means the lowering of the topographic surface, sometimes ascribed to natural causes; but very frequently depending on men power (induced subsidence), with more rapid effects¹⁶. The complete absence of official data and recent bibliography does not allow to evaluate the topic in this context.

¹⁶ The principal anthropic causes consist of a) excessive water worn out from underground basins, b) extraction of hydrocarbon from geological porous formations which become solid, c) large loads for the constructions of urban and industrial centres, and infrastructure.

In order to have a systematic evaluation of the vulnerability, fundamental characteristic of the Megarese area, it is essential to comprehend the anthropic load while quantifying the effects; mainly considering an eventual environmental crisis and the effects it could lead to, in relation to the land and the surrounding air.

The crisis effects would affect the towns of the Megarese area (Augusta, Priolo Gargallo and Melilli) and the surrounding towns (Syracuse, Floridia and Solarino) for a total surface of approximately 546 km², which represents a quarter of the total province; in the area, lives more than half of the entire population of the province (more than 200.000 inhabitants, 120.000 of which are in the city of Syracuse) with a very high density (table 3).

Tab. 3 - The resident population and density in the Province of Syracuse (2001)

Municipality (Province of Syracuse)	Population			Population density
	MF	M	F	
Augusta	33.466	16.457	17.009	306,1
Avola	31.080	15.242	15.838	418,5
Buccheri	2.320	1.103	1.217	40,4
Buscemi	1.200	591	609	23,3
Canicattini Bagni	7.510	3.568	3.942	497,0
Carlentini	16.840	8.192	8.648	106,6
Cassaro	909	432	477	46,9
Ferla	2.759	1.366	1.393	111,4
Floridia	20.803	10.260	10.543	793,4
Francofonte	13.097	6.337	6.760	177,1
Lentini	23.711	11.493	12.218	109,9
Melilli	12.202	6.131	6.071	89,7
Noto	22.971	11.255	11.716	41,7
Pachino	21.048	10.277	10.771	417,0
Palazzolo Acreide	9.109	4.300	4.809	105,5
Portopalo di Capo Passero	3.500	1.786	1.714	235,4
Priolo Gargallo	11.752	5.911	5.841	204,1
Rosolini	19.920	9.844	10.076	261,6
Syracuse	121.000	58.958	62.042	592,9
Solarino	7.232	3.552	3.680	555,9
Sortino	9.086	4.482	4.604	97,5
Total	391.515	191.537	199.978	185,7

Fonte: ISTAT Census 2001; our elaboration

It is then important to underline the role of the planner, which represents the person in charge of organising the territory taking into account its weaknesses. Among the duties of the planner creating risk prevention measures, stabilising damages after the occurring of events. A further duty relates to the reduction of environmental risk, with the high cost involved, the planner should be able to manage the expenses wisely in terms of prevention and forecast¹⁷. The realization of the latter is mainly introduced by the national policy of “Servizio Nazionale” of Civil Defence, for the

¹⁷ Prevention interventions consist of studies and determination of phenomenon causes, identification of risks and limiting the zone affected. Prevention interventions, aims to avoid and decrease the possibility and/or the consequences of disastrous events in a specific area, on the basis of acquired knowledge deriving from the forecasting. In relation to the seismic risk intervention relates to three levels: 1) information and training of inhabitants; 2) emergency structures; 3) regulated constructions against seismic events (Iliceto *et alii*, 2002, p.16).

law 225/1992 “al fine di tutelare l'integrità della vita, gli insediamenti e l'ambiente da danni o dal pericolo di danni derivanti da calamità naturali”.

The situation of environmental risk, has been certainly worsened by human activities. It is inevitable that a rural society that shifted to industrialisation, increases its vulnerability, but on the other hand it is impossible to deny that the excessive level reached depends on men activities, mainly caused by irrational uses of the soil, in the years '50-'60.

The strong expansion, the exploitation of coastal areas, the urbanization of vast areas as well industrial plants has strongly increased the exposition to disastrous events.

High grade of social-systematic vulnerability, in the sense of scarce power of events able to alter the social environmental system. The risk evaluation, has to take into consideration the functional characteristics that the territory has developed over the years; which means considering urbanised soil (distribution of plants, construction typology) economic relations (distribution of economic activities and infrastructures) and cultural (urban elements with an historical value, archaeological sites and all the other site not renewable to their value), aiming to restart the system in the shortest time possible after the event occur (Cirelli, Di Blasi and Porto, 2004).

For every element that is monitored from the scientific community, must correspond a correct programme of territorial planning and different urban constraints; Those also constitute the basis for intervention for prevention and protection against risk, in order to provide satisfactory response to public security and territorial development.

In the past the resolution of environmental problems has preferred certain choices, paying attention to technical or political-administrative reasons rather than environmental, creating a model of development and usage of the environment in which the planning instruments were modified according to interests. It is hoped that the actual tendency may lead to prevention not only in relation to disasters but also in terms of planning and resource management.

Planning programme co-existing with risk become urgent when related to industrial plants of great importance for regional and national economy.

The danger level in the area is not satisfactory when compared to the urban planning so far adopted; in theory, knowing the risk lead to the automatic revision of the existing planning programmes, adapting them on seismic zoning, reality is nowadays quite far from theory.

It becomes essential to act efficiently and immediately in relation to “anti seismic” transforming of constructions and operational making of emergency plans not only involving the municipality, to be integrated in a single system ready to issue emergency plans to cope with industrial risk in every plant (for instance inflammability in petrochemical plants). The largest can be integrated to “small urban communities” with high population density.

“Acceptance of risk” means creating a fair relation between economic benefits and respect of cultural and environmental value. It must be also considered those factors affecting the population psychology, in addition real factors such as the risk of economic activities loss, employment loss and so on; in this way the application of efficient prevention policies, sometimes not accepted from the population, push the population to be informed about the their risk¹⁸.

Information about natural risks, causes and effects, represents the preliminary introduction for operating valid planning policies, in order to define prevention policies and the territorial organising for the Civil Defence.

“Risk perception” and “risk awareness” are fundamental factors for a diffuse intervention culture, they must be spread by educational institutes, local and regional bureaux. They represent an essential introduction for the realisation of risk reduction and relaxed integration (Cirelli, Di Blasi and Porto, 2004), also preparing the population to possible emergency situation.

¹⁸ This attitude is called “Cassandra syndrome” referring to mythology, having she refused Apollo love, she has been damned to forecast future events without being believed (Santoian, 1996).

4. Water defilement, air and soil pollution in the industrial triangle of Augusta-Priolo Gargallo-Melilli

The mining and manufacturing activities have always cause pollution, even cities, in the sense of agglomerates of human being, have produced garbage, spreading throughout the environment in large quantities, as a consequence pollution was already present previously to the industrialised society.

It is difficult to provide an exact definition of pollution, being a concept in permanent evolution rather than a static concept. Human knowledge of the environment not always represents dangerous form of pollution. In addition pollution does not mean introducing “not natural” substances in the environment.

A British scientist, Weale defines pollution in such way: “pollution means introducing into the environment substances able to damage or compromise human health, the environment itself and the built environment. Such substances are not always produced by men. There is pollution present when substances are introduced in large quantities enabling to contrast or diminish the natural purification” (Weale, 1992).

Pollution in large industrial towns is a well known phenomenon from ‘800, for instance Great Britain, the north eastern part of United States, German Ruhr; high smoke-stake, symbol of industrialisation in the past, were used in order to spread gases and scum into the air far from the plant, reducing toxicity. The growth of industrial plants and power plant after the second world war has determined vast emission of gas and scum, added to car emission and urban warming (Manzi, 2002).

Examining grade of pollution through emission methods gives clarity to global and local effects.

The industrial area is located in the south east of Sicily, on the Mediterranean sea through the port of Augusta. The area is peculiar on account of a vast number of landing-stage along the coastline also outside the port infrastructure.

In order to afford detailed studies on the evaluation of the environment, it is needed to include the chemical and petrochemical issue, which has strongly influenced the actual environmental situation. The industrial Megarese area is mainly composed by petrochemical plants and refineries; it covers a surface of 44 Km². It represents the largest Sicilian complex also being one of the largest in southern and central Italy. In the area are also located many companies operating services and maintenance of plants. The most important plants are (in terms of employment and environmental impact): two ENEL power plants, ESSO, ISAB and AGIP refinery. ENICHEM Priolo and CONDEA Augusta, SARDAMAG and at last Cementeria of Augusta. The ENEL plant in Priolo Gargallo, comprehends an area of 100 hectares with two twin sectors. The TIFEI power plant with 15 hectares and three twin sectors. The two power plants comprehend 900 units, their polluted substances are continuously spread in the atmosphere and are mainly constituted by nitrogen and sulphur oxide and dust.

The Italian ESSO refinery, also located in Augusta and Melilli, presents a surface of 280 hectares with 800 employees. Also in this area substances produced are nitrogen and sulphur oxide and hydrocarbon. The ISAB refinery, now ERG Petroli S.p.A., located in Priolo Gargallo, Melilli, Syracuse, presents an extension of 400 hectares with 700 units; residual emission are continuous and mainly composed by fuel gas; with relevant dispersion of nitrogen and sulphur oxide as well as dust.

The PRAOIL-AGIP Petroli located in Priolo Gargallo, Melilli and Augusta, employing 1.000 people, is constituted by a refinery unit and a production unit for aromatic products as well as a production unit for power (for their own use). The plant produces huge quantity of sulphur dioxide and nitrogen oxide; in addition the peculiar rock system of the plant facilitate the emission of hydrocarbons and sulphured compounds.

The petrochemical plant ENICHEM Priolo located in Priolo Gargallo, Melilli and Augusta presents three Km² with 1.350 employees. The plant is divided into two sectors: the artificial fertilizer area and the production of ammonia, in which logistic services as well as reception and distribution of fertilizer take place. The ENICHEM plant produces a large quantity of organic substances, chloride and hydrochloric acid. Moreover annual emission of nitrogen oxide, sulphur dioxide and carbon monoxide are huge. The plant also produces little quantity but still relevant of chlorine and mercury. The pollution created is enormously dangerous because harmful substances are inhaled.

Since many year authorities have forbidden the traffic during certain business hours during the day when an high level of toxicity is reached, exceeding the allowed limits.

The air pollution of the Augusta area is totally determined and caused by industrial plants; the amount of pollution deriving from urban activities (traffic and warming) is of no value when compared to the industrial activities. The most relevant contribution is given by emission of sulfur dioxide (SO₂), total dust and organic volatile compounds from the petrochemical plants while the carbon monoxide is mainly to be ascribed to traffic in the south part of the area. Plants have been involved in the reclamation of the area, since then the emission has been diminished. At the moment the legal limit imposed are respected in relation to most harmful compounds, even if monitoring system is not completely reliable.

Monitoring is realised by a system installed by the Hygiene Laboratory and Chemical Prophylaxis (LIP) of Syracuse and ENEL, controlling air quality in the industrial area.

In Italy, the first laws regarding pollution are dated 13th of July 1966, law 615, representing the first attempt to regulate the complicated environmental issues. The law 615 regional institutes against atmosphere pollution are created, in Sicily the regional law n. 39/1977, for the environment protection and against pollution.

It is possible to divide primary and secondary polluting substances. Primary gas have direct action on the human health, secondary ones (nitrogen dioxide and Ozone) are the result of reactions between primary, or between primary and components of the atmosphere. It is not possible to list harms, because of their diverse degree of toxicity. Many other factors are involved in the atmosphere pollution (www.augustaonline.it).

Not only the atmosphere but also water supply of the area is contaminated and polluted. In the industrial area the more exploited waters are the underground water, as well as superficial waters and recovered waters from water purifier; in order to cool the plants sea water is also used. As mentioned earlier the exploitation of underground water resources has determined the lowering of water level allowing the entrance of sea water and consequently increasing chlorine percentage, mostly in the coast nearby.

Levels of water pollution causes concern in the tract harbour of Augusta and the joint coast of Priolo Gargallo; coastal water pollution is caused by: waste of plants collected in the IAS depurator discharging in the sea nearby the Penisola Magnisi; discharging of cooling waters (thermal pollution), port activities, charging and discharging of ships off the port (hydrocarbon pollution). (Piano di Risanamento Ambientale, 1995). Water have different usage, mostly primary needs and also needs related to human activities. In this sense, "water is compared to oil in the third millennium" as stated by the World Health Organization (WHO), forecasting in the new millennium water shortage becoming a serious problem (Clasadonte *et alii*, 2005).

Rapid and scarcely controlled evolution of the Megarese area has created problems that up to that point were not known at all: chaotic and not planned development of the area surrounding the plants, as well as the nearby cities such as Augusta, Melilli, Priolo Gargallo, Syracuse and Sortino. In the Megarese area water pollution is also determined by discharging in waters and soil scum and waste from petrochemical as well as chemical plant. Discharging of fertilizing chemicals scum, in the sea and the rivers increased the phenomenon of eutrophication, which relates to the growing of marine vegetation.

Progressive intensification of human activities and the consequent enlarging of cities and industries, amplify the use of artificial fertilizers and detergents contributing to increase the pollution load and the modification of natural conditions (Dagradi, 1995).

Urban growth amplified the first problem, while many cities have large depuration plant, Melilli, Augusta and Priolo Gargallo are not equipped in this sense.

In the past year recent laws provide strict guidelines for detergent production. Agriculture and farming, are also causing discharging of huge quantity of polluted substances in rivers released from rain or artificial irrigation. Even in this case, growth of agriculture and farming, in farmland, have increased the environmental impact with polluted substances, while reducing absorption processes and natural replenish.

Public attention is very interested in industrial activities, provided that they are the main actors in water and air poisoning, and their substances are easier to be measured and detected. Depuration of industrial discharging is costly, and provided that the affected area were quite limited few measures have been taken. To be added to continuous emissions of substances, accident, with strong concentration emission, media are very keen to emphasise these kind of events; even if continuous emission called "normal" generate larger volume of pollution if compared to accidental events, less attention is given.

Other typologies of pollution are experienced around steel-plant or complex industrial plant.

Only in the last years, petrochemicals and oil plants are aware of their need for social acceptance, mainly involved by national and European policies rather than their specific desire to fix the situation with the community. They have mainly decided to apply strategies in order to fix the environmental balance, rather than adopting prevention measures.

The soil pollution is strictly related to the lack of waste discharging system. The discharging occurs through waste systems, some of them are located inside or outside the plant itself, but frequently some waste are temporarily stored when it is difficult to be released. The existing and operating waste dumps are not sufficient for the huge demand; in case intervention does not occur in the shortest term the area will be saturated with abundance of waste, it may increase the transportation of dangerous waste destinate to other plants far away, as well as increasing internal storing with negative effects (Piano di Risanamento Ambientale, 1995, pp. 174-177).

5. Health issues related to inhabitants of the Megarese area

Health is a complicated issue, when discussing large industrial plants, it does not relates to the work place but also involves the population of the surrounding areas, so-called "areas at risk". The population is in fact directly or indirectly in contact with plants residual, in the air, soil, rivers and in the sea. Winds make it difficult to limit the involved areas.

Studies of environmental problems cannot avoid an accurate analysis of the effects of industrial activities on actual and future generation, living in the surroundings of industrial plants.

Main health issues are: working accident, fire and explosion risk, illness related to chemical agents, desertification. A further issue is to determine, on the basis of statistical data, the area in which it is operated.

The health issue in industrial areas, as the environmental one, is very delicate and not well accepted: industrial groups are interested in strengthening and increasing (especially during recession) administrative authorities (from local and national ones), very often they are suspicious regarding scientific research, according to research that may influence their industrial agreement and businesses.

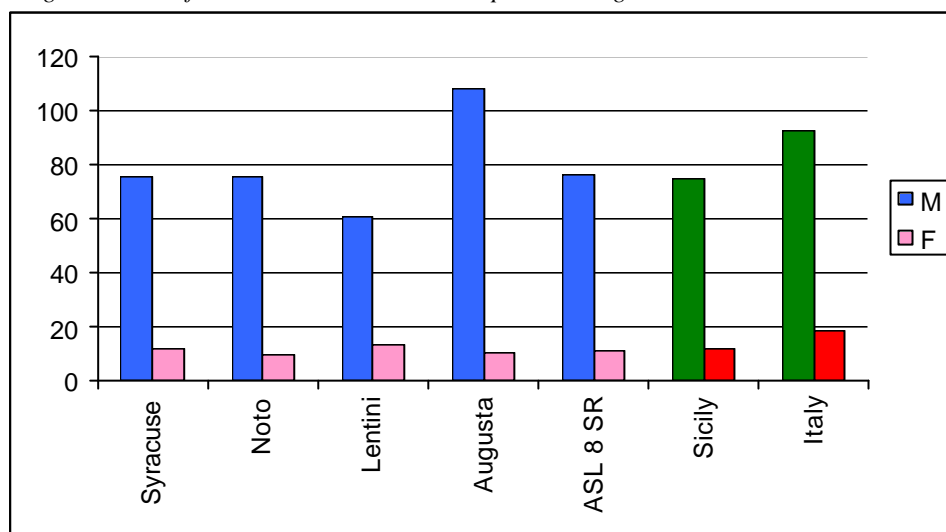
At the beginning of the 80s, after twenty years of intense industrial activities, in the triangle Augusta-Priolo Gargallo-Melilli, a case broke out, caused by a wise number of birth defects. In 1981 the Ministry of Health, in order to investigate pollution in the area, set up an inquiry with a

specific Health Commission. In the same period nineteen officers were arrested accused of omission of official documents and other proceedings. Many other Italian industrial plants are under accusation. In Europe during the same year was adopted the concept of sustainable development.

Recent studies (Sciacca *et alii*, 2003) focused their attention on the state of health of the population of Syracuse in the three years from 2000 to 2002. Analysing in particular major pathologies¹⁹ connected to exposition to risk occurring from the industrial triangle Augusta-Priolo Gargallo-Melilli.

The number of people affected by neoplasia has grown. Comparing the data of 2000-2002 with the data of the previous analysis (1995-1999), it is noticeable the growth of tumours in Augusta (figure 4) men population (+26,3% against the +7,3% in the entire province).

Fig. 4 - Cases of tumours in 2000-2002 compared to regional and national media



Font: Sciacca *et alii*, 2003

The results led to the necessity of an oncology department, so far not existing in Syracuse.

According to the *Consulta Interassociativa Italiana per la Prevenzione*, defining industrial hygiene as a “discipline interested in prevision, characterisation, evaluation and control health risk in the work environment, aiming to health and benefits of workers as well as safeguarding the population in general” (CIIP, 2001). According to the latter there are two levels of risks: for the employees and the population. Through industrial hygiene, chemical, biological and physical factors deriving from production activities are evaluated (identified as risk factors). “Industrial hygienist” is in charge of drainage, as well as being in charge of previously recognised potential dangerous factors that may affect lives of the people, and must suggest control strategies (Fizzano, 2001, p. 453).

In the Megarese area intervention has been undertaken for safeguarding population health. In 1974 the Associazione Provinciale degli Industriali has instituted the Consorzio Industriale per la Protezione dell’Ambiente (CIPA). Major industrial groups of the area have joined the CIPA, aiming to reach an equal balance between technological evolution and quality living.

The CIPA duty consist of managing control networks of harmful substances which are spread from industries. Twelve stations in the surrounding area and a Centre for data analysis (CIPA, 2002, p.11).

¹⁹ Congenital birth defects and general tumor pathology.

CIPA has a Technical Committee representing the industries belonging to the Consortium while collaborating with experts.

The twelve stations cover a surface of 300 Km², providing 65 measures related to concentrated polluted agents in the soil²⁰ and principal meteorological index²¹.

Data are then compared with further information deriving from two more networks (one belonging to Provincia Regionale of Syracuse and ENEL).

Have been stated by CPA in 2002, that started from 1994 “substantial and progressive upgrade of air quality [...] as well as concentration of monitored substances are controlled by the law” (CIPA, 2002, p. 12). The “Regione Sicilia”, with the decree 888/1993 of the Assessorato Regionale Territorio e Ambiente has defined the levels of “attention” for certain substances.

The LIP is an important member of CPA in Syracuse; belong to the Azienda Sanitaria Locale 8 also being an institution of primary importance in order to achieve institutional objectives such as environmental control and prevention.

The Laboratory is a multi-purpose instrument, able to undergo environmental controls, supporting technical-scientific performances and providing information services for the associations and private sector, lastly, able to support services to Regione Siciliana, to Provincia Regionale and local bureaux.

The intervention sectors of the LIP regards health protection. Mainly relating to waters (potable, bathing, rain), foods produced in the area, atmosphere pollution, toxic substances, radiation, soil, waste and waste dump.

Legambiente and WWF, are also located in the area mainly working towards sensitisation and information.

Environment and health should be analysed in an integrated context; even if any scientific study has yet demonstrating the relation between polluted agents which are produced by industries and population health problems, this work aims to clarify this connection.

On one hand there are reassuring analysis of CIPA, while on the other hand dramatic conclusions of the study on the “studio sulla mappa dello stato sanitario” of Syracuse. On the Internet there are lots of websites of the Environmental Protection Associations (Legambiente), on-line files relating to the triangle issues: under accusation the Megarese industrial system. In conclusion, considering that major industries of the area belonging to the CIPA, have strong economic interests, it becomes necessary to legally control industrial activities, in order to avoid risk factors (obviously related to health) to be hidden or diminished. In the last year, the introduction of new concepts such as the Total Quality Management (TQM), the operational and management system of enterprises have been modified. TQM is based on oriental philosophy of continuous improvement, also characterised by a 360 degree vision of the quality concept: quality and safety of the work place, pollution reduction. It is today considered a single integrated system made by Quality-Environment-Safety, the single elements cannot be managed and discussed separately. Prevention, continuous improvement and modernization of techniques, procedures and human resources are fundamental aspects of the system, focusing on total quality.

International rules are UNI EN ISO 9000 (quality systems), UNI EN ISO 14000 (environment management system) and BS 8800 (health management system and work place safety). They are characterised by similar point of view and the same final aim: improvement of products quality, services, environment, safety and health (table 4).

²⁰ Bioxide sulphur, benzene, hydrocarbons, hydrogen sulphurate, ozone.

²¹ Direction and speed of wind, atmospheric pressure, temperature and humidity.

Tab. 4 - Comparison between international rules

<i>System</i>	<i>Quality (Iso 9000)</i>	<i>Environment (Iso 14000)</i>	<i>Health & Safety (Bs 8800 e D. LGS. 624/1994)</i>
<i>Object</i>	Production Process. Products and services	Environmental management. Processes and environmental effects	Processes, Plants, work places
<i>Aims</i>	Improvement of production process. Client satisfaction	Environmental respect. Integrated business organisation	Safety and security of employees. Hygiene in the working place
<i>Documents</i>	Manual of quality. Procedures. Instructions. Models	Environmental manual. Procedures. Instructions. Models	Environmental manual. Procedures Instructions. Models

ISO 14000 and BS 8800 revise the concepts of ISO 9000: systematic vision, continuous improvement, pollution and risk prevention. During last years, enterprises have respected the community. This objective has been pursued through the creation of appropriate offices, undertaking controls and advertisement. It is doubted the real interests of entrepreneurs in environmental issue. Very often enterprises are suspicious in relation to request of information and data from third parts. In conclusion many of the industry intervention has only to be ascribed to strict legislation and a large attention given to the issue. Fundamental aim of an integrated system of environmental management is to improve environmental performances. The system will be planned, put into action, controlled and re-examined. The integrated system should provide the industry with environmental policies, identifying environmental aspects connected to its activities in order to determine the environmental impact, identify priorities, set objectives and react to hypothetical modification of the circumstances.

Conclusion

The presence in a restricted area, of diverse activities producing strong impacts, has caused a combination of harmful factors that added to seismic character, made of the north eastern Iblea coast an environmentally risky area. The risk is enormous and presenting many different aspects, such as the Iblean layer, and the industrial development. Sensitization for environmental issues, through eco compatible behaviours, has led companies to undergo certain procedures in order to diminish emission danger. Companies, profit dependant, must then accept the new concept for the environment.

In order to protect population health as well as biological components of the area, it is not only needed to adapt every single plant to the law, bat also it is needed to manage problems in a co-ordinated way. A type of conscious and well reasoned management, involving all actors, will be able to diminish environmental risk, in order to improve quality of life.

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