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"Salting fresh waters"
Industries, Tourism and the Environment on Tuscany's Central-Southern Coast

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Introduction

The coasts of Tuscany extend for about 400 km (not including the islands of the Tuscan archipelago). From a morphological point of view the coasts of Tuscany presents three different basic typologies: 1) Coastlines are characterized by low and sandy shores, with a low gradient and shallow waters even at a considerable distance from the coastline. These are low energy coasts, with scarce possibilities of mixing water and dispersing pollutants; 2) High coastlines with sudden considerable depths. These are high energy coasts, with a remarkable capacity of mixing and dispersing pullutants; 3) Archipelago coastlines, with absolute predominance of high rocky coasts, with very high energy.

The water catchment areas along the coastaline are crucial zones for the understanding of environmental phenomena and problems which interest the coasts of Tuscany. The six principal rivers, in fact, discharge a significant pollution load into the sea: an organic load that is equivalent to 10,075,528 inhabitants (population equivalent), 60,418 tons of nitrogen and 25,504 tons of phosphorus (Tab. 1).

Table 1 Chief rivers of Tuscany: pollution load (Year 2000)

Basin	Organic Load Population Equivalent	Nitrogen Load Ton/Year	Phosphorus Load Ton/Year
Serchio	941,152	3,569	1,164
Arno	7,477,779	34,950	13,496
Cecina	114,169	1,874	959
Cornia	78,110	1,014	478
Bruna	86,791	1,168	547
Ombrone	1,157,308	14,909	7,382
Albegna	220,219	2,934	1,478

Source: Regione Toscana, *La qualità delle acque marine costiere in Toscana*, 2010.

As to population density (Tab. 2), the maximum concentration is found in the northern sector: stretching from Carrara to Cecina – which represents only 22 per cent of the total length of the Tuscany coasts – here we find over 70 per cent of the inhabitants of the total coastal area with a medium density of over 720 inhabitants per km^2 and peaks of over 1,500 in the municipalities of Viareggio and Livorno. In the remainder of the coasts, densities amount, in the main, to a little over 120 inhabitants per km^2 (the medium density of Tuscany is around 150 inhabitants per km^2 and that of Italy, 190).

Table 2. Chief coastal Communes. Population

	Communes	Population	Density Inhab./km^2
	Livorno	161,152	1,548
Val di Cornia	Campiglia marittima	12,543	151
	Piombino	33,917	262
	San Vincenzo	6,528	198
Val di Cecina	Bibbona	3,017	46
	Castagneto Carducci	8,204	58
	Cecina	26,355	613
	Rosignano Marittimo	30,558	253
Piana di Scarlino	Scarlino	3,718	42
	Follonica	22,142	397

Source: Regione Toscana, *Piano Regionale di Azione Ambientale 2004-2006*, 2007.

The coastal areas are characterized by two major anthropogenic pressures: Industrial activity and tourism.

The coastal areas are characterized by the presence of four main industrial centres – Livorno, Piombino, Rosignano and Scarlino – which are "*critical areas*" with regard to the use of natural resources[1].

The stretch of coastline from Livorno to Piombino contains most of the heavy industry of Tuscany; the presence of big industry makes the productive system of this area different from that of the rest of Tuscany which is characterized by light industries districts and scattered industrialization. Much of the chemical, petrolchemical, iron and steel and metallurgic industries in Tuscany are found in Livorno, Rosignano and Piombino. In Livorno are located chemical, petrolchemical, mechanical and thermal power plants. In Rosignano we find the Solvay chemical plant which produces sodium carbonate, caustic soda, polyethylene. In Piombino a steel plant was established for the production of steel, steel sheets, welded tubes, and there is also a thermal power plant. In addition to the industrial area of Piombino, there are also two chemical industry plants for the production of titanium dioxide and sulfuric acid in the adjoining gulf of Follonica.

As for tourism, the municipalities of the centre-south coast boast significant annual attendance with average values ranging between 300,000 and 800,000.

Where major industries has left free stretches of coastline, there very intensive Summer tourism has developed which, in time, has caused huge changes to the morphology of the coast, generating such intense human presence often superior to the carring capacity of the area, thus contributing to the exasperation of some serious environmental problems. Such tourism is essentially oriented to bathing, concentrated both in time and territory and generating congestion on the coast by being characterized by an irrational use of space and available resources.

[1] On industrial development see: Mori 1986; Preti 1986; Becattini 1986; Irpet 1988; Pozzana 1987; Luchetti, Poli 1982; Celati, Gattini 1993 e 1995; Barberini 1985.

The excessive human presence restricted to the Summer months only along the coastline generates reperecussions not only on the natural environment, but also upsets the organization of services along the coast, which cannot answer to the demands of such great number of tourists. To this the increased demand for water and for the disposal of waste is added (in the coastal municipalities such demands doubles in Summer with respect to Winter months) the increase in car traffic aggravates air pollution and noise pollution. The gravity of the problem of a congested coastline thus emerges, along with that of an irrational planning of the territory and of its consequent deterioration.

A controversial development model: heavy industry and tourism

Industrial development

The existence of port infrastructure, the proximity of mining sites and the presence of a railway line, was conducive to the establishment of industry along the coast. Industrialization process, which here started in the second half of the nineteenth century, intensified in the early decades of the twentieth century, and then accelerated again in the Fifties and Seventies of the 1900 (the period known as the "*economic miracle*").

The process of industrialization prompted a significant repopulation of the coast. In 1861, 10 per cent of the population resided in the coastal municipalities; in 1901, 11.22 per cent; in 1951, 20.33 per cent and 23.29% in 1981.

In Livorno the first factories were built in the second half of the 19th Century: the main businesses were connected with shipbuilding, metallurgy and chemicals (glass) (Guarnieri 1962; Bettini 2004). In the Thirties of 1900, a large mechanical factory was built (the *Moto Fides Company* producing torpedoes for the Italian Royal Navy) and the first establishment of the Livorno Refinery, which gave way to the settlement of the oil industry on the coast of Tuscany. The Refinery which was completed in 1939, had a processing capacity of 1.6 million tons/year of crude oil aimed at the production of fuels (incluiding liquid gas), lubricants and paraffine. In

1954, the Refinery reached a production capacity of 3.2 million tons/year of crude oil destined to the production of fuels and lubricants. The increasing commercial demand for petroleum products promoted the expansion of the refinery, which in 1971 reached a processing capacity of 5.2 million tons/year of crude oil. Currently, the refinery is the main industrial activity in the Livorno area where there also are some chemical industries (among them a plant of Dow Italia, Italian associate of the Dow Chemical Company) and a thermal power station.

In Rosignano, the Solvay plant was established in 1916 when the production of caustic soda started. In 1957, the Solvay Group also decided to join in starting the construction of a plant for the manufacture of polyethylene, which induced Solvay to build a pier enabling the firm to receive liquid ethylene (necessary for the production of Polyethylene) at low temperature, by the sea. In 1959, Solvay decided to start the production of hydrogen peroxide, and of sodium perborate and, in 1971, of plastics. Currently the Solvay plant of Rosignano is operating in the following production units: *sodiera* (production of sodium carbonate, sodium bicarbonate, calcium chloride), *electrolysis* (the production of chlorine, hydrogen, caustic soda), *polyethylene* (resins production); *peroxidized products* (sodium peroxide, sodium perborate), *chlorinated products* (Solvay 1988; Saviane, Cresci 1988).

In Piombino, iron and steel industry was installed in 1865. After the complex events which are beyond the scope our narrative, currently the companies present in the area are Lucchini-Severstal (full-cycle steel company, the main Italian centre for the production of long sheets), the Magona d'Italia (an engineering company among the main producers of galvanized and painted metal sheets), Dalmine (galvanized pipes) and the thermal power stations administered by Ise Spa (which manages the central services located inside the Lucchini-Severstal plant) and Enel (a power plant fuelled with oil with a capacity of 1280 MW) (Panciatici 1996; Bertelli, Moretti 1989; Arrigoni, Giachi 1998; Lungonelli 1991).

A very special case is represented by the plain of Scarlino (Barducci, Casule 1982; Fuga 1996; Luzzi 2009, 129-130). For the construction of the industial area of Scarlino, part of the *padule di Scarlino* (the Scarlino Marshes) were reclaimed. These

constituted the last remaining example of such marshes as were typical of the Southern Tuscany coast. In the early Seventies, Montedison (a major industrial group, chiefly active in the chemical sector) completed the construction of a plant for the production of titanium dioxide.

The population had welcomed the plant, since it was expected to provide around 400 jobs. However, industrial production was marred at the outset by the local governments and by the Ministry of the Merchant Navy, who regarded the plant as extremely harmful to the ecosystem, since it involved the dumping at sea of processing residue (approximately 3,000 tons per day of ferrous sulfate). This situation fuelled a bitter conflict between on the one hand the firm and the workers who feared unemployment and, on the other, the local authorities supported by environmental committees.

Between 1972 and the beginning of 1974, Montedison continued to dump ferrous sulfate into the sea, by virtue of provisional permissions granted by the Livorno Harbour Authority. By 1973 the situation had become very tense: there was an attack on the ships used by Montedison for the dumping of ferrous sulfate in high seas, and violent disorders erupted even in Corsica, since ferrous sulfate reached the coasts of the French island. Furthermore, the Regional Council of Tuscany took on the matter, prompted by a question put to it by some Christian Democrat Councillors concerned about the «economic impoverishment» of the Scarlino area, in case Montedison decided to close down the plant. The controversy ended on 28 April 1974, when the Court of Livorno condemned the management of the Scarlino plant for the ecological devastation caused in the Tyrrhenian Sea.

Currently the plant for the production of tytanium dioxide is part of Huntsman's (a chemicals multinmational company) and – albeit through a rigid control protocol – it continues to employ sea water in its production processes (3,651,800 m^3/year).

Since 1962, in the plain of Scarlino also operates Solmine (today *New Solmine*), a company producing sulfuric acid (up to 1994 Solmine used mineral

pyrite, later replaced by sulfur). The processing of pyrite caused pollution due to arsenic contained in pyrite ash.

Even today, the presence of establishments for the production of titanium dioxide and suylfuric acid makes the plain of Scarlino one of the most polluted areas in Tuscany.

The development of tourist industry

Towards the end of the 19th Century, the medical world looked again at the beneficial functions of the sea air and sun: in the final glimpse of the century the spread of sand traeatment (hot sand baths) opened the way to a closer relationship of man with the beach, which only in the 20th Century began to slowly fill up with people[2].

Until the first decade of the 20th Century, beaches were lacking infrastructures and were only regarded as places where to walk. The turning point came in the Twenties and Thirties when the myth of a sun tan made the beach a focal point for bathing life. The relationship with water also changed: bathing lost its therepeutical function turning into leisure. The discovery of sunbathing caused a revolution in the turist bathing map, causing the Mediterranean coasts, already for some decades very popular for Winter tourism, to begin to attract a growing number of holidaymakers during the hottest months: for the first time these had competed with the cold coasts of the North Sea, then, within a changed cultural and aesthetic context, they won the day.

During the 20th century, the up and coming turist resorts of the Mediterranean prepared to receive entirely different guests from those of the past, since élite tourism, if retaining some prestige, it no longer represented the economic hub of such industry. In fact, in the period between the two world wars, it not only lauched the fashion of taking the sun but it witnessed the emergence of middle class tourism:

[2] On development of tourism see: Mariotti 1958; Cadorna 1994; Boyer 1997; Battilani 2001. On tourism in Tuscany see: Treves 1967; Confesercenti regionale 1984; Irpet 2001.

the main flow tourists no longer contemplated big hotels, but preferred less expensive solutions such as pensions and small hotels.

In Italy, élite seaside tourism was restricted to the Ligurian Riviera, Sorrento and the Amalfi coast, and places such as the Lido of Venice and Taormina. The growing demand of middle class tourism, gave rise to the development of a second group of bathing localities, concentrated along the north central Adriatic coast and the Tyrrhenian coast: these hosted a clientele that generally demanded less expensive accommodation, though with a degree of differences within it.

The seaside resorts of Tuscany became very popular destinations: their customers came from the upper-middle income bracket, even though there were boardinghouses for the less prosperous holidaymakers.

Between the 50s and 70s, Italy became the leading country in Europe for seaside tourism, attracting – in addition to Italian holidaymakers – 60 per cent of European tourists who decided to stay in seaside towns. Italy was able to create, first among the Mediterranean countries, a minimum level of tourist facilities which allowed to enter the market with a highly varied accommodation offer, able to satisfy all classes of income which were now discovering tourism: the number of hotels, of boardinghouses and lodgings, continued to grow decade after decade in perfect harmony with the increase in the number of tourists. In the sector of seaside tourism, therefore, Italy was a precursor (along with France), anticipating all other Mediterranean countries and conquering a leadership which remained unchallenged till the first half of the 1980s.

The other side of this success was the growth of urbanized areas along the coasts, characterized by a process of urban expansion without regulations which has ended with irreparably upsetting the coastline environment: in Tuscany too, the coastline appears disfigured by unplanned urban development, from the illegal construction of holiday homes, to the erection of great hotels built next to the beach, to the construction of yackting harbours.

The grabbing of land is a constantly growing phenomenon and is likely to further disfigure the coast (in the town of Livorno, imperemeable surfaces increase

by 0.25 km^2 each year and is equal to about 23 per cent of the total area). Land use continues unabated even in the face of the profound transformation which the tourist industry is undergoing: for example, the stretch of coastline here taken into consideration is the stage of blatant development speculation phenomena. The estate of Rimigliano, in the commune of San Vincenzo – an area of great environmental value (640 hectares), next to the coast which the Municipality has not inscribed among the protected natural areas of local interest – is the stage of an intense urban development process which contemplates the erention of hotels (about 30,500 m^2) and of holiday homes (around 17,000 m^2). Still in the municipality of San Vincenzo a new tourist port has been built, which is causing a rapid erosion of beaches to the north and south of the harbour zone.

Along the coastal area of the municipality of Castagneto Carducci 60,000 m^3 of new buildings are being costructed as holiday homes which will infringe upon the dune system of the area and on the Tombolo di Donoratico (characterized by a pine forest and by a system of sand dunes) for a total surface of little less than 800,000 m^2.

The legacy of economic development: an affected environmental situation

Over exploitation of water resources and the salinization of the water table

The coastal area is characterized by a considerable consumption of water (generally above 150 litres per person per day): for example, the requirements of Val di Cornia is 83,000 m^3/km^2 and that of the Huntsman Dioxide plant of Scarlino of about 7 million m^3/year. The total demand is thus distributed: 14.7% civil; 43.5% industrial; 41.8% agricultural[3].

From the 1970s to the present, the development of heavy industry and tourism (to a lesser degree also of intensive agriculture) along the coast has caused a

[3] On environmental problems discussed in the article see: Arpat 2001; 2005; 2007; 2008; 2009a; 2009b; Mazzoni 2001; Melley, Iozzelli 2001; Arpat 2004.

progressive increase in water consumption: water has not been obtained from surface sourses like rivers since these are of a seasonal nature and their capacity veries greatly in the course of a year, with long periods of almost total dryness. Water has been obtained by digging wells into the deep water tables of the coastal plains (in the Val di Cornia alone, the number of wells has increased from 49 in 1928 to 1,000 at the beginning of the 1990s): the overexploitation of water tables has caused considerable lowering of the piezometric level (in some areas around 10 metres lower from 1961 to 1984). The decreased pressure of freshwater has allowed the gradual infiltration of saltwater into the water table: infiltration started near the coastline has progressively advanced inland, affecting the water table utilized for agriculture and the wells of industries which had to subject the water used to lengthy and expensive desalinization processes.

The tendency to extract water from wells for all uses has caused a process of increasing aggravation in the balance between extracted water and the natural reserves of underground water. The presence of chemical, petrolchemical, mechanical and steel industries underlines a highly critical problem for what concerns the availability of water. The problem becomes even more worrying when we think that the quota utilized does not take into account water consumption in irrigation and for tourism, which is considerable.

The high inrease in human presence, which occurs in the Summer months, in tourist areas causes that during these months, water extraction from the aquifers becomes excessive thus aggravating the problem of salinization and rise of chlorides levels in water up to 1,200 mg/litre (the maximum tolerated level is 200 mg/litre).

Water pollution

The area is experiencing significant water table, rivers and sea water pollution (industries and urban areas discharge mainly at sea)

For what concerns sewers drainage, problems frequently derive from the technical inadequacy of purification plants whose effectiveness is inadequate in consideration of the magnitude of waste: this problem magnifies during the Summer

period when the the coastine is invaded by high number of tourists, and water treatment plants, sized on a magnitude of people inferior to the actual, cannot provide a satisfactory treatment of the waters which flow into them.

As to industrial pollution, the situation is made complicated by the existence of the industrial plants of Livorno, Rosignano, Piombino and Scarlino. The main problem is related to heavy metal contamination (mercury, chromium, nichel), whose presence in the water is due to industrial discharges and residues deriving from ore bodies. Mercury pollution is caused by the ores of Monte Amiata and by geothermal activity; in particular from the geothermal power plants of Piancastagnaio and Bagnore. The other relevant source of mercury contamination is represented by the industrial plants producing soda by means of mercury electrolytic cells. The most important industrial plant is that of Solvay Italy of Rosignano which utilizes mercury catodic cells for the production of chlorine, hydrogen and caustic soda: the immission of mercury into the sea has been great until 1976, but still occurs today (furthermore water contamination derives from mercury residue settled beneath the deeper marine sediments). In addition, the Solvay plant directly discharges a significant amounts of calcium carbonate and sodium chloride into the sea (the waste flow rate was estimated at about 200,000 tons/year in 2003) which are utilized in the productive processes of the Solvay soda: the result is the *white spot* that is typical of beach and sea shallow water opposite the Solvay plant.

As for chromium, sources of contamination from human activitties are mining, production of metal alloys and production of finished products containing chromium (dyes, paints, chrome plated objects).

As for nickel, the main sources of anthropogenic contamination are represented by mining, production of nickel alloys and the use of finished products containing it.

Coastal erosion

The massive pumping of water from underground water tables, intensifies the effects of subsidence which is in progress in many coastal areas. The considerable subsidence occurring in many areas represents a risk for the land adjacent to the

coast whose altitude lies at almost seal level, and it is at times even lower. Besides intensifying subsidence, human activity has contributed to aggravate erosion along the coast. The building of piers, breakwaters and other structures has generated changes in the processes of deposition of sediments, which are now causing serious erosion. To this we must add the fact that many beaches were replenished by the contributions of river estuaries rich in lime. Reclamation processes in many swampy areas and the excavation of streams – with intent to prevent flooding and for utilizing gravel and sand for building – have reduced the accumulation of sediments, causing serious erosion and a retreat of the coastline which in parts of the gulf of Follonica extends up to 200 metres, but such retreat has also reached worrying magnitudes in some stretches of the coast around Vada Marittima and Marina di Cecina.

To accentuate such erosion phenomena contributes, to a considerable extent, the human impact, which in the Summer months becomes very considerable in tourist areas: dune areas are often used for parking cars and campers, the underwood is devastated or destroyed altogether thereby exposing the soil to rapid erosion. In many areas of the coast consolidation efforts based largely on artifical beach nourishment are practiced, but the severity of the problem and possible future scenarios (furter retreat of the shoreline, flooding of past reclaimed land) make one understand that it is necessary to adopt planning policies for the territory which must carefully face a future use of the coastland, envisaging the exclusion or certain areas to development, the safeguard of dune areas and the prohibition of quarrying river beds for inert materials.

More environmental problems

In addition to the above mentioned environmental problems, there are others pressures on the environment, which cause a more or less marked deterioration of it. The industrial areas of Livorno, Rosignano and Piombino are affected by widespread air pollution caused by the emissions of industrial plants (sulphur dioxide, nitrogen oxides, particulate matter) (Comune di Piombino 1991; Commissione paritetica Comune di Piombino-ENEL 1992; Mossa Verre 2000). There is also the problem of

industrial waste (lead and granular ashes, waste water treatment plants sludges and water decarbonation sludges). The question of waste disposal is especially critical in the plain of Scarlino where the Huntsman Dioxide plant produces significant amounts of red gypsum derived from desulfurization of liquid and gaseous effluents in the production of titanium dioxide. Red gypsum is disposed of chiefly in the area of the plant and in a dump in the territory of Follonica.

The continuity, along the whole coastline, between industrial and tourist-residential urban areas means that frequently the pressures exerted by industrial establishments affects the tourist bathing areas. Think for example of the blatant effects of Solvay plant, whose activity has repercussions on the coastline area where beaches are called "bianche" (white) due to the whitening of the beach due to the discharges of the industrial plant into the water. Once again, think of the fall of dusts – the so-called "spolverino" – which issued from the steelworks of Piombino fall on the coastline with effects, which if not dangerous, surely downright unpleasant for those who happen to be there.

It happens also that industrial activity and tourism generate combined effects upon the natural resources thus exacerbating the effects which one or the other could produce in a non-combined way: the most emblematic case is the pressure on groundwater from coastline industrial plants, jointly with agriculture and with water pumping for the municipal waterworks: in Summer, when tourist activity is most fervernt, the crisis of water resources is manifested in a heightened pressure as the various factors act synergetically.

Conclusion

The model of economic development characterized by the combination of heavy industry and tourism on the coast, has generated a high density of business, settlements, infrastructure and, consequently, an overbearing human load. The development of modern industry in Livorno, Piombino, Rosignano and Scarlino drew workers from all the surrounding areas and has conveyed a lot of people on the

coast from inland, the lure of industry has joined that of beach tourism, providing good gain perspectives and employment, it has accentuated migration to the coast.

Human activity has resulted in a consumption of natural resources, the dumping of pollutants into water and air, the occupation of land and other forms of pressures which have often pushed matters beyond the load capacity of the coastal area.

During the Eighties of the 20th Century the decline of great industry began, and consequently there followed a loss of jobs and a need to divert the workforce towards other sectors. Sea bathing tourism along the coastline, too concentrated in time and space, is not only incapable of providing new jobs, but has generated such a congestion on the coast as to demand an intervention aimed at decreasing the human load in the Summer months.

The coastline demands further interventions to restore the quality of the environment generally, in the first instance reducing erosion, restricting pressure on the water table, along with the recycling of water and the restoration of its quality.

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