



Post-normal Rationality in Assessment of Environmental Damage and Environmental Risk

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Abstract. The concern about the effects of environmental pollution, due to industries, energy extraction, waste, that has been spread into the society and increase the behavioral change of citizens. The paper tells about the environmental conflict that affects South of Italy, since the '90s, starting from the pollution due to steel industry, carbon power-stations, drilling and piping gas or petroleum. The conflict arose at the highest political level of discussion, by involving political and judiciary power. The perception of risk changed among people living near the work place since a long time, but exploited in the last decade.

The paper compares the estimation of damage due to the consideration of the simple physical damage to soil and construction, and the assessment of the damage due to the change of behavior of consumers. It is a real pollution or only a simple perceived risk?

Even in judicial processes the main concern was about the solution of such economic damage, and about how to estimate with a generally accepted method the economic damage. An iconic case study is shown, regards in the first case the loss of value of rural land crossed by Total pipelines in Basilicata region.

Keywords: Devaluation · Post normal science
Environmental damage assessment

1 Introduction

The trade-off between environment and market economy is a major topic in social/environmental sciences and economics. It looks at medium-long term effects of the dissipation of resources, the unsustainable use and production of energy, the artificialization of soil and so on. When the tradeoff shifts from the counter-position between environment and market towards the counter-position between health and work, the uncertainty and the stake increase. Economists studied several approaches to limit environmental issues by taxation and incentive policies, in the traditional market, by test the consequence of increasing or decreasing profit opportunities, encourage or discourage demand, in a rational approach.

Barbier et al. [1, 2] defined the Total Economic Value (TEV) as a sum of all aspects that can be assessed by the real and potential willingness to pay added to the traditional use value. But the stake was always related with the Environment, as resource “per se”,

to be saved. The economic/environmental paradigm evolves when the dilemma about the conflict “losing environmental resource versus reduction rent”, becomes the conflict “reducing risk of health damage vs burning jobs”. In the second case «typically, facts are uncertain, values in dispute, stakes high and decisions urgent» [3]: this sentence opens the door to the Post-normality of Science. Funtowicz and Ravetz [4, 5] put on evidence the difficulty of expressing scientific evaluations in context of high environmental conflict, when the stake is so high that there is no certainty of success. The impact assessment of pollutant due to the industrial production, measured in terms of health-damage represents a a very frequent question that can considered «post-normal». Economics started studying the conflict between welfare and industrial production since a long time.

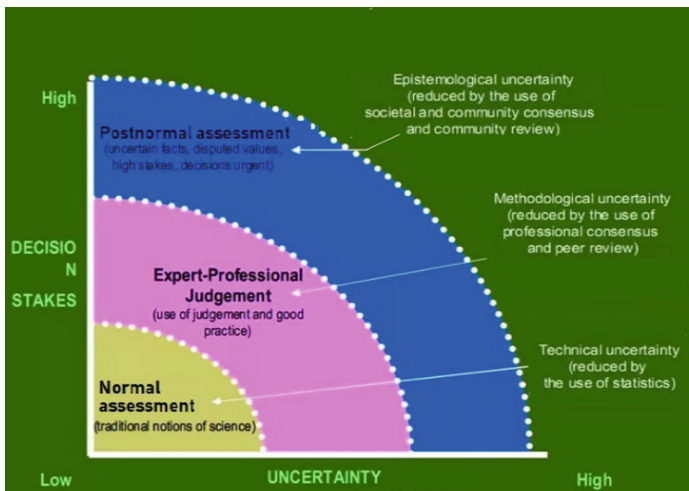


Fig. 1. Level of uncertainty in evaluations according to Funtowicz and Ravetz

Such dilemma was firstly depicted by Marx and Engels so far time ago looking at workers condition in work places; after that, it was related with pollution: the concept of NIMBY (Not In My Back Yard) Syndrome was defined looking at the unbalanced relationship between the large economic benefit of industrial production, in a global scale, and the wide health problems for neighbor communities, in the industrial districts: finally, the problem was considered at the global scale, in the light of Sustainable Development relate to the future of all humankind [6, 7] and therefore caring about all economic system supporting dangerous pollutants, from Europe to China to USA.

People now are familiar with the effects of environmental pollution, due to production systems, that has been spread into the environment and made increase the attention creating a Nimby effect. The paper tells about the environmental conflict that affected in the recent years the South of Italy, and especially the Regions Basilicata and Apulia starting from the pollution due to steel industry [8, 9], and to oil drills and piping gas or petroleum in the beginning of our millennium [10–12].

The perception of risk changed, since a long time, for people living near the work places, and exploited rapidly in the last decade. Furthermore, due to new concerns of risk, the conflict arose at the highest political level of discussion, by involving political and judiciary power. In the south of Italy more cases are on evidence, such as the damage on rural production in the lands crossed by Total pipelines in Basilicata, the depreciation of residential neighbors of on urban neighbors of the City of Taranto after the increase of diseases attributed to the toxicant coming from steel industries, the conflicts due to carbon power-stations in the southern Italy.

After some episodes of failure in the pipeline system, a request by the Environment Department of the Basilicata Region asked to ENI to check as soon as possible “the state of integrity” of the entire pipeline (for a length of about 140 km) that transports the oil from the core of “Val d’Agri” (the valley basin of the River “Agri”, near the town of Viggiano) to the refineries in the harbor of Taranto (Fig. 2).



Fig. 2. The network of oil fields and treatment centers in Basilicata, and oil refineries in Taranto, connected by oil pipelines along Agri Valley (in Italian “Val d’Agri”).

The mix between physical damages and worry for health damage open to the doubt about

1. Is there a real effect, and consequently a potential damage?
2. Is there anyway an expanded effect also on the production of farms and their activities?
3. And, in case, how to estimate the effect on the market of physical pollution and risk perception?

In judicial processes the main concern was about evidence of the loss, and to estimate with a generally accepted method the economic damage. The paper tries to describe the attribution of different gap value to soil, that produces a paradox maybe explicable with the “magnifying glass” of Post-Normal Science.

2 The Case of Devaluation of Bio-Farms Crossed by Oil Pipelines in Basilicata

2.1 The Interplay Between Agricultural Economy and Oil Drilling

Basilicata has been interested in the last twenty years by a multitude of environmental conflict after the discovery of a relevant amount of oil fields accompanied by oil-treatment centers. In addition to the 140 km of pipeline connecting oil centers with Taranto, a further develop of 500 km of pipes connects the wells of the entire area of Val d’Agri conceived for drilling with the oil center of Viggiano. The system of oil connections, finally, include the develop of oil pipelines from the oil center to the area of oil drills owned by Total and named “Tempa Rossa”, in the municipality of Corleto Perticara.

The activities of drilling and transport of oil caused several conflicts, due to the risk of loss of Hydrogen Sulfide from pipes and wells, and from treatment plants. The high point of conflict regards the Val d’Agri. Around the river basin, the most important lines across the rural land and connect the drilling points to the pipeline that runs towards the Gulf of Taranto and its Harbor, where oil is refined.

Most population of the Basin of Agri River live in small towns, with the consciousness of the potential danger due to the risk of exit of Hydrogen Sulfide (the dangerous propeller of oil) from drilling plants and pipes. In the same time the existence of oil fields provides an artificial richness to the small communities, from the mountain to the river. Great companies, like Total of the Italian ENI, pays royalties to the municipalities, fund research to the Region Council, and to the University of Basilicata. In the last years public inquiries promoted by the Courts of Justice, made reducing the support provided by Companies to Regional Authorities. In this panorama, multiple conflicts arose when the companies impose the transit of pipelines in touristic areas, and mostly, in rural farms.

2.2 The Interplay Between Agricultural Economy and Oil Drilling

A quite seminal case can be considered the justice conflict between one of the biggest Bio-agricultural Company of Basilicata (named in this paper BioagriCO), and one of the biggest French Oil company in the World (named in this paper OilCO). Even if BioagriCO was very important as Rural Company, the conflict against OilCO, it could be looking like a “David” against “Goliath”.

The conflict regarded the damage compensation due to the transit of an important oil pipeline in a bio-farm owned by BioagriCO. The product of a Bio-agricultural farm (Bio-farm) is more expansive if compared with an ordinary agri-food product. The infrastructure crossing the center of the biggest bio-farm owned by BioagriCO was

addicted to the transport of oils from the “Tempa Rossa” oil fields, the biggest in the area, posed between the municipalities of Corleto Perticara and Guardia Perticara (Fig. 1).



Fig. 3. In ocher color at right the oil field “Tempa rossa”, 5 km far from the limit of the BioagriCO properties (in green), crossed by pipelines (adjusted 3D photomaps) (Color figure online)

According to the Italian laws, Oil pipelines are not considered as simple facilities, as they are defined “Infrastructure of National Interest”. Therefore, the path of a pipeline cannot find obstacles, even when they across area of natural importance.

As pay-off, farms have the right to be re-paid for the economic damage they suffer, due to interferences between pipelines and properties. According with the Presidential Decree 327/2001, three consultants, representing the interest respectively of BioagriCO, OilCO (BioagriCO, OilCO are “dummy” names) and the Italian Government, should assess the amount of the damage repayment. Such categories of damage, are regarding the procedure of expropriation and occupation of private properties for public interest (again identified according the Presidential Decree 327/2001):

- (a) loss of property by expropriation of the soil occupied by pipelines
- (b) limitation of use in the buffer areas around pipelines
- (c) temporary soil-take during the works for the pipeline’s tunnel
- (d) permanent Reduction of the rent due to damage on production
- (e) devaluation of products rent due to risk perception of polluting pipelines

In Fig. 3 two estimates of damage categories are shown by histograms: the histogram on the back side show the monetary value of damage due to all components as estimated by BioagriCO accepted by consultants of the Italian Government; the data in histogram at front side, instead, show the assessment by the consultant of OilCO (Fig. 4).

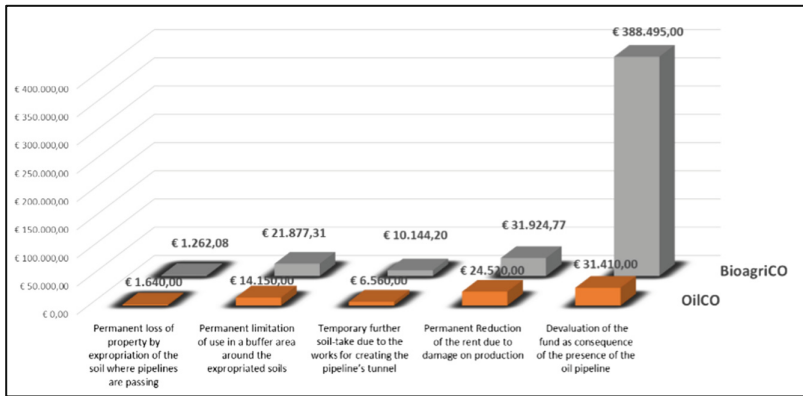


Fig. 4. Damage estimates by BioagriCO and OilCO (source: Court of Justice of Potenza)

As we can see, the main gap between the two estimates is represented by the last category of damage (Devaluation of the fund as consequence of the presence of the oil pipeline). The relevant gap between the two amounts (€ 388.495 according to BioagriCO to be compared with € 31.410 according to OilCO) is due to the different methodologic interpretation of the “devaluation” by consultants.

Consultant of BioagriCO, despite to Consultant of OilCO, considers a consistent decrease of rent from the “ex ante” condition to the “ex post” (after the installation of pipelines, and supporting security plants), by estimating a loss of productivity, mainly due to excavations and loss of crops. The estimate of annual rent, by consultants of BioagriCO and Italian Government, decrease about 5%. The measure of this loss is a diminution of capitalized rent from € 60.759.20 (with a capital rate equal to 2.5%) to € 52.802.70 (with a capital rate equal to 2.6%). Consequently, the difference

$$(\text{€ } 60.759,20 \times 2.5\%^{-1}) - (\text{€ } 52.802,70 \times 2.6\%^{-1}) = \text{€ } 388.495 \quad (1)$$

is equal to € 388.495. The rate considered by the Consultant of OilCO, instead, considers the loss only along the stripe of soil covering the pipeline is around 1% of the rent and the derived amount has the value of € 31.410.

The different rationale between estimates of BioagriCO and Italian Government against consultant of OilCO, is related with a different concept of the interference between pipelines and productive soil. The amount of 388.000 euros represent an “enlargement” of the functional damage due to a perception of a wider buffer around pipelines, that increase the unproductive area.

2.3 From Devaluation by Pipelines Intersection, to Devaluation by Risk of Pollution

The difference between the estimates of devaluation is already relevant; but there is a worse interpretation of effects when the potential risk of pollution is considered: the presence of pipelines is a permanent signal of the presence of Hydrogen Sulfide that

can cause an irreversible loss of competitiveness of products on the market, since the potential different perception of consumers after the disposal of pipelines. The change of perception creates an incomparability of “ex post” and “ex ante” choices of consumers. It is like to say that the bio-farm, after the pipeline intersection, is losing its special character and starts to be perceived as more or less equal to an ordinary agrofarm.

Generic consumers, looking at bio-farm products, and having the possibility, *ceteris paribus*, probably will not choose a bio-farm crossed by pipelines, and will buy from an “untouched” bio-farm. Therefore, the bio-farm will lose a relevant part of its yearly rent, if its soil will be crossed by pipelines. The Consultant of OilCO does not consider such behavior as rational, since the risk of failure of pipeline is “only theoretical”, due to the unbreakable security systems of pipeline with a more than minimum probability of failure.

Therefore, OilCO considers “epidictic” a reasoning conditioned by risk of failure, and does not estimate the increase of devaluation as price of discount because of environmental risk and does not admit any probability of discrimination between farms, despite the existence of pipelines, because the behavior of consumer cannot be rational. According to OilCO Consultant, people are rational and therefore they will not care about pipelines. But it is not rational to consider that if you can choose, you start buying products coming from “untouched” farms (Fig. 5).

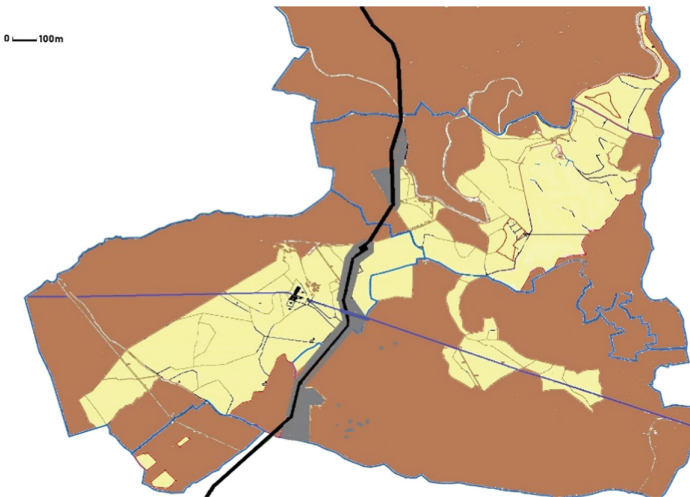


Fig. 5. The interested area in the southern part of the municipality of Guardia Perticara (brown), the property crossed (yellow) by pipelines (black) and the hypothesis of further affected areas (grey) (Color figure online)

Actually, the pipelines system had some failure, reported by media. Furthermore, some recent studies, that still need to be confirmed by other comparable studies, showed findings *significant amounts of hydrocarbons and metals as barium, aluminum, iron, manganese (and other metals), some of them exceeding the threshold values of Italian*

legislation (when present). Sediment analyses confirmed the anomalies of lake waters, with pollutant concentrations far superior to those of waters, so documenting lake conditions even more critical and unfavorable to the life of carps, fishes living mainly near the lake bottom [12].

Therefore, it is possible for consumers to apply the rationale based on the “precautionary principle”. A precautionary behavior by consumers can justify the diminution of demand suffered by farms crossed by pipelines due to a potential discrimination respect to “untouched” farms.

Facing with a rational approach, generic consumers will buy firstly bioproducts available in the market of “untouched” bio-farms. Obviously, when the availability of products from such “untouched” farms will decrease, the prices will increase.

To increase the interest of consumers, in case of bio-farms crossed by pipelines, farmers will offer their product at a higher discounted price. Due to the reduction of available agriproducts from ordinary bio-farm and to the consequent increase of prices, when the “risk-free offer” of bio-farm will be near to last, or when the price of risk-free offer will increase so much to exceed the capability of consumers, they will buy from the “compromised” bio-farms. Furthermore, if the risk is perceived with a small probability, the price of “apparently compromised” Bioproducts will be discounted at a small percentage. If bio-farmers would try to be immediately competitive since the beginning against the risk-free products, they will accept to sale with a greater discount: the more the risk percentage appears probably in the mind of consumers, the more the discount percentage by bio-farm will increase (Fig. 6).

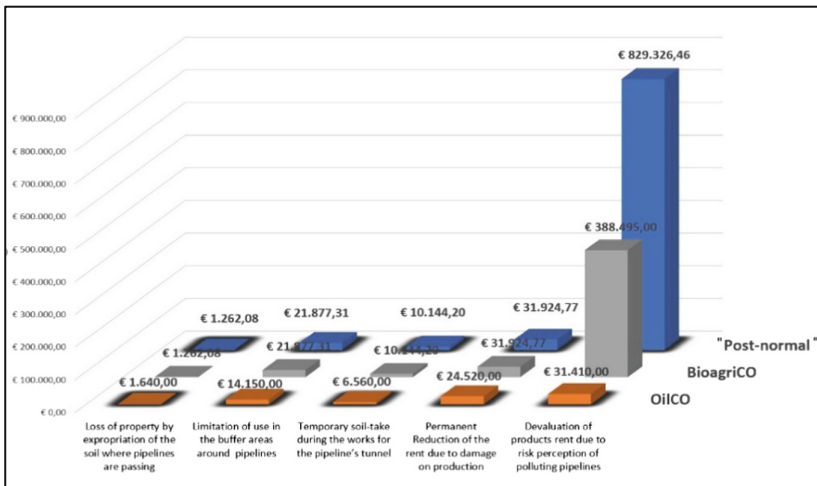


Fig. 6. Comparison between the first two estimates (by BioagriCO and OilCO), with Post-Normal estimate

At the end, the final step could be that some consumers will not accept any discount, and demand will take place between decrease and default: by the rule of

“flipping a coin”, can be the fifty percent of the gap between prices of bio-foods and normal agri-food. Since the average gap between price of bio-food and agri-food is just up the 20%, the devaluation will be the 10%. Following the previous reasoning, the estimation of damage due to devaluation of farm products, increases from more less 388.000 (devaluation due to loss of great functionality of farm) to 829.000 (devaluation due the loss of perceived naturality of bioproducts).

At the end of the process, the consultant of the Court of Justice produced an estimate quite close to the estimates of BioagriCO (that is 829.326), but he did by using a different approach: he estimated the amount of pieces of the property of BioagriCO that could be considered totally compromised: therefore devaluation increased due to a forecasted decrease of productivity, quite close with the 10%.

3 Social Dimension and Environmental Risks

In this point it is useful to give a brief remind about the inter-action among perception of risk and economic behavior in critical conditions. The nature of the risk perception and the relationship with economic behavior was there was in Seventies and Eighties a relevant scientific production based on “behavioral economics”, honored by the Nobel prize, given to Tversky and Kahneman [12] and others [13, 14]

The results of reasoning shows that are two distinguished point of view:

1. accepting the negotiation to buy after obtaining a discount: in this case the deal is to obtain the best discount
2. refusing “a priori” to negotiate: in this case no trade-offs are recognizable as convenient: and just the consumer does not accept any possibility to buy: there is no pay-off for health risk

In absence of further information, the devaluation is “based on case”: it is possible to find a buyer that negotiate, or a buyer that it is not available for negotiation. It can be for instance, by the rule of “flipping the coin”, the fifty percent of the gap between prices of bio-foods and normal agri-food.

In order to test the causes of a potential loss of attractivity of bioproducts, a survey has been conducted on a sample of consumers (211) about agro-bio products in the area of oil fields. The result confirms the existence of discrimination of products, and the acceptability, for a number of consumers on the total, of trade-offs between risk and a discount, testifying the selective priority choice for untouched farms by oil pipelines.

The questions in the survey are:

- (1) which discount is considered acceptable to buy products from a farm nearby an industrial activity
- (2) which activity you consider more dangerous for farm’s products, among the following: pipeline, factory of concrete, factory of furniture, factory of solar panel

The sample of selected consumers was composed of non-residents in the district of oil fields, selected by short interviews in 2016, when phenomenon of pollution was exploiting with public inquiries (Fig. 7).

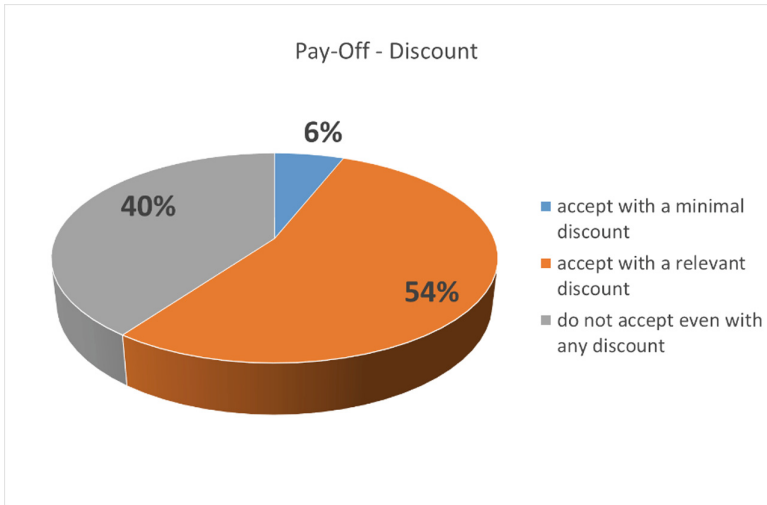


Fig. 7. Acceptability of products from farm acrossed by pipelines

As regards the acceptability by a discount of products of bio-farms nearby industrial activities (first question) results are as follows: 40% of the sample do not accept products from bio-farms nearby a pollutant activity: among the others, the 54% accept with a discount from 70% to 90%, the 6% accept with a discount from 50% to 70% and no answer with a proposed discount less than 50%.

As regards as the most dangerous industrial activity for agri-bio products (second question) the result are as follows: pipeline is considered the most dangerous (around 54.5%), followed by: factory of concrete (around 29.5%), factory of furniture (around 14.5%), and factory of solar panels (around 1.5%). Products, therefore, cannot be seen always as bio agri-food, when the consumers refuse to buy.

A prudent calculation that can translate the average gap between price of bio-food and agri-food suggest a devaluation will be the 10%. After the result of the questionnaire that see high percentages of refuses, the hypothesis of 20% is quite acceptable.

4 Discussion and Conclusion

The case of study points the evidence of incomparable ratios in the different hypotheses: the difference of possible results according the two way of estimating devaluation, due to the presence of pipelines, differ by a ratio of 1 to 12,5 (more less 31.000 euros against 388.000) or by a ratio of 1 to 26 (more less 31.000 euros against 829.000).

The result appears so paradoxical, because there is a “change of paradigm” [15]. It is therefore necessary to give an interpretation of the economic behavior that generates the result of the questionnaire.

Therefore, if the devaluation cannot be estimated as a simple discount between polluted bio-food and normal agri-food, the perception of danger can lead consumers at refusing any offer. The absolute represents that saying “no discount is enough”, means accepting an infinite discount and/or a risk rate. That is the rationale of incommensurable, introduced by Kuhn [15], the anticipator of post-normality of science. In some way the case of study is accompanying towards a study of the concept of incomensurability in economic behavior, as testified by Shrader-Frechette et al. [16]

The ratio among estimates due to devaluation of rent of a bio-farm, crossed by pipelines, appears more than twenty times greater, if compared with the physical interference of pipeline, just considering the behavior of consumer in front of the dilemma about trusting or not product from bio-farm nearby pollutant oil pipelines and plants. We will face with an “incommensurable” (Kuhn). But in a public judgement also incommensurability should find a “measure”. Due to this need of answers, the question is a “paradigmatic change”: methods are always based on the same approach, that is to say, “giving a monetary dimension to effects”: it could be a good approach, when the category of soil use can be considered “business as usual”, with manageable problem of control of impacts, and analysis of trade off [17, 18], but when premise changes, increasing the investigable effects, from the physical dimension [19, 20] to the behavioral [21].

According to the precautionary principle, the consumer chose the best option (Agro-farm without pipelines). But the question becomes more explainable if we put the hypothesis that the consumer renounces at all, if there is a second better option. Even if it could be not probably dangerous a well-protected and surveyed pipeline path. The behavior of consumer is not due to a irrational behavior facing a very small possibility of pollution: the refuse is due to a lack of trust in technology. Consumers do not trust the efficiency of techno-sciences when applied to high environmental risk. The lack of trust is also strengthened by article on media and on scientific reviews, that allow to have some doubt. In such Decision Context, the Expert’s point of view is considered not enough affordable by consumers. Consequently, Funtowicz and Ravetz recall the attention of scholars, and suggest to enlarge the arena of points of view, by consulting consumers, looking at their real behavior instead of the theoretic one.

The story shows the rationales of mutually incompatible economic behavior also in a post-normal dimension of evaluation. The post-normal behavior is evident in front at the impossibility to consider a trade-off between health and polluted food. At the end, if consumers will not accept any discount, demand will pass from decrease to default. Only when (in a theoretic future) the polluted food is the only remaining on the market, the risk for health will became acceptable for a limited number of consumers.

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