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# How to Value the Benefits of a Recreational Area? A Cost-Benefit Analysis of the Conversion of a Brownfield to a Public Beach in Muggia (Italy)

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In this paper, we evaluate the potential reconversion to recreational uses of a brownfield area on the shoreline of Muggia (North-East Italy). We perform a Cost-Benefit Analysis of the value to society of such a reconversion compared with alternative scenarios (excavation and "do minimum"). We investigate why existing methods, including the "Economic Impact", are not be appropriate to provide normative recommendations. As an alternative, we propose a parsimonious method based on contingent valuation and a pressure-intensity function, for valuing the recreational value in a context where available data are scarce. Our results strongly support the reconversion of the area to recreational functions.

Keywords: *recreational value; cost benefit analysis; beach regeneration*

JEL classification*: L83 H43*

## 1 Introduction

Brownfield areas reconversions are usually not seen as a resource for tourism and recreation. However in contexts where land is scarce, reconverting dismissed or polluted areas can constitute a relevant opportunity for recreational functions. This paper is based on a Cost Benefit Analysis of various scenarios for the reuse of a polluted area on the shoreline in Muggia, in the North-East of Italy. It reviews different methods available for evaluation of benefits of increased recreational area and proposes a parsimonious yet consistent approach to the measure of visits based on a Pressure-Intensity function.

Section 2 of this paper reviews the context and scenarios for the future of the area. Section 3 examines the different approaches available in the literature for the evaluation of beach

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extension or restoration programs. Section 4 consists in the valuation of costs and benefits of the various scenarios. Section 5 concludes.

## 2 The Acquario area in Muggia: an Intriguing and Intricate Situation

In this section, we first present the situation of Acquario area and subsequently identify the scenarios for its future.

### 2.1 Acquario from a development project to a brownfield area

The Acquario area is situated in Muggia, the last village on the Italian coast, before the Slovenian border, few kilometers away from Trieste, the largest (200 000 inhabitants) city of the area. Acquario was inexistent until the mid-90's, as the place was only consisting of a tiny coastal road below the hills. Acquario was just the name for a project: developing a recreational area mainly devoted to bathing in order to cope with the high demand of local population in a context of scarce supply of beaches (this scarcity is due to orographic conditions with a semi mountainous shore line, and to the presence of large port infrastructures that make around 11 km of shores, between Trieste and Muggia, unavailable for bathing). The project entailed the creation of an area of 28 000 m² taken to the sea. The "beach" would have been awarded to a licensee, as is common practice in Italy.

While the civil works were close to completion, it turned out that part of the material that had been used for embankment, was contaminated with a large variety of pollutants (Hg, CSR, Arsenic, Dibenzo(a,e)pirene, Dibenzo(a,l)pirene, hydrocarbon C13-C18). Considering Italian regulations (legislative decree 2006/152), concentration of these pollutants were incompatible with so called "residential uses" (in a broad meaning, including recreational use) and compatible with commercial use in around 3/4 of the area. This led to the closure of the area, together with legal suits for the developer. The area remained in this status quo situation for a number of years, during which the only relevant action taken has consisted in pollutant measurements being achieved.

With sufficient knowledge having been acquired thanks to these measurements, it then turned possible to think again of the future of the area.

### 2.2 Possible scenarios for the future

In this section, we describe three possible scenarios for the future of the area. These scenarios are based on discussion with the various stakeholders involved in the process. They form the alternative set for the Cost Benefit Analysis.

The first possible scenario is constituted by **excavation of the polluted material** to a regulated landfill. This scenario is conforming to the general wisdom that pollutants should not be kept in place but should be removed from areas where they were brought.

The second scenario is based on the idea of **mixed recreational reuse**. The first scenario, indeed, is in conflict with the idea that the area, rather than being brought back close to its original conditions, could be used for purposes aligned with the original intentions of the projects' developers: recreation and bathing. This possible alternative is the basis of the second scenario. It entails creating parks and meadows together with some side amenities (small sport fields) and services (parking). This scenario obviously requires some substantial interventions in order to make the area compatible with recreational uses. This is achieved through a capping of the area taking into account the various pollutant concentrations found in the ground and carrying out the necessary interventions to make the area compatible with the recreational use. A relevant question is whether one should assume, in the scenario definition, access pricing for the area. From our point of view, free access appears as the most welfare improving situation. This relates to the well-known economic result stating that welfare is maximized when price is equal to marginal social cost. Considering that the marginal social cost of a beach visitor is probably in the order of magnitude of a few cents/visit, and considering that there is no available technology or contractual framework that would allow to levy such a fee without incurring into significant transaction costs, free entry is very probably be the best situation for this area. If the project were to be realized with a concession operator, the net benefit for the society would be reduced.

The two scenarios: excavation and recreational use, can be compared to a reference case defined as the evolution of the area in absence of intervention. Strictly speaking, this scenario is rather a "**do minimum**" than "do nothing" in that some actions are, in any occurrence, necessary: this relates to the fact that in parts of the embankment of the area caves are forming which is a threat to environment in that it allows transport of the pollutants to the sea. It is thus, in any case, necessary, and even compulsory, to restore acceptable structural conditions of the embankment and to protect against transportation of the pollutants from the soil to the sea.

To summarize, three different scenarios are considered: **excavation**, **recreational reuse** (after capping) and **do minimum**, this is used for comparison in the computation of costs and benefits. Consistent with Cost Benefit Analysis theory, costs and benefits are defined as the changes that occur compared to some well-defined "no policy" scenario.

Having identified the different scenarios available for the future, one can investigate how economic analysis can help to identify the best among these scenarios.

## 3 Cost and Benefits Analysis of Beach Creation and Regeneration

### 3.1 A Variety of methods and results are available to evaluate recreational benefits

In this section, we review the current practice in Cost Benefit Analysis of recreational areas focusing on beach and coastal management interventions. Readers may also refer to Murley, Alpert et al. (2003). We find that the following practices are in use: hedonic analysis of the housing market, travel costs methods (these two, pertaining to the Revealed Preferences paradigm), Stated Preferences and Economic Impact. We review in turn these different practices and investigate whether they would be relevant for the assessment of Acquario scenarios.

A first stream of literature measures the effect of beach improvements through housing values. This method has had a number of applications since at least three decades in the area of beach improvement programs Edwards and Gable (1991). Many debates and technical issues are still going on in the scientific community about the relevance of hedonic pricing techniques to value the socio-economics benefit of these programs. Some issues are of technical nature[1]. More fundamentally, the hedonic approach appears suitable to measure the value of the improvements for residents, but needs to be complemented or substituted with other approaches when considering benefits to persons that are not living in areas directly impacted by the project but who may still benefit from it.

Travel cost method offers an alternative or a complement to housing values in order to measure the value of benefits to non-local users. Travel costs methods applied to beach recreational values are not fundamentally different from the applications to other environmental or recreational assets Bell and Leeworthy (1990). A number of applications of the method have been made in various recreational contexts like on Xiamen Island in China by Chen et al (2004).

A third stream of results pertain to the Stated Preferences paradigm, relying on surveys that investigate interviewees reactions to hypothetical situations (like in Blackwell, 2007). Some of these surveys have been made in European context, or in Italy like in Marzetti dall'Aste Brandolini (2009) and Polomé et al. (2005).

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[1] For instance, Blackwell, C., S. Sheldon and D. Lansbury (2011). "Beach Re-Nourishment and Property Value Growth: The Case of Folly Beach, South Carolina." SSRN eLibrary., Cordes, J. J., D. H. Gatzlaff and A. M. Yezer (2001). "To the Water's Edge, and Beyond: Effects of Shore Protection Projects on Beach Development." Journal of Real Estate Finance and Economics **22**: 287-302. found that, when using repeated sales index, beach nourishment had no detectable effect on real estate values. Gopalakrishnan, S., M. D. Smith, J. M. Slott and A. B. Murray (2010). The Value of Disappearing Beaches: A Hedonic Pricing Model with Endogenous Beach Width. Working Paper Duke University. Durham, NC. found that making beach width endogenous in house pricing model can seriously impact the estimated implicit prices)

Another type of approach relies on the "economic impact" or "expenditure" approach. Economic impact measures the benefits of a given asset through the expenses that this asset generates. Suppose for instance people may spend money when using the recreational area. The measure of this spending is sometimes proposed as the "value" of recreational activity to the users (see, for instance, Eurobuilding and Nomisma (2004) and Antonelli et al (2006),). Additionally, indirect or induced effects of these expenditures can be estimated through the use of multipliers. There are however concerns about the validity of such methods. First, whether the expenses that are measured by this approach can really be found "additional" is a matter of discussion. This relates to the fact that when creating an additional recreational area, it cannot be generally concluded that the expense taking place there will not be displaced from other areas or expenses[2]. Second, one may wonder whether expenditures is an adequate measure of the benefits for society as a whole. As put nicely by the Committee on Beach Nourishment and Protection in Australia: "*economic impact measure market activity, how much money changes hands, they do not take into account what is being given up of existing alternatives*" (Commitee on beach nourishment and protection 1995).

Figure 1 provides an illustrative example of how both measures could be computed and how they would generally differ. On this figure, we see that a calculation of the additional expenditure on a new product, for instance a new beach, would provide a flawed assessment of the benefit of the project. First, if one considers that expenditure increase is an informative indicator, one should compute this expenditure net of reduced expenditures on the alternative goods, for instance a preexisting beach (rectangle on the left graph- rectangle on right graph). Second, and more fundamentally, extra expenditure is not a welfare measurement (the rectangle on left figure would generally have a different area than the dashed triangle).

### 3.2 Existing valuation outcomes

Making use of these different methods, a number of results have been produced about the benefits of beach and their regeneration.

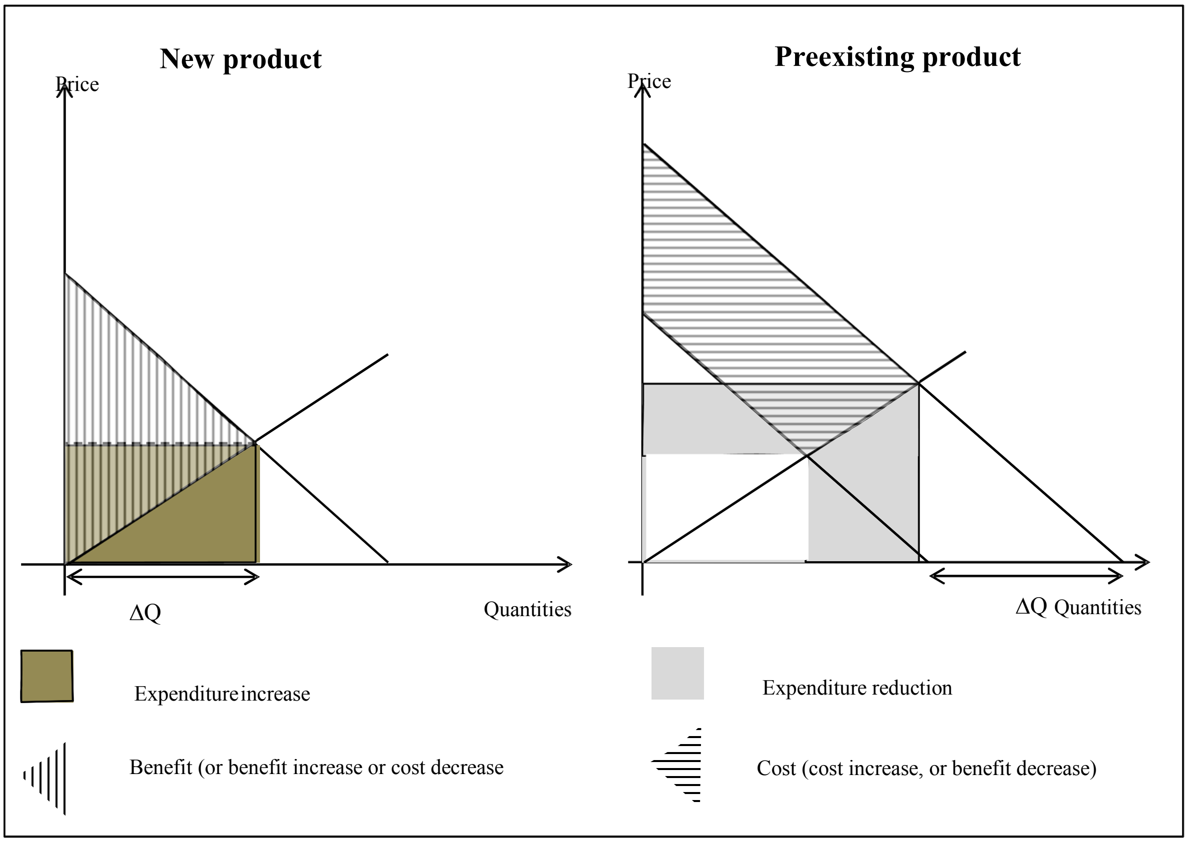
Broward's beaches in Florida were estimated to contribute $1.351 billion in local property values, $547.9 million in local economic production, and $29.2 million in local government revenues (Stronge and Schultz 1997). Eurobuilding, and Nomisma (2004) found that a set of 25 meters widening operations in various Italian resorts[3] were exhibiting an annual rate of return between 12 and 15 % per year on an average. A result that, together with the previously quoted one, suffers however from the limitations of the "expenditure" approach that was used.

[2] Although users of economic impact state that there approach is more comprehensive than others in that it also takes into account indirect and inducted effects, a rigorous application of the economic calculation method should take into account the (negative) reduced expenditures on the substitute goods.

[3] Gabicce M., Senigallia, Civitanova M., Porto S. Elpidio,Tarquinia, Ostia Lido

Lamberti and Zanuttigh examine the Lido di Dante beach in North East Italy, based on contingent evaluation survey and find that the willingness to pay for a visit in summer would be reduced of 14 €/person.day (from 27.67 € in the status quo to 13.26 € in the hypothetical situation of erosion) if large erosion would occur while it would increase of 0,6 €/person.day if nourishment was undertaken (Lamberti and Zanutigh, 2005). This latest result suggests strong convexities in the value of beach surface: diminution of beach width have costs that are higher than the value of beach extension.

Figure 1: How Expenditure and Welfare Measures Can Differ.




### 3.3 Application of Cost Benefit methods to Acquario

As can be seen from the review of existing methods, economic analysis is not helpless when having to deal with the evaluation of beaches. Actually, some countries have developed consistent working habits or methodological guidelines to deal with similar issues, as for instance the beach nourishment operations in the USA that have to go through an evaluation by the US Army Corps of Engineer (2001). However, although beach evaluation corpus has grown to a certain maturity, there remains some areas that are still open to research. Specifically, considering the evaluation of the Acquario area, a number of specific features are challenging for existing methods:

- Most of the future visitors will be local, and travel costs methods may be deceptive when dealing with short distances travels. But the visitors will not be residents of the area, strictly speaking, but rather coming from the settlement of Muggia a few kilometers away, which moves us away from housing pricing approaches.
- The site will supply a type of recreational activity that is remote from the general model of sandy beaches dealt with in most of the existing evaluations. This is a challenge when considering how results obtained for sandy beaches could be informative of willingness to pay of the visitors.
- Additionally, the number of visits to the area cannot be easily estimated as most of the existing models and methods rely on sandy beaches.

In the next section, we present how we tackled the estimate of the cost and benefits of the different scenarios.

## 4 Cost Benefit Analysis of Acquario Reuse Scenarios

Our analysis is made on a 30 years horizon, which, apart from being consistent with a general practice in cost-benefit analysis, is also consistent with the foreseeable lifetime of the civil work considered. We take into account costs and benefits at a regional level, this means only economic agents within Friuli-Venezia-Giulia region have standing in the analysis. While the benefits of the project may slightly exceed this regional scale, the inclusion of these non-local users would have raised data availability issue and would have raised questions about the general consistency of the analysis (some results could be computed for a scale larger than the regional one, but other could not, which would create inconsistency).

Actually, the main issue relates not to the costs but to the benefits of the different scenarios. In the next paragraphs, we focus on the question of recreational value assessment. Other benefit items, which are less challenging to quantify will be discussed later in this paper.

First, we consider the different methods available for the valuation of this recreational value. The economic impact was discarded due to its intrinsic limitations to capture value of the benefits to the users. We concentrated on users' willingness to pay. We also dedicated some energy to investigate "Willingness to invest" (or willingness to pay of the investors) as an innovative approach to measure benefits for society of the creation of an additional recreational area. The basic intuition behind willingness to invest is that it reflects the expectations of well-informed economic agents about both the usage and the operating costs of a paying recreational area. If the public planner is interested by the value of recreational benefits (net of operating costs) and has knowledge of the willingness to invest and profit expectations of private operators, it is fair to use this willingness to invest to estimate the net benefits of the project for society. However, the relevance of this approach is limited when considering that the data on investor's willingness to pay is often scarce, and was found in our case insufficient.

Another approach is to rely on the willingness-to-pay of the visitors and on an estimate of the number of visits. In considering this latest solution, an important issue is what sources of information are available about the willingness-to-pay. For our purpose, a contingent evaluation survey made a few years before in a comparable site was found helpful. Specifically, this relates to a survey made in the Trieste-Barcola, a seaside park and promenade in the outskirts of Trieste, only 15 km away of Barcola and comparable, with reasonable adjustments (see below), to Acquario both in terms of geophysical features and in terms of socio-economic traits of the population. It thus appeared reasonable to start from these willingness-to-pay estimates to value the benefits of this new recreational area.

The value of recreational activities in Acquario can be based on the number of forecasted visits to the area and the average monetary equivalent to these visits. We examine in sequence these two elements.

## 4.1 Beach attendance forecast

Forecasting the number of visits to the area is a challenging task and to our best knowledge, an established method, like using ratios of visits/inhabitant.year, is probably too coarse for our topic. Limitations of such approach deal with the way they poorly represent specific features of the recreational site and the traits of the potential visitors population. In contrast to this approach, we propose to calibrate a "pressure-intensity" function. Literally, the population of a given catchment area has some recreational requisites and these "requisites" will spread among the different available areas. Pressure expresses the ratio of inhabitants of the catchment area per unit surface of recreational area (so it is not the population density, which relates to all surface area available). The intensity of use of any (existing or additional) recreational area will be driven by this "pressure". This implies that a given surface of recreational area receives more visits if it belongs to a highly populated catchment area or alternatively if it belongs to a catchment area with few recreational sites.

Formally, this is expressed by a function *f* that relates pressure to usage density.

$$V_{i,s} = S_i . f_s (P(Pop, S_i, S_j), X_i, Z) \quad (1)$$

where $V_{i,s}$ is the number of visitors of area *i* in season *s* (visits/years in a given season), $S_i$ is the surface of the recreational area, $f_s$ is a function providing the number of visits per m$^2$ and per year. The subscript *s* of the function *f* allows for different regimes across seasons. $X_i$ are the attributes of the area, *Z* are the characteristics of the catchment area population. *P* is the pressure (inhabitants of the catchment area/square meter of recreational area) defined as

$$P(Pop, S_i, S_j) = \frac{Pop}{S_i + \sum_j S_j} \tag{2}$$

With $S_i$, surface of recreational area *i*, $S_j$ surface of the other recreational areas of the same catchment area, *Pop*, population of the catchment area.

In situations, where one is interested in fairly comparable recreational sites features and population traits, the effect of $X_i$ and *Z* in the relationship can be considered as parameters and integrated in the Pressure-Intensity function giving rise to:

$$V_{i,s} = S_i . g_s(P(Pop, S_i, S_j)) \tag{3}$$

In these circumstances, the minimal requirement to calibrate function $g_s$ is a number of observations equal to the number of parameters in $g_s$ (one parameter in the simplest assumption where *g* is just a proportional function).

In the case of Acquario, this condition is fulfilled thanks to the DELOS research project survey performed in 2002 on 600 interviewees (Polomé et al., 2005). This survey provides the number of visits of Trieste inhabitants per year to Barcola, in conditions fairly comparable to Acquario, and based on these data it is possible to compute the pressure (inhabitants of the catchment area/m² of recreational area) and attendance (visits/$m^2$.year).

Apart from the data, attention should also be given to the functional relationship between pressure and use. Actually at least two different settings could be considered.

$$V_{i,s} = S_i g_s(P(Pop, S_i, S_j)) = S_i k_s P(Pop, S_i, S_j) \tag{4}$$

This latest equation depicts a linear relationship where $V_{i,s}$ is proportionate to *P* and $S_i$. $k_s$ is an homogenization parameter that also have a behavioral interpretation (visits in a season/inhabitant.year). A limitation of this formulation is that, consistent with its linear nature, it does not take into account congestion, which is usually found to be relevant for beach visits (McConnell 1977). The number of visits/inhabitants is not affected by the extent of the supply, which may seem unreasonable when congestion actually matters.

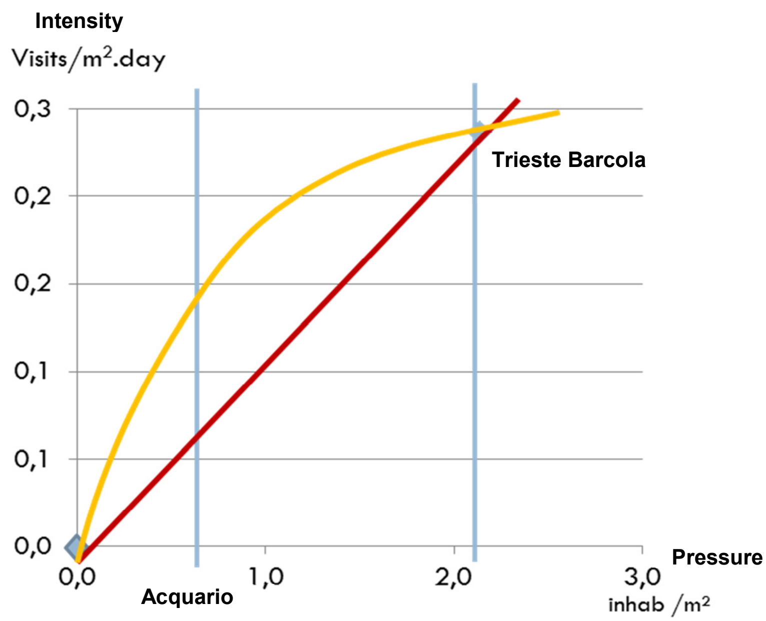
A natural alternative is to rely on the well-known logistics sigmoid function that typically accounts for saturation.

$$V_{i,s} = S_i \left( \xi_s . \frac{1}{1 + a_s e^{-r_s P}} - \frac{\xi_s}{2} \right) \tag{5}$$

with, $\xi_s$, saturation level, $a_s$, $r_s$ parameters, $P(Pop,S_i,S_j)$, pression on the site. The term $\xi_s / 2$ is an adaptation of the usual logistic function, used to "shift" the curve so that it passes through the origin, or, in other words, it respects the constraint $F_{is}(0)$ =0, just replicating the fact that a 0 $m^2$ area can only have 0 visitors.

A graphical representation of such functions is displayed on Figure 2, additionally it contains indications of the observed value of *P* and $F_{is}$ for Trieste-Barcola. A vertical line indicates the value of P in Acquario suggesting how the calibrated curves could produce an estimate of the use intensity.

Figure 2 : Pressure-Visits relationship (linear and non linear assumption)




The parameters $\xi_s$ , is based on an assumption about the maximum number of visitors per day and square meter. It is based on the actual numbers measured in Trieste-Barcola and compared to evidences available about maximum observed density (Robert et al., 2008). $a_s$, $r_s$ are also be calibrated based on the situation observed in Trieste-Barcola.

## 4.2 Willingness to Pay for a visit to Acquario

Apart from the number of visits, evaluation of recreational benefits also requires an estimate of the monetary equivalent for the visits. Several types of data could be used. First, a formal value transfer function could have been retrieved based on values collected in different contexts. However this method was found to be of limited help. Apart from some general indications that value transfers applied to recreational value of beach could be deceptive (Polomé, 2002), one has to consider that a vast majority of available valuations relate to sandy beaches. On the contrary Acquario, in the projected recreational scenario, is not a sandy area, but rather an embankment on the sea. Thus, again, it turned out useful to look at data collected in Trieste-Barcola as being the best point of comparison with Acquario. The DELOS survey in Trieste-Barcola included a question on how much visitors value their visit to Trieste-Barcola. The elicitation technique used was "value of enjoyment" as in (Penning-Rowsell, 1992). An advantage is that the phrasing of the DELOS survey directs interviewees to provide their "average", rather than "marginal" value of enjoyment. This is an advantage considering that marginal value of visit is not the relevant information for project evaluation which should on the contrary consider the whole area under the demand function.

DELOS survey indicates an average value of 5.24 €/visit (summer, 2002 prices). Could this value directly be implemented to Acquario? In order to allow for possible differences in the value of recreational visit between the two sites we set up a comparison matrix based on (Morgan, 1999) and included in Table 1. This point per point comparisons suggests a general comparability of the two areas with a somehow higher general standard of Trieste-Barcola (this relates in particular to the landscape that is mainly a view on the sea in Trieste, and is mainly a view on an industrial harbor in Acquario). Given this situation, it does not seem inappropriate to use a 20 % discounting to the value of the recreational visit in Acquario compared with Trieste-Barcola.

Table 1 – Assessment Matrix of Acquario versus Trieste-Barcola

| | | | | | |
|---|---|---|---|---|---|
| Landscape Quality | - - | Rainfall | = | Rock Pool Fauna | = |
| Beach Safety | = | Thermal Sensation | = | Water Sport Management | =? |
| Water Quality | = | Dangerous Animals in Water | = | Washing/Drinking Water | = |
| Sewage Debris | = | Beach Material Colour | = | Wave Size | = |
| Litter | = | Vehicle Noise | + | Refreshment Facilities | = |
| Odours from Industry | - | Sunshine | = | Beach Slope | = |
| Oil on Beach | = | Insect Pests | = | High Tide Beach Width | = |
| Cleanliness of Toilets | = | Dog Control | = | Odours from Catering | = |
| Industrial Noise | = | Sea Temperature | = | Flora | = |
| Dangerous Cliffs | = | Car Park Location | =+ | Beach Exposure | - |
| Traffic Fumes | + | Lifeguard Provision | = | Road Access | = |
| Toilet Provision | = | Submerged Obstacles | =- | Low Tide Beach Width | = |
| Vehicles on Beach | = | Wind | = | Fishy/Seaweed Smells | = |
| Beach Material | = | Alcohol Availability | = | Seaweed on Beach | = |
| Water Clarity | = | Underwater Beach Slope | = | Showers | = |
| Floating Material | = | Access onto Beach by Path | = | Chairs/Sunbed Availability | = |

Legend: -- worse, - somewhat worse, =- marginally worse, = equivalent, =+ marginally better, + somewhat better, = ? cannot decide

Based on these data we can estimate the value of recreational services provided by Barcola as illustrated on the next table.

Table 2 – Value of Visits to Acquario

| | | Summer | Winter |
|---|---|---|---|
| Unit value (€/visit) | | 4,91 | 2,46 |
| Number of visits (000" visits/yr) | Low (linear function) | 308 | 69 |
| | High (logistic function) | 435 | 88 |
| Total value (mio €/yr) | Low (linear function) | 1,51 | 0,17 |
| | High (logistic function) | 2,14 | 0,22 |

### 4.3 Other benefits

In addition to recreational functions, other benefits should be considered. This relates first to **health**. Sanitary conditions are the basic concern when considering pollutants. However, it is a legitimate assumption to consider that Health benefits are similar across the scenarios. The basic reason for this is that in all three scenarios, the incidence of pollutants on health is kept at a minimal level and conforms with the existing regulations. Thus, health is not a criteria of differentiation among the three scenarios and it would have no effect to include it among scenarios benefits.

Second, additional benefits relate to **residential benefits**: some residents are living aside Acquario area and suffer from the current conditions of the site. Excavation scenario will relieve them from this stigma, while the recreational scenario will offer them additional advantage. These benefits have been taken into account by considering the likely increase of housing value based on local market conditions. In the estimation of these benefits we considered housing that had a direct view on the site. This delimitation is not found to be too artificial in that there is actually discontinuity in the land use with very few constructions for which this criteria would not be uncontroversial.

### 4.4 Additional Costs

In this section, we expose the computation of ancillary costs, which, in our view, should be taken into account in the computation of the net benefits of the project.

Typically transport costs, private as well as external, are to be deducted from the benefits of the users[4]. This is done by using some assumptions on the distance travelled to the site and some assumptions about the modal shift for reaching the area. While we recognize that these calculations are, in a way, speculative we are open to any suggestion on the use of additional

[4] The issue of how much private costs are a cost to the system is a complex one. These costs are indeed benefits for other economic agent. The reason for considering them as a cost, in our calculation, is that road transportation relies heavily on non-local providers (think about fuel, cars and there parts that are not significantly produced in the Friuli region). This implies that such expenditures can be considered as costs for our purpose.

data. Incidentally, we note that, in the absence of more structured data, the alternative solution, to exclude ancillary expenditures from the calculation, would raise more serious problems.

Private transportation costs are based on assumptions about the modal shares for reaching the area in each season, the average number of kilometers, and how much of these trips are additional or substitutive to other trips.

To compute externalities we also use an assumption about urban-rural decomposition of the trips. We also take into account the Heavy Goods Vehicles' movements that are necessary for the realization of the scenarios. Externalities are monetized based on CE Delft guidelines (CE Delft et al., 2007).

### 4.5 Assessment

Table 3 displays the costs and benefits of different scenarios. All results are computed based on a comparison with the "do minimum" scenario: this means for instance that the cost of the recreational scenario has to be interpreted as the extra cost compared with the cost of not doing nothing (or, to be more rigorous: "doing just the minimum"). As is apparent from the table, the results are driven by two items: the large costs of excavation and the high magnitude of the recreational benefits. This result is found consistently for our two beach attendance assumptions: the high assumption that considers congestion and is based on a logistic attendance function (then the creation of Acquario beach is freeing some latent demand resulting in higher overall attendance), and the low assumptions that considers no effect of congestion.

Table 3 Costs And Benefits of the Scenarios (computed as scenario "do minimum")

| | **Excavation** | **Recreational** | |
|---|---|---|---|
| | | **High** | **Low** |
| **Costs:** | | | |
| Civil works | 20,8 | 2,6 | 2,6 |
| Maintenance | -0,3 | 0,6 | 0,6 |
| Ancillary expenditures | 0,0 | 10,6 | 7,7 |
| Transport externality | 0,2 | 0,6 | 0,4 |
| **Benefit:** | | | |
| Recreational value | 0,0 | 40,5 | 29,0 |
| Housing | 2,7 | 3,7 | 3,7 |
| Intrinsic damage | p.m. | p.m. | p.m. |
| Total | -18,0 | 29,8 | 21,4 |

## 5 Conclusions

In this paper, we have undertaken a Cost Benefit Analysis of Acquario area reuse scenarios considering three scenarios: excavation, recreational use and do minimum.

From a methodological point of view, we had to find a method for the evaluation of recreational benefits compatible with the general fairly limited amount of data available. We proposed to base our approach on the calibration of a pressure-intensity function, which appears parsimonious and compatible with data limitations, and yet consistent approach to forecast the number of visits to the site. Additionally, willingness-to-pay data, based on a fairly comparable context (namely the Trieste-Barcola area), provided an adequate method to estimate the benefit of users for each visit.

We reckon that the results could be improved by the availability of other data. Probably, one of the promising methods to derive consistent demand functions for recreational activities would be Stated Preferences surveys. Such surveys would make visit forecast intrinsically dependent of attributes of the area, and the trade-offs with costs would normally be introduced in the choice mechanisms, allowing for consistent use in a welfare analysis framework. While we have found only a limited number of these studies were available (and certainly not enough to be used for our purpose), we identify this as an area of potential progress.

As far as our results are concerned, even considering the uncertainty of beach visitors' quantification, as reflected by the low vs. high assumptions, a clear advantage appears for the recreational use. These results are driven by the high civil work costs of the excavation scenarios and the high recreational benefits of the reuse.

A concluding remark relates to the ethical challenge posed to society by the fact that the illegitimate presence of pollutants in a terrain should not be remediated thoroughly but could be left in place, in some kind of sarcophagi. In a way, we are aware that our findings tend to legitimize the "*fait accompli*". It is however fair to consider that policy can only change the future and not the past. For this reason, it would be harmful to society renounce to the most beneficial re-use of the area. Whether parallel to this, society should also consider who has to bear the costs resulting from the terrain pollution, is another question, that we reckon, probably also deserves an answer.

## Appendix: Computation details

### Benefits

- Recreational benefits:

Recreational benefits are based on the beach visit (two different assumption)

$$V_{i,s} = S_i\left(\xi_s \cdot \frac{1}{1+a_s e^{-r_s P}} - \frac{\xi_s}{2}\right)$$

$$V_{i,s} = S_i g_s(P(Pop, S_i, S_j)) = S_i k_s P(Pop, S_i, S_j)$$

The number of visits is multiplied by the unit value of each visit (one for summer, one for winter).

- Housing values:

We compute the number of square meters for residential buildings close to the area, based on “carta regionale tecnica numerica”. The 10.753 square meters floor are valued at 1700 euro/m$^2$ based on data from the local tax office. We posit an increase of 10% of the housing value in case of excavation and 15% in case of recreational reuse.

## Costs

- Private Transport Costs

Transport costs$_i$= $\Sigma v_{is} d_i.r_m.m_{sm}.c_m$

$V_{is}$ is the number of visits in beach $i$, $d_i$ stands for the average additional distance to the beach (additional compared with other beach peoples would have visited, this includes some substitution effects), $m_{sm}$ is the mode share (among: car, bus and motorcycle) for each season, $c_m$ is the private km cost per vehicle for each mode $m$, $r_m$ is the average number of occupant per vehicle.

Parking costs are a cost for users and a benefit for the local administration, there computation is not detailed here.

## Transport externalities:

Transport externalities = $\Sigma v_{is} d_{ia} r_{ia}.r_m.m_{sm}.e_m$

Computation is pretty similar to transport costs except that we make a distinction between urban and non urban areas. The unit costs are taken from (CE Delft et al., 2007)

| | | | |
|---|---|---|---|
| veh.km car | Urban | 0,067 | €/veh.km |
| | Extra urban | 0,033 | €/veh.km |
| veh.km bus | Urban | 0,348 | €/veh.km |
| | Extraurban | 0,194 | €/veh.km |

We also take into account the externalities for the veh.km travelled by truck for the civil works in the various scenarios.

| | | | |
|---|---|---|---|
| veh.km camion | Urban | 0,348 | €/veh.km |
| | Extraurban | 0,194 | €/veh.km |

- Civil works

Excavation scenario: these costs consists in: the installation of a provisory sheet pile to isolate the excavation area from the sea. Additionally, excavation itself plus transport and consignment to a land fill are accounted as costs.

Recreational scenario: the civil works consists in punctual repair of the embankment and in the capping of the area.

Do minimum scenario: punctual repair of the embankment.

**Maintenance:**

Maintenance mainly relate to pollutant monitoring ("do minimum" and recreative scenarios) and public area cleaning (recreative scenarios).

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