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Investigating the Difficulties in Assessing Aesthetic Pollution through Experimental Economics

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Abstract: This present work deals with the research of some difficulties that we encounter in the evaluation processing of aesthetic pollution. Experimental economics techniques, such as answering a questionnaire (including quantitative indicators in the form of Willingness to Pay/Accept), have been incorporated into the FTS/A (Fault Tree Synthesis/Analysis) methodology. Such a methodological application is presented in the present document with reference to the archaeological site of Eleusis, where the visual & aesthetic pollution is apparent due to the heavy anthropogenic impact that takes place in the major area. It has been proved that EAP (Extended Aesthetic Pleasure), used as an indicator of "visual exterior", can contribute to the conceptual determination of the optimal value in the intensification effort and the resources expended (I_{opt}) to achieve a particular aesthetic result. According to this analysis, I_{opt} decreases in the short run (due to lack of dissemination of information, mainly to the public) and increases in the long run, due to the accumulation/transfer/dissemination of knowledge. The methodology presented herein has been successfully applied in the case of the archaeological site of Eleusis, where the corresponding extensive aesthetic enjoyment of EAP is reduced by the ongoing intensified industrial activities.

Keywords: Aesthetic pollution, optical pollution, experimental economics, hypothetical evaluation method, FTS/A, Fault-Tree-Analysis.

1. Introduction

It is scientifically accepted that there is no significant linear correlation between WTP (Willingness to Pay) payment willingness and WTA (Willingness to Collect) recovery willingness. Therefore, it is not only the WTA-WTP dimension, which is also mentioned by some authors and confirmed (in cases other than aesthetic pollution), but in addition, the lack of correlation is proven (applied to the other two industrial areas close to Athens as well).

The difficulty in assessing aesthetic pollution arises from the fact that this type of pollution cannot be vaguely defined. In addition, the same object may be considered by some as a contribution to beauty, while at the same time others may feel uncomfortable when looking at it. Financial interests also play an important role in this conflict [1]. For example, some may find street ads that have some aesthetic value, especially when combining successful photographic material or graffiti with social media. On the other hand, several cities have banned outdoor advertising, responding to both public demand and expert opinion [2].

To investigate the difficulties in assessing aesthetic pollution, we have adopted the Contingent Valuation Method (CVM), which is a key technique in the newly formed field of experimental economics. This technique is subjective at its core, trying to gain objectivity by extracting an opinion/attitude and information/knowledge from a representative sample of respondents, who are asked to value non-tradable goods (e.g., the environment or the culture) or an externality (also known as a secondary transaction in Finance, which means a cost or benefit that is not transmitted through market prices). We have called this goodness/exterior EAP (Extended Aesthetic Pleasure), as the objects we are considering belong to the category of ancient monuments or works of art which are of extensive value, retaining a historical/symbolic significance or referring to the

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environmental/natural context. For example, all the ancient temples in Greece were built in places of exceptional natural beauty, while the oracles that were placed in places that were transferred, until today, gave a mystical impression [3, 4].

2. Methodology

The conventional method of hypothetical CVM assessment of historical monuments and sites of ecological interest has been extensively reported [1, 2], though not in the light of EAP extensive aesthetic enjoyment, as measures of economic value from the center of gravity in the respective questionnaires. WTP reflects the maximum amount of money a person would pay to acquire a non-tradable good/service under consideration, and WTA reflects the minimum amount of money required as compensation from an individual so as to give up this good/service [4]. The error tree that we have compiled in order to reinforce this methodology, is used as a

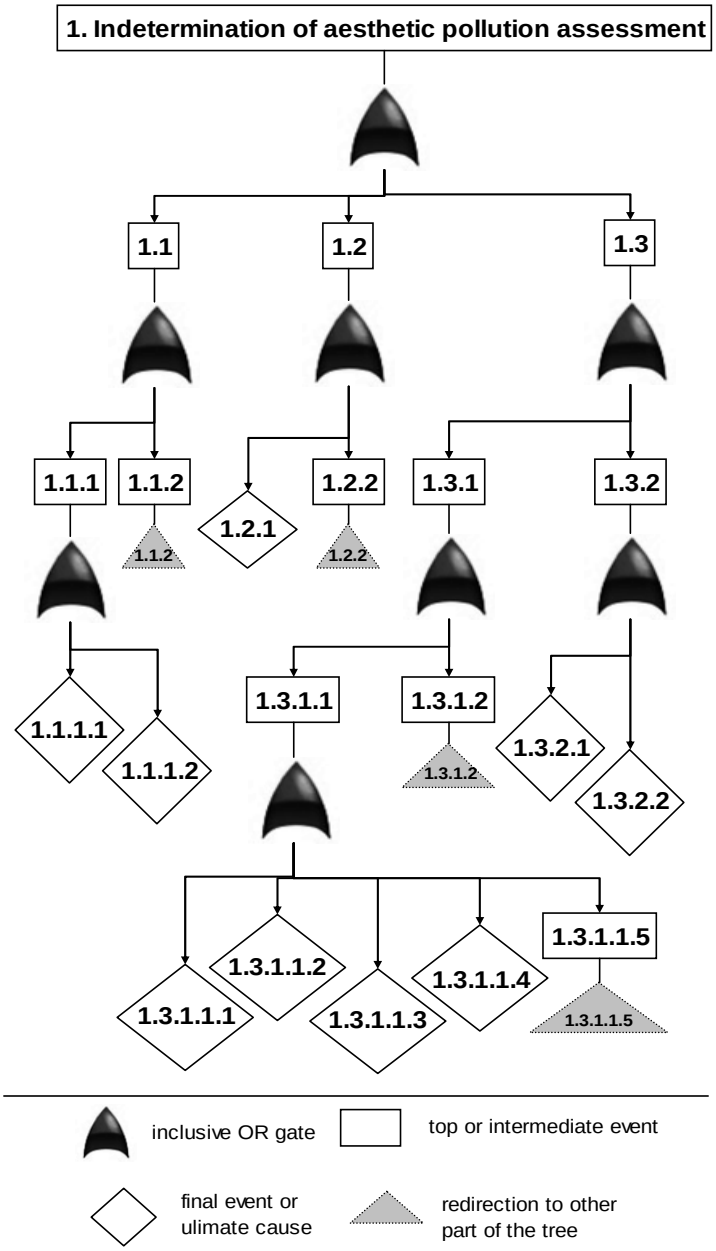

Fig. 1 Representative tree designed analysis developed to investigate the causes in the assessment of the indeterminacy of aesthetic pollution.

"top case" to check the basic/source weakness under investigation: unspecified assessment of aesthetic pollution [5-7]. Part of this tree is described below and illustrated in Fig. 1. 1.1: Lack of widely recognized product quality standards. 1.2: Lack of widely recommended practices. 1.3: Weakness in the correspondence of the observations (including experimental proofs) with the corresponding theoretical side, leaving the observed performance without a fixed definition. 1.1.1: Failure to apply a reliable verification procedure to assess whether the assessment complies with the *ex ante* specifications. 1.1.2: High spatio-temporal dependence of the aesthetic result. 1.1.1.1: High degree of subjectivity in the evaluation of the aesthetic result. 1.1.1.2: Failure to state the exact specifications in advance. 1.2.1: Strong disagreement among experts as to the rules to be taken in advance of the evaluation process. 1.2.2: Insufficient availability of specialists of the required specialization, who combine experience in art with knowledge of the answers of the public. 1.3.1: Economic mismatch. 1.3.1.1: Large disparity between WTP payment willingness and WTA recovery willingness. 1.3.1.2: Theoretical point of view with a significant difference. 1.3.1.1.1: Low income. 1.3.1.1.2: High availability of satisfactory substituents. 1.3.1.1.3: Large difference between an ex-ante aesthetic value and the corresponding ex-post evaluation (i.e., after the start of the experimental process for estimating the aesthetic value, in order to combine this value with a kind of cost). 1.3.1.1.4: Significant impact of heritage. 1.3.1.1.5: High ambiguity about "real value" in financial terms. 1.3.2: Ethical mismatch. 1.3.2.1: A strong social model against the abandonment of cultural property/monuments (usually symbolizing either the glorious pages of history and/or cultural landmarks) in exchange for money. 1.3.2.2: Great tendency to avoid responsibility by participating in an activity that could prove (later) destructive.

3. Implementation

The methodology described above (i.e., a questionnaire based on the hypothetical CVM evaluation method, reinforced by the corresponding Fault FTA error analysis methodology) has been applied in the case of Eleusina, a small industrial city between Athens and Corinth, in Greece, known as the site of the "Eleusinian Mysteries", one of the most famous events of the ancient Greek religion, and the birthplace of Aeschylus, one of the three great tragedies of antiquity. Nowadays Eleusina is an important industrial center with facilities that contribute to the aesthetic degradation/destruction of the archaeological site. An excerpt of the input-output is shown in Fig. 2. Since the index rule has been adopted for the FTA error analysis methodology, we present a sample of the fuzzy rules (used to measure uncertainty), which illustrates a chain leading from the four-digit combination 1.1.1.1, 1.1. 1.2, in the single digit with a leading point: If 1.1.1.1 is H and 1.1.1.2 is L, THEN 1.1.1 is M; If 1.1.1 is M and 1.1.2 is L, THEN 1.1 is L; If 1.1 is L and 1.2 is H and 1.3 is L, THEN 1 is L. The symbols L, M, H represent the linguistic terms low (L), medium (M), high (H), which are obtained by dividing the space of variables. The input of the triangular fuzzy numbers assigned to each event of the path used to present an example of quantification from the point of view of numerical analysis is given below. 1.1.1.1: 30, 39, 51; 1.1.1.2: 28, 36, 45; 1.1.2: 19, 27, 36; 1.2: 41, 49, 60; 1.3: 23, 37, 48. The results given in their vague form by the shaded trapezoids are shown in the diagrams of Fig. 2, corresponding to the intermediate events (1.1.1, 1.1) and the top event (1), which can be clarified to give the clear numbers/indices 55.61%, 18.27% and 15.72% respectively, indicating a low/mild effect of the input mentioned above. Regarding intermediate cause 1.3.1.1, we found a very large difference between WTP payment willingness and WTA recovery willingness (for industrial plant relocation or

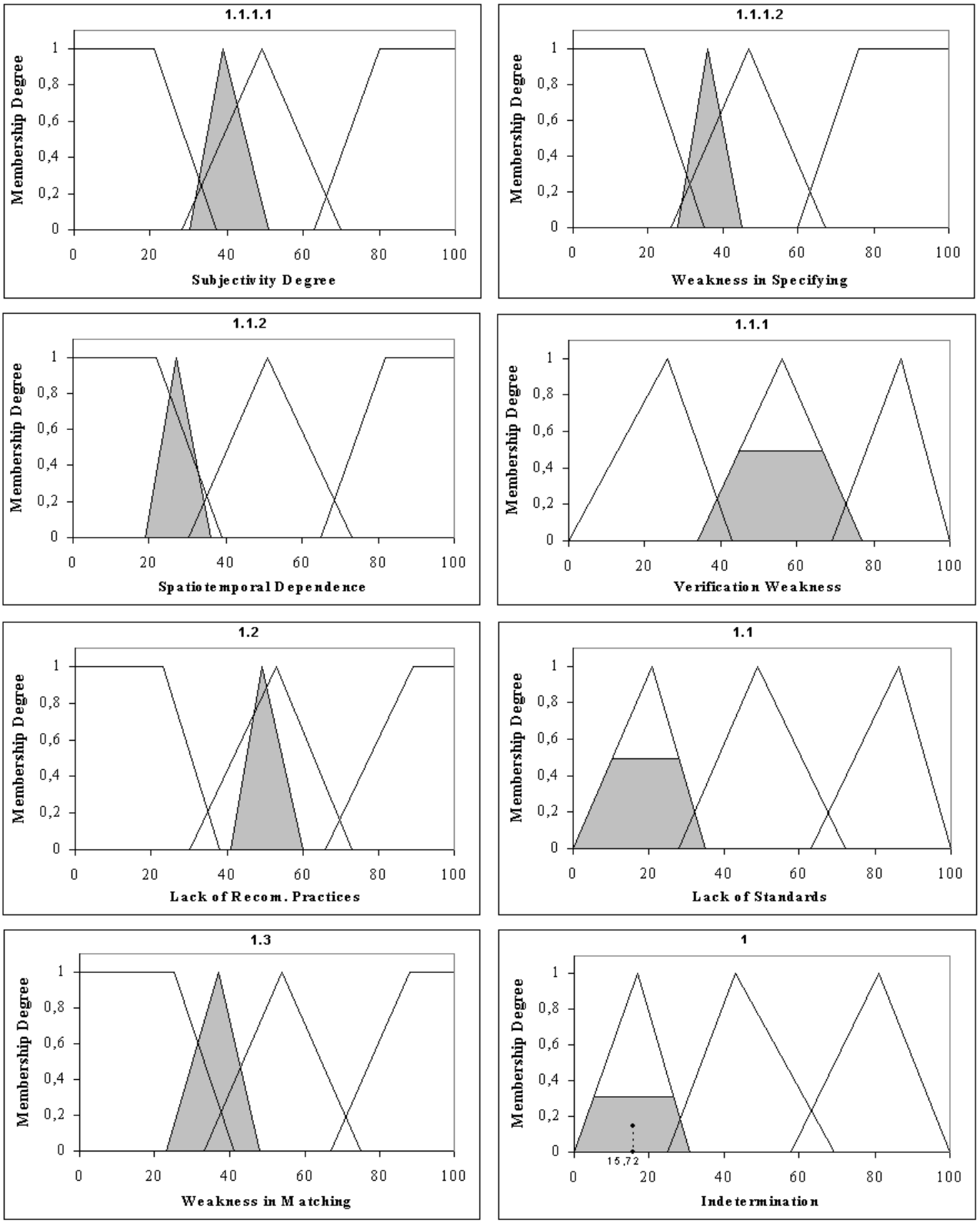

Fig. 2 Unclear intermediate and the final result (as shown in the event/cause diagrams falling under codes 1.1.1 and 1.1 and 1, respectively) and input (in the remaining diagrams) representing the FTA error analysis for branch 1.1 in Fig. 2. The results are given in vague form by the shaded trapezoids that can be clarified to give the clear numbers/pointers mentioned in the text, indicating a low/slight input effect.

still remaining, respectively), and no correlation between them, as evidenced by the very low Pearson product-instant (or "simple") correlation coefficient r = -0.111. It is worth noting that similar low prices have been estimated for two other industrial areas as well, Agioi Theodoroi (51 km south of Athens, where an oil refinery is in operation) and Chalkida (55 km north of Athens, where a cement plant is in operation), with r-values 0.133 and -0.091, respectively. An additional reason (with those mentioned in the error tree of Fig. 1) of the lack of correlation and big difference is that the respondents in these areas are not familiar with dealing with supposed transactions, while everything shows a passive attitude, avoiding taking responsibility to engage, even with the mere expression of opinion, in an activity that could prove (later) destructive, as described in the final cause 1.3.2.2 and confirmed by a post-questionnaire.

4. Discussion

The spatio-temporal dependence of the aesthetic result (intermediate cause 1.1.2), as it is evaluated by both, the experts and the public, is also related to the effort and resources spent to achieve this result. To evaluate the contribution to the EAP up to the determination of the optimal value of the effort intensification (in a specific spatio-temporal domain), I_{opt}, we can consider the total benefit B as consisting of two collision variables $B_1(I)$ and $B_2(I)$. The first, depending on the EAP and more generally on exteriors, is an increasing function of I with a reduction rate (i.e., $dB_1/dI > 0$, $d^2B_1/dI^2 < 0$), due to the force of the law of diminishing returns. The second, depending on the economic rating of I, is a decreasing function of I with decreasing algebraic or with increasing absolute percentage (i.e., $dB_2/dI < 0$, $d^2B_2/dI^2 < 0$ or $d|dB_2/dI|/dI > 0$), as opportunity costs (as defined in terms of the value of alternatives or other opportunities that must be waived in order to achieve the predetermined goal) become disproportionately higher as they increase. Obviously, I_{opt} is the denominator of B_{min} or $(B_1 + B_2)$ min or $MB_1 = MB_2$, where $MB_1 = dB_1/dI$ and $MB_2 = |dB_2/dI|$ are the allowable values of the partial benefits B_1 and B_2, respectively (Fig. 3).

In the short term, the B_1-curve is expected to be in a lower B_1' position, due to the lack of information for both the public and the staff working in the relevant services. The slope of the new curve is smaller for identical I values; derived from a flatter arrangement, since the deviation from the original curve is greater in the area of the higher I-values where the effect of the lack of information is higher (can be critical in some cases). As a result, I_{opt} shifts to I'_{opt}, where $I'_{opt} < I_{opt}$. In the long run, the B_1-curve is expected to move upwards towards B_1", due to the accumulation/transfer/dissemination of knowledge. The slope of the new curve is greater for identical I values, derived from a more pronounced arrangement, since the deviation from the original curve is greater in the region of the higher I-values, where the effect of knowledge accumulation is higher. As a result, I_{opt} shifts to I''_{opt}, where $I''_{opt} > I_{opt}$.

It is worth noting that, instead of expecting such an achievement we can facilitate/provide public participation in the respective events, in order to (i) accelerate the dissemination of information and (ii) cultivate the respective aesthetic criteria. In such a case, the B_2-curve will move downwards, due to the increase in cost, and will also become steeper, as the different shape from the original B_2-curve will be larger in the area of the highest I-values. As a result, I_{opt} will move to I^*_{opt}, where $I^*_{opt} < I_{opt}$, i.e., in the opposite direction of I''_{opt}-shift, while the synthesis of these two vectors will give the final result that should be evaluated against the provision (or grant) (Fig. 3).

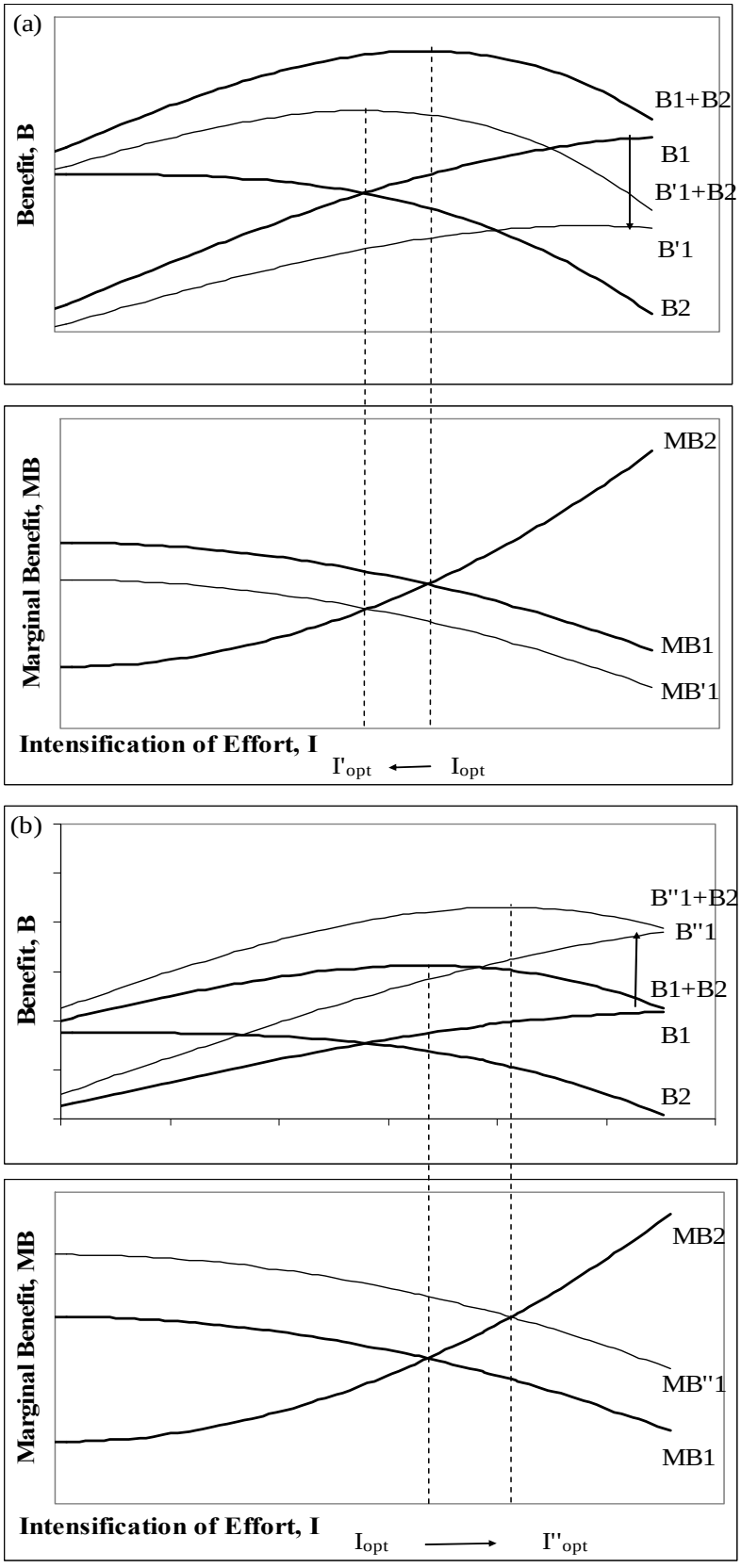

Fig. 3 Dependence of the partial benefits B_1 and B_2 on intensifying efforts I, and shifting B_1 (a) in the short term and (b) in the long term.

5. Conclusions

It has been shown that Experimental Economics can provide techniques that, when incorporated into an FTS/A (Fault Tree Synthesis/Analysis) methodology, are suitable for investigating difficulties in the aesthetic assessment of pollution. We have also noted that EAP, used as an indicator of visual exterior, can contribute to the conceptual determination of the optimal value in the intensification of effort and resources expended (I_{opt}) to achieve a specific aesthetic result. According to this analysis, I_{opt} decreases in the short run (due to lack of dissemination of information, mainly to the public/public) and increases in the long run, due to the accumulation/transfer/dissemination of knowledge. The methodology presented here has been successfully applied in the case of the Eleusina Archaeological Site, where the corresponding extensive aesthetic enjoyment of EAP is reduced by the industrial activities taking place in the area, producing atmospheric/visual pollution and changing the original beautiful blue color. of the homonymous bay.

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