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NATURE RESERVE PRICING: YES, NO, HOW? THE CASE FOR THE DARGA RIVER RESERVE[1]

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Abstract

Managing nature reserves often necessitates achieving mutually exclusive goals. Ecological goals, social and economic ones, can never be fully realized, and the compromising process should best be handled rationally.

In this work, the problem of upgrading nature reserves and financing their operations is examined. A corollary to this problem is also explored, namely: what should be the pricing mechanism at the reserve's entrance? This problem encompasses two dimensions: whether to charge entrance fees? And if so, how much? These questions are important in times of budget limitations, and our suggestion is to enhance the use of cross subsidization as a tool to minimize deadweight loss while keeping the budget constraint relevant.

These questions were examined for the Darga River Reserve. In order to examine the viability of improving the park and its operation, both present costs and the costs of upgrading were studied. The difference in costs was then compared to the resulting difference in benefits. It was found that the upgrading process passes the cost-benefit analysis, as the added costs amount to NIS 531,000 and the added benefit is valued at NIS 4.8 million (based on the non-market valuation study presented later).

The problem of financing was examined for both present costs as well as for upgraded ones. Four forms of monetization were then analyzed: free entrance, charging entry fees that maximize revenue, charging entrance fees that cover the costs of operation, and differential pricing. To this end, we have also used data from the Gamla Nature Reserve, in order to examine joint management and the potential to cross-subsidize between the two reserves.

It has been found that upgrading of the Darga River Reserve can carry itself financially (i.e., with independent management). A fee of NIS 12.73 at

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the entrance could cover the added costs, as opposed to NIS 11.50 charged currently (assuming operation costs are met at present state). The reason is that an upgraded park will also attract more visitors.

At the same time, however, financing the upgrading projects using entrance fees only will create a deadweight loss (DWL). Economic desirability versus managerial collaboration is then called into question. In the case of joint management, the DWL is minimized. That is, the surplus of one reserve, say of Gamla, will cover parts of the operating costs of the other, Darga. This cross-subsidization between nature reserves can bring about an improved state of nature conservation while minimizing visitor losses from the excess burden resulting from the improvement project.

1. INTRODUCTION

The central question in this work pertains to the financing of nature reserves operations and doing so in the most efficient way. In periods of budgeting hardships, it could be desirable to charge the visitors entry fees, despite the public element inherent in the product. This work attempts to examine different ways of subsidizing the operations and the upgrading of nature reserves on the basis of economic valuations of derived benefits. Although we focused on the case of the Darga River, the analysis may serve as an example of the problems and solutions that face the considerations of many nature reserve operations. Thus, our work can serve as a benchmark to the regulating agencies when the issue of pricing becomes relevant despite the public good characteristic of the good (nature reserves in our case).

The Matsok Haatakim in the Judean Desert (Darga River Reserve) is an open reserve bearing costs of maintenance. The important question is whether the damage caused to the reserve as a result of unimpeded visitor traffic is greater than the additional cost required to properly protect it. A positive answer will induce the question of how one might finance this protection. The premise underlying this question is that an added budget will result in greater social welfare, for a reserve properly managed will improve visitor experience, and its value will thus increase. Charging entrance fees creates problem both on an economic basis (DWL), and with regard to social justice (nature being offered at a cost).

In the reserve there is no permanent presence of inspectors on behalf of the Nature Protection Agency (NPA). Many problems are then not properly addressed due to the dilute presence of inspectors in the area; the visitors treat the area as a free-for-all. For example, tourists descend into the Darga canyon in the afternoon, with the length of the trip being 7 hours, and ignore warning signs asking them not to descend after 9:00AM; tourists descend with too little water or with ropes that are too short. All these create emergency situations in which travelers are stranded in the canyon, and helicopter aid must be summoned. Such activities cost taxpayers much, even when not including the loss of human life.

Other problems include the irresponsible use of the night parking lot – tourists allow themselves to sleep and/or light fire in any area they see fit, as there is no organized night-parking service. The lot has no inspector that remains in the region for the entire night, and there is no way of providing people with such services while still preserving the authenticity of the desert. Unorganized sleeping in the region allows individuals to travel on sensitive grounds, to collect wood for fires, to leave dirt, etc. Recent years has also seen greater pressures from Bedouin flocks that put into danger entire plant populations, notable of those is the Desert Rotem.

It is clear that the increased budget must come from alternative sources. In this study, we do not consider this issue, besides the question of whether the use of the funds from the alternative source will ultimately create more damage than benefit. The question analyzed here is whether the added budget will create benefit that exceeds the original addition, and what the optimal means of reaching this goal is.

This question is especially important as there exist continuing differences of opinion regarding the identity of payers. Should the entrance to the reserve be free, as it is a public, or at least, a partially public good (and the financing come via a general budget)? Or should the visitors (in this or in other reserves) finance the upgrades and their operations? In other words, who should pay for nature conservation?

Four different types of financing were examined. Each type of proposed pricing is followed by its associated advantages and disadvantages: Free entrance to the site is beneficial for the general public, and its financing is accomplished via taxpayers' funding or via other reserves. Revenue maximizing financing lies on the opposite side of the spectrum. Although it supplies the highest income, it decreases the number of visitors. This method does, however, allow for diverting the excess funds to other reserves that may then maintain a free entrance status. Cost covering financing is financing that is set to cover the cost of operations without resulting in surpluses or losses. And finally, differential pricing financing is similar to the third method, while here there are neither surpluses nor losses, for neither the nature reserve system as a whole nor a particular nature reserve park. Such a method depends on cross-subsidization between the different nature reserves, and is based on price discrimination on the basis of Ramsey (1927) and Baumol and Bradford (1970). It should be noted that this kind of pricing is used already at the NPA (e.g., Massada vs. other national parks). However, in this paper we suggest an optimal way of dealing with this method.

In order to answer our central question, there is a need in a preliminary analysis of the following parts:

Part I: What is the value of the site? What are the values of the site's characteristics? What is the public's willingness to pay for upgrading the reserve in such a way as to fix the currently unaddressed problems?

Part II: Could the social benefit (as measured via the willingness to pay) be derived from upgrading the reserve be higher than the costs of the upgrade? In other words, could the net benefit, including the costs of the upgraded operations, be higher than the net benefit, measured in the state where this cost is as it is today? Is it possible to fund the costs of operations and of upgrading using entrance fees alone?

Part II will be briefly examined – the discussion of which policy should be preferred for nature reserve pricing[2].

After background information about the Darga River Reserve will be explored in chapter 2, we shall define the economic problem in chapter 3. Chapter 4 will examine the relevant literature on the subject, chapter 5 will describe the methods employed, and chapter 6 will examine the conclusions. Chapter 7 will discuss the various methods of financing upgrade operations and chapter 8 will conclude the work.

2. GEOGRAPHICAL BACKGROUND

The Darga River Reserve is a part of the Faults Cliff (matsok haatakim) Nature Reserve in the Judaean Desert, and lies adjacent to the principal access road to the desert, reaching it through the shores of the Dead Sea to its north-west.

The Darga River is one of the longest and most spectacular rivers in the Judaean Desert. Its upper tributaries drain the eastern slopes of the hills of Jerusalem and Hebron. The river traverses the height of the Judaean Desert, and flows to the Dead Sea near Mitzpeh Shalem, in the district of the Faults Cliff Nature Reserve.

In some of its sections, the river creates deep and narrow canyons. In these canyons, large holes keep their waters throughout the entire year, and so attract a rich diversity of animal life, including foxes, wolves, quills, ibices, hyraxes, small rodents and sweet water invertebrates. Nesting sites of birds of prey can be found in the cliffs of the area,. The river vegetation is rather typical of the desert's canyons and includes, among others, lavender, Desert inebriation, capparis, Podonosma orientalis, and Chiliadenus iphionoides. In the upper canyons the Ephedra campilopoda, typical of Mediterranean nurseries, can be found. In the fall, the Drimia plants flourish on the foothills (Skolnik, 2004).

Fascinating archaeological artifacts may also be found in the Darga River. In the northern cliff of the lower canyon are four caves, giving this section of the river the name "The Quadruple Waadi". In 1951, the French Archaeologist Rolin De Vue unearthed remains from the time of the Bar-Kokhba Revolt, among which are letters of Bar-Kokhba himself, writing to his men. These were the first findings that indicated that Bar-Kokhba's fighting units had operated in the Judaean Desert. The tall river cliffs provide access for surfing sites and climbing activities, drawing to the area both amateurs and professionals. These sites are organized and well designated for surfing activities (Scholnik, 2004).

The hiking path in the river is challenging and includes crossing waterfalls and water-holes via both swimming and the use of ropes. Cooperation between a group's members is necessary. Vista points present impressive sights of the canyon.

There are also possibilities for individual seclusion in the area, enjoying the peace of the desert, and even watching the Dead Sea scenery and spending the night in the partially-organized night parking lot.

[2] The analysis may be obtained by contacting the author.

The rich and diverse system of the Darga River is very sensitive to even slight changes, especially those created by man. Those include hunting, cutting plants for fire, improper garbage disposal and the trampling and crushing of the grounds by motor vehicles. Proper maintenance and supervision requires additional human resources at the site.

3. THE ECONOMIC PROBLEM

Several economic problems arise in the Darga River Reserve. The principal problem apparently stems from the designation of the reserve as an open reserve, and the fact that its budget does not suffice for its operations. It is possible that the benefit of the park is greater than the cost of its operation, but this fact does not necessarily indicate economic efficiency, as additional steps may be taken that, though they may increase its expenses, may nevertheless increase the benefit even more. In order to decipher whether this is indeed the case, there is a need to quantify several parameters: the current cost of operation, the current benefit derived from the site, the additional cost necessary for an ecologically safe operation, and the added benefit derived from such action.

In order to quantify these parameters, we must present the relevant data pertaining to both sets of cost and benefit. The cost data have been received from the NPA. These data include the current costs of operation and the costs of operation in an ideal state – i.e., in the case where we receive all that we wish for. The benefit results have been calculated independently by the use of economic valuation techniques for non-market goods. The two most common valuation techniques were used: the Travel Cost Method, and the Contingent Valuation Method. The application of these two methods yields the benefit of both scenarios.

The form of estimating the benefit yields a number proportional to a monetary sum, although the valuation itself is not monetary. The question, then, is posed – in the event an expanded budget is the favorable course of action, where should the money come from? The problem arises from the fact that once fees are collected from visitors, their numbers decrease. For this reason, it is also necessary to conduct an evaluation of the relation between the entrance fee and its effect on the number of visitors. This is the main point of this discussion.

The first three methods are trivial from an economic theory perspective. One should not charge an entrance fee for a public good, and if such fees are collected, they result in a DWL. In this article, we examined two forms of pricing for the cases where the reserves are independently run: revenue maximizing pricing and cost covering pricing. It is clear that the DWL is higher for the first method than it is for the second, which is why independently run reserves have no use in the former. A cross subsidy between nature reserves, on the other hand, may result in higher total welfare. Hence, a pricing policy that produces higher revenue than the costs of operation, should, for at least some of the reserves, be taken into consideration.

This issue, of cross subsidization, has been in debate for over a century, and it includes both economic questions as well as social justice ones (as it appears to favor one group over another). From an economic point of view, one may quote Baumol and Bradford (pg. 278, 1970) who claimed that:

For particularly if the firm is subject to a constraint on its overall profit, the opening of a market which makes any net contribution [to common cost] may permit or may even require a reduction in price elsewhere.

In our case, the limit on the "zero profit", is especially fitting as the NPA is a non-profit organization. That is, it is possible to write down the net benefit for both parks, X and Y, using the following equation:

$$(3.1)\quad NB = f(V_X) + g(V_Y) - a(V_X) - b(V_Y) - A - B + \lambda(P_X V_X + P_Y V_Y - a(V_X) + b(V_Y) - A - B)$$

Where NB = Net Benefit, V = Number of visitors, a,b = operation variable costs, A,B = fixed operation costs, P = price of entry, and λ = the shadow price of the budgetary constraint.

The first order condition (F.O.C.) for a maximum yields the following equation:

$$(3.2)\quad \frac{P_x - a'(V_X)}{P_Y - b'(V_Y)} = \frac{\eta_y}{\eta_x}$$

Here, the left hand side of the equation expresses the mark-up equation (the increase in the price above the marginal cost, or what Baumol and Bradford term the quasi-optimal price). The right hand side is the elasticity of demand relations for the two parks. If we assume that the variable costs of operations (as a function of the number of visitors) are marginal, then equation 3.2 reduces to the Ramsey rule, which argues that the optimal price relation ratio be equal to the inverse of the price elasticity ratio. As a result, in our case, the one park with the lower elasticity of demand ought to subsidize the other.

4. LITERATURE REVIEW

a. Measuring benefit from Nature Conservation

Natural assets such as scenery, clean air, clean water, and biological diversity are but "products" of rather high value, but no market price. As such, it is customary to assess the value of non-market goods using several different quantification methods. These methods are based on the principle of willingness to pay, and that itself is derived through indirect approaches (such as via the Travel Cost Method) and direct ones (such as the Contingent Valuation Method).

The two most prominent methods for quantifying natural resources such as the Darga River Reserve are the "indirect method" and the "direct method". In the former, one bases his observation on the actual behavior of the subjects and then infers as to the benefit derived from the site. The most common model for doing this is the Travel Cost model, in which a correlation between the travelling cost and the travelling frequency is found. Using this correlation, one is then able to obtain the demand function, and its derivative, the benefit from the site. This method was developed in the US in the early 1950s and has been used in hundreds of studies (Ward and Beal, 2000). The main advantage of this method depends on the fact that it is based on the actual behavior of subjects. Its main disadvantage, however, lies on the fact that it is difficult to use the method for non-use values. The direct method, on the other hand, is based on hypothetical questions for a representative sample of the relevant population. The most common method for doing so is using the Contingent Valuation Method. Its disadvantages lie mainly in the fact that it is a hypothetical scenario builder. In our case, however, as had been mentioned, non-use values cannot be derived from the visiting frequencies, and so this case has no choice but to resort to using direct methods (Mitchell and Carson, 1989).

Several studies have been conducted in Israel in an attempt to quantify different natural reserve assets: The Carmel Park (Shechter et al., 1998), the Gamla Reserve (Becker et al., 2007), the benefit of the agricultural scenery in the Jezreel Valley and in Hula (Fleischer and Tsur, 2000), the Dead Sea (Becker and Katz, 2006), and the Coral Reef Reserve in Eilat (Weilgus et al., 2003). These studies are but tips of the iceberg made up of hundreds of studies done worldwide with the goal of quantifying the benefit derived from unique natural resources, regardless of whether entrance to which involved fees or not. In this study, we attempted to delve into the root of the problem inherent in nature reserves, and not necessarily in quantifying the benefit from it. The focus of this study will therefore not be in valuation methods, but rather, in their connection to the problem of financing.

b. Nature Reserve Pricing Policies

Financing public parks and nature reserves is a problem common to many countries. In most cases, the entrance to public parks does not cost money (this is true for urban parks as well, as in Central Park, New York, and Hyde Park and St. James' Park in London).

In recent years, however, the understanding that these parks cannot rely solely on governmental funds and hence must find additional financing sources has become common. Today, more and more countries adopt the idea of charging entrance fees (Versailles, Paris, The Botanical Gardens, London, Yosemite and Sequoia National parks, USA), in order to preserve and develop these same reserves.

Theoretical justifications can be found both for supporting the pricing of nature reserves, as well as for opposing it. Similar studies have been conducted in Portugal (Mendes, 2004), although there, the main goal was to find what the suitable conditions are for pricing a park as opposed to allowing free entry.

Arguments supporting nature reserve pricing (efficiency):

1. User pays – Park maintenance and its operation ought not be forced on all of the country's citizenry (as in, when government pays). As in every product with a market, whoever is interested in a certain product ought to pay for it.

2. Government budgets are limited – The government cannot always pay for the maintenance and preservation of the park, and hence, it must be priced. Government officials are aware of the fact that subsidizing park entries may create deadweight loss (a net loss of social welfare), and given that the state budget is limited, these funds will be better diverted to causes with higher efficiency of social investment (i.e., a higher social welfare).

3. Carrying capacity – in the event entrance to the park is priced, fewer visitors arrive there, thus lowering its density. This scenario is beneficial for both the ecological state of the park, as well as for the experience of every visitor.

4. Improvement of the Nature Reserve – in order for services to be offered to the visitors, and for those services to be improved, there is a need for financing. Visitors arriving at the park require at least basic services, and often more than that. These services come with a cost.

5. Conservation and development of less visited parks – we are also interested in conserving and developing less visited parks. The resources needed for their operation can be obtained using the policy of price discrimination. At a park with a non-elastic demand (such as Masada), a higher price may be charged, and the excess funds may be diverted to less visited parks (where their development may encourage greater visits in the future).

Arguments opposing nature reserve pricing:

1. A public good – nature belongs to everybody, and hence there is no reason to charge money for it. Even at a park, in case the state decides that it is open to the public, there is no marginal cost for an additional person coming to the park, and so there is no reason why they should be charged an entry fee. An entrance fee will lead to deadweight loss.

2. Nature exists and is not produced – nature had not been produced. It had already been in existence, and there is no cost for supplying its services. Hence, it is immoral to price nature. Its pricing will lead to lower social welfare.

3. Equality in natural resources – since nature belongs to the entirety of the population, its pricing will inevitably exclude certain socio-economic strata, which will no longer be able to enjoy it. There is no reason why those of fewer means should not be able to enjoy the natural resources enjoyed by those of greater means, when they belong to the former as much as they do to the latter. Furthermore, it is beneficial for the state that each of its citizens may enjoy the country's treasures, for both educational purposes, as well as those of heritage.

From the viewpoint of implementing the different pricing policies, several examples should be mentioned. Richer and Christensen (1999), for example, examined the willingness to pay for leisure in public areas and found that about 62% of the respondents are willing to pay more than the average cost of maintenance per visitor. The result of pricing by the median induces a 17% decrease in the number of visitors, as opposed to a 52% drop for a pricing policy that maximizes revenue. A similar result has been obtained in the present study, albeit not by using the median, rather in the policy which covers costs. Wu (2010) examined what the determining factor is for preferring different pricing policies in Taiwan. It is interesting to note that in contrast to the factor found in Western countries, the most important factor for the Taiwanese is social justice, as manifested in under-pricing (and the completion of costs via tax funds). Stamieszkin et al. (2009) discuss the case of a Marine Nature Reserve in Mexico, and they reach the conclusion that one of the necessary conditions for sustainable management of the reserve is raising the price of park entry (given a meticulous monitoring of all ecological systems and the consideration of the most efficient diversions of funds using this entry fund). Finally, Edwards (2009) examined the case of a coastal nature reserve in Jamaica. His conclusion was that raising the entry fee by $2 per visitor will result in a 0.2% loss in the number of visitors, while at the same time, create an additional annual revenue totaling $3.4 million. It is clear that the elasticity of demand is rather low in this specific case, and that this empirical example may easily vary depending on the country and the alternatives that face the visitors.

If we disregard the question of the viability of the pricing: whether we should or should not price it, it is also possible to ask: if we are to price the park – how should we go about it? Pricing policies may be based on several approaches. It is possible to price the entry to all nature reserves with a fixed price, but in most cases differential pricing is preferable. The latter mechanism differentiates between the different visitors, and it is the most efficient with regard to lowering deadweight loss. Price discrimination can come about in several ways: discrimination between domestic versus foreign tourists, between different visitors of the same reserve (by age, for example), or between different reserves.

For example, a study conducted in Italy (Naples) for the management of the park known as the Royal Wood of Capodimonte shows that price discrimination for entry fees between different populations, increases social welfare and the public benefit derived from the park. The results of the study show that even when free entry is granted to senior citizens, and when children (younger than 18) and students (ages 18-25) are given 50% discount, this option is still preferable to the fixed price alternative (Willis, 2003).

In a comparative study of different pricing strategies in three parks in Costa-Rica, using the Contingent Valuation Method, it has been found that it is possible to cross-subsidize between parks that offer similar experiences (Chase et al. 1998). A differential pricing between the parks may motivate the visitors to "relocate" from one park to another, in order to discourage an over-density in the first park while creating more employment for those living near the second park.

The question of how much one should price the entry fee to one nature reserve, then, depends on the goal one wishes to accomplish (Laarman and Gregersen, 1996; Sibley et al., 2001). The most social and egalitarian alternative is to grant all visitors free entry, or at least, to have a pricing strategies consistent with the principle of cost coverage. On the other hand, it is possible to devise an extreme alternative of revenue maximization. Finally, joint managing of parks can utilize cross-subsidization as a tool to minimize the DWL caused as a result of pricing the entries (Walpole et al. 2001).

5. RESEARCH METHOD

a. Measuring Benefits

In order to measure benefit from a given reserve, a questionnaire had been composed, consisting of three parts. The questionnaires that were handed out to park visitors are concerned with the section between the recreational village "Mtzookei Dargot", through the night-time parking lot, and extending to the opening to the descent to the Darga River canyon. The questions pertain to the willingness of the visitors to pay for improving the park's inspections and for improving the guidance in these particular areas. The questionnaires were handed out in two sites: in the Cafe of the "Mtzookei Dargot" recreational village, and at the entrance to the Darga River canyon, prior to the actual descent.

178 questionnaires were handed out, out of which 164 (92%) were usable. The first part of the questionnaire was used as the source for the Travel Cost Method, while the second part was used as the source for the Contingent Valuation Method[3].

The final analysis of the results yields the average or median of the willingness to pay, in the case of the Contingent Valuation Method, and the visiting function (from which, the benefit), in the case of the Travel Cost Method. Multiplying this value by the size of the relevant population (such as the annual number of visitors for a site, or the number of households in the state), gives the total value of the resource or of the site.

b. Different pricing methods

The principal part of this study is to examine what the effects of the different pricing methods are both on the visits in the sites, on the resulting public welfare as a result of this visit, and on the possibility of improving the reserve. The different pricing methods were: (1) free entry, (2) cost covering pricing, (3) revenue maximizing pricing and (4) differential pricing between two nature reserves.

As mentioned above, the first method is consistent with the idea that the site is a public good (at least, up until a certain number of visitors). And since the cost of personal use is rather low, if not negligible (most of the involved costs are not a function of the number of visitors, but are fixed costs), the price ought to follow suit. That is, a zero price, or free entry. This condition, however, would only be implemented in the event the government should, using its own budget, subsidize the costs of preserve. Since this is not the case the consumers are asked to pay for at least part of the price. In this context two alternatives have been discussed: the first, to price the entry such that the derived revenue will suffice to cover the costs of preserve. The second is to price the entry in such a way as to maximize the revenue. Given that the NPA is a non-profit organization, the question is then asked, why is there a need to charge a higher price that the cost of maintenance of the site? The answer hinges on a different pricing policy which aims to price different reserves simultaneously in a mixed system. It is possibly preferable to charge a higher price for some of the sites, while charging a lower price for others, in order to cover the costs of operations that are not covered by the government. This is the basis of the fourth method. It was examined using an integrative analysis of the Darga River Reserve *in tandem* with the Gamla Reserve in the Golan Heights.

[3] A copy of the questionnaire may be obtained upon request.

6. RESULTS

a. Benefit assessment using the Travel Cost Method

In order to assess the benefit from the reserve, a multi-variable regression model had been built, where the explained variable is the number of visits per capital per annum. The explanatory variables that have been used to construct the model are the responses of the respondents with regard to questions of the importance of the reserve's characteristics, activity in the reserve, the travelling cost[4] and other socio-economic variables[5].

The socio-economic variables include: Sex, age, country of birth, membership in green organizations, number of adults in the group, number of children in the group, education and income. The regression results are given in Appendix 1.

In order to obtain the visits per capita function (VPC) only as a function of total cost (TC), the coefficients of each variable, except that of travelling cost, have been multiplied by the average value obtained from the questionnaire data. In other words, all of the variables, besides that of travelling cost, were held constant and added to the derivative of the linear equation. The equation obtained is given by:

$$(6.1) \quad VPC = 2.20391 - 0.00462\ TC$$

It is possible to calculate, therefore, that the average number of visits per capita among the visitors of the site is 1.24 visits per annum. And from the average number of visits per capita, the average travelling cost has been calculated, and an average net benefit was found (consumer's surplus). This benefit is given by the integral of the visiting frequency function between 0 and 1.24, minus the costs associated with these same 1.24 visits. It has been found that the average traveling cost per visitor is NIS 149.74, while the average net benefit per visitor is NIS 167.57 (or NIS 135.14 per visit).

It is possible to now calculate the benefit of the site for its users by multiplying the net benefit by the number of visitors in the site per annum. On the basis of 60,000 visitors per annum, the value of the site is calculated to be NIS 10,053,960.[6]

[4] The travel cost was calculated by having the distances (obtained from Google Maps) multiplied by the cost of gas, normalized by an average travelling velocity and cost of NIS 1.40 per KM. In addition, 25% of the hourly wage has been added as opportunity costs of the time (Mckean et. al, 1995).

[5] In the models where the respondents are asked for the frequency of their visits in the past year, the OLS regression may result in biased coefficients. Here, however, they are asked for the total frequency of their visits. That is, the dependent variable is continuous. We still have a bias in our sample, however, as the ones at the park are more likely to have higher frequency of visits, hence, not a representative sample. Benefits obtained, then, are overestimating; the relative value of the coefficients, however, does not itself change. The analyzed results pertain to a linear regression, which could be integrated over the whole site. Two additional regressions were then also performed: a semi-logarithmic regression and a count regression. Due to the limits of space, the results shown here pertain to the linear case.

[6] The questionnaire also includes questions regarding the change in visiting frequency as a result of the absence of elements in the reserve. Answers to these questions allowed for identifying the value of each element. These may be obtained upon request.

b. Assessing the value of improvements using the Contingent Valuation Method

In order to use this method, each respondent's willingness to pay was calculated for each improvement of a given problem, using the monetary means presented in the questionnaire. Afterwards, the average willingness to pay for solving all of the problems simultaneously was assessed. The public willingness to pay for each resource and for all of the resources together was calculated on the basis of 60,000 visitors per annum.

The data obtained are presented in Appendix 2. As can be seen in the appendix, the total public willingness to pay for improving or preserving the reserve's characteristics sums up to NIS 4,809,917. That is the public benefit derived from improving the environmental services that the reserve yields.

We shall notice that, in effect, increasing the value of the reserve's characteristics has caused an increase in the demand function. In fact, increasing the value of the reserve has also induced an increase in the number of visitors (but differentiating between existing visitors and new visitors is both impossible and irrelevant for our economic analysis). Given that the benefit derived from improving the reserve has brought about an increase in the value of the reserve by 47.8% (NIS 4.8 million out of the current benefit of NIS 10 million), it is clear that the net benefit for visiting ought to have grown by the same amount.

The change in the area of the net benefit ought now to equal an increase of 48% of the original NIS 167.57, the current benefit per visit. Substituting the frequency variables of the relevant visits in the visits per capita function yields 1.83 visits per capita. That is, the intersection of the vertical axis ought to occur at 421, as equation 6.2 needs to be satisfied:

$$\begin{aligned} &\{1.83\,[(419 + X) - 150\}/2 = 167.57\,(1.48) \\ &\Rightarrow X = 2.04 \end{aligned} \tag{6.2}$$

If we add this result to the old intersection, 419, we shall obtain 421.

The number of visits per capita has increased to 1.83. We shall notice that this is close to the full potential of the reserve (1.94 visits per capita at a price of 0NIS per entry). If, in the old condition, there were 48,387 visitors who have visited 60,000 times, the total number of visits has now increased to 88,548 (43,387x1.83).

c. Assessing the costs of reserve operations

The costs of operation and improvements are listed in Appendix 3. These costs are split into the costs associated with the current management method, and the method which would allow the increase in benefit calculated above.

As can be seen from the table, the added cost needed to improve the reserve is NIS 531,000. Today, the reserve is operated by 0.9 inspectors, whereas following the improvement, it will have been operated by 3.6 inspectors (a 400% increase).

Investment in training, management and inspection in the Darga River Reserve with higher budgeted resources can bring about a decrease in the costs of rescue out of the river channel. These costs are comprised of both direct and indirect costs. The direct costs are given by the cost of the rescuing unit in a mission. The indirect costs include the value of human lives lost (in the case of death), or the costs of medical treatment and loss of workdays (in the case of injury). According to the data given by the NPA, there are 5.4 persons rescued per event on average, and 78.36 persons rescued in an average year. To this end, 2 helicopters and 105 rescuers have been used annually over the years, where the number of rescuers per event is 8.48. The annual number of vehicles being used currently stands at 45.63, where 3.7 vehicles are used for an average mission. The data also indicate that 1.82 visitors are rescued in conditions that necessitate hospitalization and 1.45 visitors lose their lives in an average year.

In order to assess the direct costs of rescuing, we shall categorize the different types of costs. The amortized value of fixed costs (especially with regards to equipment), assuming a discount rate of 5% for 10 years, stands at NIS 45,326 per annum. In addition, there are other costs associated with rescuers and helicopter-time. The total yearly costs of rescuing stands at NIS 113,241.

Emergency rescues often end in serious injuries and in loss of human life. In order to assess these costs, we shall use the average data of injury and death and monetarily quantify them. With regards to injuries, the estimate is made that each injury involves treatment and by the loss of workdays. Injuries may be either non-serious or life-threatening. Given that the distribution of these separate injuries is not listed, we shall assume that the typical injury is a medium-one. Such an injury necessitates hospitalization and half a year's treatments and a corresponding loss of workdays. Based on a measure of NIS 1,750 per hospitalization day (Ministry of Health, 2007), the yearly cost as a result of such injuries is NIS 319,375. An average yearly wage currently stands at NIS 92,400, and so the loss of wage as a result of the injury is NIS 46,200. The sum of the two types of costs yields the total indirect cost per injury, NIS 365,575. Given that there are 1.82 such cases per annum, they cost an annual NIS 665,346.50. The value of human life, in economic literature, is generally measured by evaluating the risk premium for very dangerous jobs. Such a figure is 6 times higher than the value of human life obtained by more traditional methods, such as those based on the current value of the lost wages (Becker, 2000; Shmueli and Nisan-Anglechein, 2007). We decided the use the lower figure of the two. If we suppose 30 years of lost work for a deceased person and an average income of NIS 92,400 per annum, the present value of such an income flow is then NIS 1,420,414 per human life (assuming a 5% capitalization rate). Given that there are 1.45 deaths in an average year, the annual value of lost human lives in the Darga River is NIS 2,059,600.

What is the benefit from the reserve management which takes into account both costs and indirect benefits? The answer to this question is not clear, as it is uncertain how many rescues one could have prevented had a more budgeted management been in place. Roughly, all of the rescuing missions have been examined and were split into two: rescues as a result of negligence, and those as a result of the natural risks associated with hiking along challenging paths. It is estimated that 50% of the rescues could have been prevented (according to the NPA's inspectors, information told in person). This result indicates that 50% of all costs could have been saved (higher saving rates will not change the essence of the results). We emphasize that this is only a rough estimate, and a separate and more focused study is necessary. The rough orders of magnitude, however, do indicate as above.

The final table in Appendix 3 summarizes all types of costs, both with a budgeted management and without.

7. DISCUSSION

The economic analysis above shows a public preference for higher funding of the Darga River Reserve. Table 1 shows the net benefit and the cost benefit ratios for the different scenarios.

Table 1
Net benefit and benefit-cost ratio for different scenarios

Benefits	Environmental value (NIS)		Environmental value + rescue costs savings (NIS)		Environmental value + rescue costs savings + morality & injury costs savings (NIS)	
Value	Total value	Use value only	Total value	Use value only	Total value	Use value only
Net benefit (NIS million per year)	4.279	0.239	4.335	0.391	5.698	1.754
Benefit-cost ratio	9.06	1.45	9.16	1.73	11.73	4.3

As can be seen in the table, the benefit increases as one takes into consideration indirect benefits. Given that the previous study conducted with regards to the benefit from the reserve yielded only 18% of use-value and 82% of non-use values, the net benefit and the cost benefit ratio were determined for both the total benefit as well as that of only the use-values. As can be seen from the table, even in the most conservative case, in which only the use-values had been taken into account, a net benefit of about NIS 239,000 and a cost benefit ratio of 1.45 have been found. If we continue with this conservative measure of only use-values, we can see that increasing the savings derived from the rescuing costs increases the net benefit by about NIS 150,000 per annum, while the most prominent factor is the added savings derived from treatment costs and the saving of human life. Adding those to the net benefit, increase it to NIS 1.75 million per annum (it should be noted that out of which NIS 1.029 million per annum is associated with decreasing the mortality rate).

a. Alternatives for financing the improvement

As mentioned above, the four examined alternatives were: free entry, cost coverage, revenue maximization and differential pricing.

The first step in the analysis is to derive a demand curve for the reserve, as opposed to the frequency of visits curve obtained in the last section. To this end, it is necessary to use the frequency function as well as the regional frequency of arrival. From these data, it is possible to create a simulation of the effects of a price increase on the number of visitors from each region. The inverse demand function obtained is given by equation 7.1:

(7.1) $Pd = 30 - 0.0005Vd$

where P = price of entry to the Darga River and Vd = number of visitors in the Darga River.

From the demand curve, the marginal revenue curve (MR) is obtained:

(7.2) $MR = 30 - 0.001Vd$

while the total benefit function is given by:

(7.3) $TB = \int Pdx = 30Vd - 0.00025Vd^2$

We can obtain the total revenue function (TR) by the product of the price by the number of visitors from (7.1):

(7.4) $TR = P * Vi = -2000Pd^2 + 60000Pd$

while the deadweight loss is given by:

(7.5) $DWL = TBmax - TB$

That is, the maximum total benefit minus the total benefit obtained in the examined scenario.

From the standpoint of the costs, we assume that none of the costs are changing, and so the marginal cost is zero. The total cost of the site are then fixed costs that equal NIS 108,000. Finally, the profit equation (π) is given by (7.6):

(7.6) $\pi = TR - TC$

b. Revenue maximizing pricing (MR=MC)

Equation 7.2 describes the marginal revenue. In order to maximize revenue, one must compare this equation with the marginal cost one, and since we are dealing with a public good whose marginal cost is zero, an equation for 7.2 yields Vd = 30,000. That is, the number of visitors in the reserve which will maximize the revenue. Substituting this number into the demand function yields the price where revenue is maximized: Pd = 15. The rest of the variables – the total revenue, the total benefit and the deadweight loss are found by substituting the above quantity and price in the relevant equations 7.3, 7.4 and 7.5:

TR = 450,000 ;TB = 675,000 ;DWL = 225,000, π = 342,000.

c. Cost coverage pricing

In order to cover the operation costs of the reserve, the revenue must sum up to NIS 108,000, covering exactly the current operating costs. The equation describing this equation is given by 7.7:

(7.7) $108{,}000 = -2000Pd^2 + 60000P$

This is a quadratic equation, and so has two solutions:

Pd1 = 1.92 Vd1 = 56,153
Pd2 = 28.08 Vd2 = 3,847

This equation has two roots, the relevant solution of which is NIS 1.92. If we substitute the relevant entry price into the demand equation, we shall obtain the number of visits for this price: Vd = 56,153.

Substitution into (7.3), (7.5) and (7.6) yields TB = 96,300, DWL = 3,200 and $\pi = 0$.

d. Profit maximizing pricing

In order to maximize welfare one must compare the entry price with the marginal cost of visiting the reserve. This is, in effect, the current situation in the Darga River. The entry to the site is free, and so is the marginal cost of every additional visitor.

The number of visitors in the reserve is derived by comparing the entry price from equation (7.1) to zero: the solution yields a number of visitors equal to 60,000. Since the entry is free, the revenue for the reserve is zero as well, as is the deadweight loss (as there is no limit on the number of visitors). In this case, the social welfare is maximized, TB = 900,000 and it is clear that the profit is given by minus the cost, -108,000.

e. Differential pricing

In order to analyze differential pricing, the Gamla Reserve had been included in our study, a reserve to which entry is currently not free. The Gamla Reserve is different from the Darga River Reserve in two principally different ways: the demand curve for the Gamla Reserve is <u>less elastic</u> and is <u>higher</u> (for the original study on the Gamla Reserve, see Becker, et al., 2007). Intuitively, given that this is the case, one may conceive of a situation where the price for entry to the Gamla Reserve ought to be higher than that for Darga. In fact, that is the condition for cross-subsidization. The Gamla Reserve needs to subsidize the Darga Reserve so that the deadweight loss in both will be minimized.

The mathematical model is given by:

(7.8) Max TB = TBg + TBd

Subject to
Pg * Vg + Pd * Vd = TC
TC = TCg + TCd = 1066050 + 108000 = 1,174,050

Where g symbolizes the Gamla Reserve. In words, our goal here is to maximize the benefit for both sites (subject to minimizing the deadweight loss), both under the constraint of simultaneous cost coverage for both sites. We shall note that the operation costs for the Gamla Reserve is approximately 1.07M NIS.

In order to calculate the price that should be charge, we shall use the Lagrange formula:

(7.9) L = TBg + TBd + λ * (Pg * Vg + Pd * Vd – TC)

Similarly, two demand equations are given as well. The demand equation for the Gamla Reserve is taken from Becker et al. (2007), while the demand equation for the Darga Reserve is the one shown above.

(7.10) $Pg = 354.49 - 0.0037Vg$

(7.11) $Pd = 30 - 0.0005Vd$

If we substitute both demand equations in the Lagrange function, we shall obtain the following equation:

(7.12) $L = 354.49Vg - 0.00185Vg^2 + 30Vd - 0.00025Vd^2 + \lambda * (354.49Vg - 0.0037Vg^2 + 30Vd - 0.0005Vd^2 - 1174050)$

By differentiating this function with respect to the number of visitors in both sites and with respect to the Lagrange multiplier, an equation describing the connection between the number of visitors (in both reserve) and the expansion path can be found:

(7.13) $Vg = 1.597Vd$

We shall substitute Vg into the constraint and shall obtain Vd and Pd. The only root of the price of interest here is Vd = 57,961, and hence Pd = 1.02.
By substituting Vd into the relevant equations we shall solve for Vg and Pg:

Pg = 12.05→ Vg = 1.597 * 57961 = 92552

The rest of the examined parameters are derived from the number of visitors and from the entry price in both sites:

TR = 12.05 * 92552 + 1.02 * 57961 = 1174050
TB = 17,860,857
$\pi(g) = 12.05 * 92552 - 1066050 = 48,909$
$\pi(d) = 1.02 * 57961 - 108000 = -48,909$

In order to compare this result with the one obtained in the scenario of two independent managements, we shall also list the Gamla Reserve's data for the three types of pricing. The method is similar to the one used for the Darga River, and the data is given in Table 3.

Table 2
Comparative summary among the three pricing policies – Darga Reserve

The demand function to Darga River Resort – P = 30-0.0005Vd							
Pricing	P	Vd	TR	DWL	TB	TC	Profit
Maximum revenue	15	30,000	450,000	225,000	675,000	108,000	342,000
Cost recover	1.92	56,153	108,000	3,700	896,300	108,000	0
Maximum welfare	0	60,000	0	0	900,000	108,000	-108,000
Differential pricing	1.02	57,961	59,120	1,966	890,034	108,000	-49,809

Table 3
Comparative summary among the three pricing policies – Gamla Reserve

The demand function for Gamla Resort – P=354.49-0.0037Vg

Pricing	P	Vg	TR	DWL	TB	TC	Profit
Maximum revenue	177	47,904	8,490,754	4,245,377	12,736,131	1,066,050	7,424,704
Cost recover	11.5	92,700	1,066,050	17,872	16,963,637	1,066,050	0
Maximum welfare	0	95,808	0	0	16,981,508	1,066,050	-1,066,050
Differential pricing	12.05	92,552	1,115,252	19,727	16,961,681	1,066,050	49,809

Compared to the scenario of cost coverage in the Gamla Reserve, the entry-price ought to increase from NIS 11.50 in an independent management, to NIS 12.05 in a joint management. In the Darga River Reserve, on the other hand, the entry fee ought to decrease from NIS 1.92 in the case of cost coverage in an independent management, to NIS 1.02 in a joint management.

If we compare the sum of the benefits of both reserves in an independent management with their sum in joint management, the obvious can be seen: a joint management with cross-subsidization yields the net benefit that is closest to that obtained in a free-entry (that is, the minimization of deadweight loss), while simultaneously covering the costs of both reserves.

By charging these entry costs and by the number of visitors derived from them, it is expected that the Gamla Reserve shall subsidize the Darga River Reserve with a yearly sum of NIS 48,909. It should be emphasized that there is no practical significance to charging either NIS 1.02 or NIS 1.92. Rather, the principle in hand is what is important for determining the spirit of the matter. Not all of the reserves ought to be priced the same. In practice, today the Darga River Reserve is an open reserve while the Gamla Reserve is closed one (entrance is only done for paid tickets). The present analysis showed that there is good reason for such a differential pricing, while the actual magnitude of the price discrimination is an endogenous variable to be determined by an economic model.

So far we have analyzed a situation of pricing with present-day costs. The most important preliminary step, however, was conducting a cost-benefit analysis for determining whether the Darga River Reserve could indeed be improved. The next section will show that cross-subsidization is still the most efficient tool, even in the case of improving the state of the Darga River Reserve.

8. WAYS OF FINANCING THE IMPROVEMENT OF THE DARGA RIVER RESERVE

As seen above, the cost to improve the Darga River Reserve sums up to NIS 531,000NIS per annum, such that the total costs of the site will be NIS 639,000 per annum. We shall first deal with the independent management case, and then examine the joint management one.

a. Independent management:

For the Gamla Reserve, the solution remains as before, as nothing has changed.

The prices and quantities, then, are given by: Pg = 11.5, Vg = 92700. The social welfare and the profit are then given by: $\pi = 0$, TBg = 16,963,637.

For the Darga River, the solution changes, as both the costs and the demand curve have shifted. The calculation is done as in section G.II, with cost-coverage pricing. We shall notice that due to the changes, the entry fee and the number of visitors will change as well.

In order to obtain the new benefit and demand functions for the Darga River Reserve as a result of the improvements, we have used equation 6.1 and have arrived at the new equation, given by:

(7.14) $Pd = 37.83 - 0.0005Vd$

The integral of (7.14) yields the new benefit function, given by:

(7.15) $TBd = 37.83Vd - 0.00025Vd^2$

The use of (7.14) for creating a total revenue function and its comparison to the new costs yields the solution given by: Pd = 12.73 and Vd = 50198.

We emphasize that had the number of visitors not changed, even a price of NIS 15, which is the entry price that yielded maximum revenue, would not have covered the new costs. What does allow for cost coverage, then, is the shifting demand function. Although the current price is lower than NIS 15 (only NIS 12.73), it is still possible to cover the new operating costs. This is so as the number of visitors has increased and is no longer 30,000 as in the original case, but is 50,198!

It is possible to claim, then, the costs of improvements are bearable even from a financial point of view, even in the case of independent management. The social welfare will then change accordingly. The profit will remain zero, simply by definition of "cost-covering pricing".

(7.16) $TBd = 37.83 * 50198 - 0.00025 * 50198^2 = 1{,}268{,}957$

(7.17) $\pi = 12.73 * 50198 - 639{,}000 = 0$

If we sum the current benefit from the independent management of both reserves, we shall obtain:

(7.18) $TB = TBg + TBd = 16{,}963{,}637 + 1{,}268{,}957 = 18{,}232{,}594$

Where TBd is the social benefit (welfare) from the Darga River and TBg is the social benefit (welfare) from the Gamla Reserve.

b. Cross-subsidization solution – joint management:

The calculation is similar to that shown in G.iv, namely, by setting up a Lagrange function for the two sites as expressed in (7.9), this time under the constraint of cost coverage in both reserves.

(7.19) $TC = TCg + TCd = 1,066,050 + 639,000 = 1,705,050$

Substituting the constraint in the target function yields:

(7.20) $L = 354.49Vg – 0.00185Vg^2 + 37.83Vd – 0.00025Vd^2 + \lambda * (354.49Vg – 0.0037\backslash Vg^2 + 37.83Vd – 0.0005Vd^2 – 1,705,050)$

A solution for FOC for the three decision variables (the number of visitors in both reserves and the shadow price) yields the following expansion path:

(7.21) $Vg = 2.457Vd$

and substituting the equation first in one of the new demand functions and then in the other yields the number of visitors and the prices for the two reserves:

$Vd = 71,975$; $Pd = 1.84$
$Vg = 91,145$; $Pg = 17.25$

Substituting the number of visitors in the benefit functions of the two sites yields the total benefit:

$TB = 18,368,893$

And it is possible to see, yet again, that a joint management is preferable to an independent one. In the resulting situation, however, the entry price should increase in the Darga River Reserve to NIS 1.84 (as opposed to NIS 1.02 before the improvement), while the Gamla Reserve ought to increase its entry price to NIS 17.25 (as opposed to the previous NIS 12.05). We shall notice that as a result of the cross-subsidization the number of visitors has decreased in Gamla from 92,552 to 91,145 after the improvement of the Darga River as a result of the former raising its entry price. This is the impressive significance of joint management, however: we lose in one place for a higher profit in another. Such elasticity would not have been possible had the **joint** element in the reserves been different.

In order to examine the total cost of subsidization, we shall calculate the profit for each reserve independently as a result of the cross-subsidization policy:

(7.22) $\pi(g) = 17.25 * 91145 – 1066050 = 506,485$

(7.23) $\pi(d) = 1.84 * 71975 – 639000 = -506,485$

That is, charging such entry prices, we expect that the Gamla Reserve shall subsidize the Darga River with an annual NIS 506,485. Such a sum will represent 80% of the new total operating costs of the Darga River Reserve, as opposed to the situation before the improvement, where the subsidization summed to 45% of the total costs.

9. SUMMARY AND CONCLUSIONS

The main question to be examined in this paper was with regards to the management of nature reserves:

What is the most efficient way to finance a reserve both in an original case as well as in an upgraded case?

The Darga River Reserve was used as the basis for the empirical part of the research. During the study, both the current operation costs of the reserve were examined as well as the costs of its improvement –all as grounds for a better operated reserve, with regards to managing the number of visitors, preserving natural resources, attenuating the costs of rescue. The resulting direct and indirect benefits have also been examined (as in injury, or death).

Measuring the benefit from the use of the reserve was obtained using the Travel Cost Method and the Contingent Valuation Method. These methods have yielded the present day benefit and the future benefit of the reserve in the event the services provided will be improved. The number of visitors for each scenario has also been calculated.

It has been found that the current operating costs are about NIS 100,000 per annum and the upgraded operating costs will be NIS 600,000 per annum. The current benefit of using the reserve is about NIS 10 million per annum. Improving the reserve will increase the benefit by NIS 4.8 million per annum. Hence, improving the reserve passes the cost-benefit analysis and the cost versus social benefit analysis. We shall emphasize that the obstacle for executing these operations stems from decentralization of the benefits and the costs. The NPA has no immediate interest in investing in the reserve, as the significant budgetary savings resulting from the diminishing need to rescue, and the savings for the national economy have not been budgeted for the NPA's anyway, and so will not be saved by the NPA once diminished.

While the measured benefit from the reserve is higher than the operating costs, it should be remembered that the source of this measurement is the monetary quantification of the enjoyment derived from visiting the reserve. Again, as of now, the Darga River Reserve is an open reserve, bearing no entrance fees from the visitors. In order to examine the questions of financing, four different models have been analyzed: (1) The current state – free entry (that is, public financing of reserve operation) (2) Cost covering entry fees (3) Revenue maximizing entry fees, and (4) Entry fees based on the Ramsey model of cross-subsidization based on a differential pricing of different products (reserves). To this end, we have used the data of the Gamla Reserve, a reserve with paid entrance.

It has been found that the revenue maximizing entry price in the current state (without improvements, model #3) stands at an average of NIS 15 per visitor. On the other hand, the cost covering price (model #2) stands at an average of NIS 1.92 per visitor. Finally, a differential pricing resulting in a cross-subsidization between the Gamla Reserve and the Darga River (model #4), lowers the entry fee to an average of NIS 1.02 per visitor.

Financing the improvements has been examined both for the case of independent management, as well as that for cross-subsidization. With regards to an independent management, an average entry fee of NIS 12.73 per visitor could cover the costs of the improvement. This is true even though the price increases by an average of NIS 10 more than the unimproved state. The calculated decrease in visitors is not significant enough, as the improvements should bring about an increase in value, the effect of which should combat the usual trend of price increases. The final result shall be a decrease in the number of visitors by only 10,000 while the entry price has been increased by an average of NIS 10 per visitor.

The scenario of cross-subsidization between the Gamla Reserve and the Darga Reserve has also been examined. Again, financing based on this model has proved to be the most efficient. In this case, the entry price for the Darga River Reserve needs to increase by an average of NIS 1 per visitor, at the same time as the entry price for the Gamla Reserve needs to increase by an average of NIS 5 per visitor (from NIS 12 before the improvement to NIS 17 following it).

Future points of departure may be drawn:

- The operating costs of nature reserves ought to be analyzed on the basis of social cost-benefit analyses. This is true especially when limited monetary resources are involved, as is the case for the NPA.
- Entry fees for the NPA's sites rely on the government's subsidization policies. After the latter have been chosen, it is up to the NPA to fill in the gaps. The most efficient solution is based on differential pricing of nature reserves and cross-subsidization between them. While the NPA is already doing it, it is reasonable and preferable that this differentiation be based on an educated foundation (which can then be presented to the public), as by constructing a model similar to the one shown here, between any two reserves; or in this case, between the Gamla and the Darga River.
- Improving services in nature reserves ought to be analyzed using a cost-benefit analysis, and this analysis should indeed be used, especially in cases of limited resources. In cases where the development budget of the NPA is limited, development is to be financed according to cost-benefit examinations, as was done in this study with regards to the Darga River Reserve.
- Financing the improvement could be done independently or by cross-subsidization. As shown in the study, cross-subsidization is preferable from an economic efficiency point of view. It is also possible that in some cases, such a tool will be the only one available for the financing of nature reserve improvements. In the case of the Darga River Reserve, financing the improvement could have been achieved independently, although less efficiently, than using the cross-subsidization model.
- The issue of carrying capacity may probably have its own impact through number of visitors and their effect on the visit's experience. This was not dealt in the current research and might open the door for another venue of point of view.

Appendix 1

Travel Cost results – Darga NR

Regression results (explained variable = number of annual visits)

Variable category	Variable	Coefficient	P-value	Mean value
	Constant	3.881	0.068*	
Cost	Travel cost	-0.004622	0.007*	182.83
Infrastructures	Accessibility	-0.1530	0.150	7.23
	Marked trails	-0.1860	0.358	9.02
	Terrain vehicles designated paths	0.0921	0.210	4.99
	Explanatory signage	-0.0290	0.771	7.33
	Navigation signage	0.1100	0.509	8.63
	An organized campsite	0.1150	0.197	7.12
Activities	Abseiling from cliffs	0.1580	0.073*	5.83
	Hiking in Darga River	0.0439	0.682	7.91
	Desert sceneries observation	-0.2170	0.085*	8.51
	Less crowded hiking trails	-0.2180	0.077*	8.16
	Seclusion in the desert's silence	0.2090	0.044*	7.91
Socio-demographic variables	Gender	0.0196	0.963	0.37
	Age	0.2010	0.304	2.20
	Country of birth	-0.4290	0.499	0.85
	Membership in green organization	0.0312	0.955	0.18
	Number of adults in the group	-0.1750	0.037*	3.59
	Number of children in the group	-0.0836	0.492	1.01
	Education	-0.1980	0.365	3.15
	Income	0.2590	0.195	2.98
* P-Value of 90%	$R^2 = 0.464$	N = 143		

It can be seen that the traveling cost coefficient is significant and has an obvious sign. From the standpoint of the reserve's characteristic, one may note that the significant variables are: Abseiling, desert scenic watches, less congested hiking paths and desert solitude. With regards to the socio-demographic variables, the only significant variable is the number of adults in the group. This is reasonable and results from what the site itself can offer – a challenging travel, calming desert atmosphere and a social character (which is not that unsuitable for children).

Appendix 2
Contingent Valuation Method Results – Darga NR
Mean private and public willingness to pay (NIS)

	Total	Congestion of visitors	Decreased quantity of vehicles in the trail	Aerial rescue	Animal protection	Cutting down the Desert Rotem	Garbage disposal
Private willingness to pay	80.17	11.32	11.95	14.79	15.96	12.36	14.83
Public willingness to pay	4,809,917	679,487	716,949	887,395	957,500	741,322	890,083

It can be seen that the respondents attribute the highest value for animal protection (20%) and the lowest value to the congestion of visitors in the reserve (14%). This result is interesting as one could have assumed that the benefit derived from lowering traveler congestion would affect the leisure from the reserve more highly. That being said, the result is surprising and beneficial, as it indicates a more thorough understanding of the environment than as was anticipated for the "average visitor".

Descriptive statistics for the benefit derived from improving the different characteristics (NIS)

Characteristic / Measure	Total	Congestion of visitors	Decreasing quantity of vehicles in the trail	Aerial rescue	Animal protection	Cutting down Rotem	Garbage disposal
Average	80.17	11.32	11.95	14.79	15.96	12.36	14.83
Median	75	10	10	15	15	10	15
Mode	60	0	5	30	10	10	10
Standard deviation	47.64	9.27	9.15	10.32	9.01	8.73	9.1

Appendix 3

Costs and savings from investing in upgrading the Darga River Reserve

Operation and improvement costs of the Darga RiverNR (NIS thousands)

	Current activity	Present quantity (full time inspectors)	Quantity after upgrading (full time inspectors)	Present fix cost	Fix cost after upgrading	Period of upgrading (years)	Present annual cost	Annual cost after upgrading	Total annual cost for upgrading
Reserve's operation	Number of inspectors	0.9	3				108	360	252
	Desert Rotem cutting prevention		0.14					16.8	16.8
	Illegal hunting prevention		0.14					16.8	16.8
	Visitors overload prevention	0.14						16.8	16.8
Reserve's characteristics	Access path renewing				150	5		34.6	34.6
	Marking trails		0.016					1.92	1.92
	Information signage preparation				50	5		11.5	11.5
	Preparing trails for terrain vehicles				1,226	10		158.8	158.8
	Setting up an information booth during holidays		0.08					9.6	9.6
	Organizing night campsite/parking lot	None	There is		100	10			13
Total					1,526		108	639	531

***Source:** Evyam Atar – Regional inspector, Judaean Desert and the Southern Hebron Mountain.

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