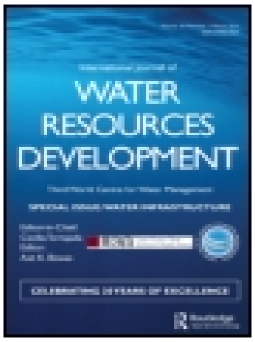

International Journal of Water Resources Development

ISSN: 0790-0627 (Print) 1360-0648 (Online) Journal homepage: http://www.tandfonline.com/loi/cijw20

Cost–benefit analysis of full and partial river restoration: the Kishon River in Israel

Nir Becker, Asael Greenfeld & Shiri Zemah Shamir

INTERNATIONAL JOURNAL OF WATER RESOURCES DEVELOPMENT
https://doi.org/10.1080/07900627.2018.1501349

Routledge
Taylor & Francis Group

Check for updates

Cost–benefit analysis of full and partial river restoration: the Kishon River in Israel

Nir Becker[a], Asael Greenfeld[b] and Shiri Zemah Shamir[c]

[a]Tel Hai College, Upper Galilee, Israel; [b]School of Molecular and Life Science, Curtin University, Perth, Western Australia; [c]School of Sustainability, Interdisciplinary Centre, Herzliya, Israel

ABSTRACT

Restoration of rivers is important because they provide many ecosystem services. However, full restoration is costly, and with limited resources, the priority of the different elements of a restoration plan needs to be considered. In this article the benefits of separable restoration components were analyzed for the Kishon River in Israel. The proposed restoration plan contained four segments: riverbed cleaning, ecological restoration, accessibility, and sports facilities. We used non-market valuation to estimate benefits and found the full restoration programme to pass the cost–benefit test, but partial restoration to be more efficient. Based on these conclusions, different funding alternatives are discussed.

ARTICLE HISTORY
Received 31 August 2017
Accepted 6 July 2018

KEYWORDS
Urban river restoration; contingent valuation; travel cost; cost-benefit analysis; Israel

Introduction

[1]As the core of most urban systems, many rivers and streams suffer from pollution and degradation, reducing their capacity to provide the range of benefits to the nearby communities they once did (Bergstrom & Loomis, 2017). The degradation and loss of streams and rivers world-wide, together with the subsequent recognition of the ecological and environmental value of the services they provide, has made their restoration an important priority to consider (Morison & Brown, 2011).

In urban locations, rivers are a significant landscape. Costanza et al. (2014) estimate the value of urban ecosystems as 2.2% of the total world ecosystem value. But this might not agree with urban citizens' valuation of such resources (Dallimer et al., 2012). By restoring the natural functionality of rivers, ecological corridors are reopened, and lost habitats are regained. This enables rivers to resume their role as 'green lungs' for the public benefit, and sports and recreation facilities can be developed along the river (Vermaat et al., 2016).

The success of restoration should be based on more than just a budgetary analysis. Cost–benefit analysis (CBA) is a method widely applied to evaluate public water policies, as government interventions often relate to the provision of public goods, and effects on society. It is the wider social value attached to these ecosystem services, besides their ecological value, that is often missing in decisions regarding river restoration policy. As river restoration is costly (Angelopoulos, Cowx, & Buijse, 2017; Bernhardt et al., 2005;

CONTACT Nir Becker nbecker@telhai.ac.il

Kristensen, 1994), individual rivers should be exposed to cost–benefit analysis according to the merits of the estimated costs and benefits.

In the past, planning of river restoration was guided by a central cause, and its assessment required the evaluation of that single cause alone (Clarke, Bruce-Burgess, & Wharton, 2003). Examples include flood protection, or habitat protection for animals (Boon, Calow, & Petts, 1992; Pedroli, de Blust, van Looy, & Van Rooij, 2002). However, rivers provide a diverse set of services, and their rehabilitation requires an array of tools and components. The combined effect of all these components has the best chance for successful rehabilitation (Muhar, Schmutz, & Jungwirth, 1995) but might also be more difficult to market to the public than a single-cause project (Skinner & Bruce-Burgess, 2005).

Another economic aspect of restoration is financing. The two obvious sources of funds for such a project are visitors and taxpayers, as the benefits of restoration are shared by both its users and its non-users. Since rivers are public goods, economic theory indicates that taxpayers should pay the cost. However, taxes are not often generated for a particular project, and governments and municipalities have upper limits on tax recruitment. Collecting entry fees from visitors adheres to the beneficiary-pays principle and ensures that those who benefit from the amenity are the ones responsible for its financing.

In Israel, the issue of river restoration is important, and increasing in importance over time (Barak & Katz, 2015; Becker & Friedler, 2013; Becker, Helgeson, & Katz, 2014). But the consideration of partial restoration and finance has not yet been dealt with. In this article we deal with both issues and thereby hope to contribute to the literature on ecological restoration in general and river restoration in particular. We identify four components of restoration of the Kishon River, which flows through the city of Haifa in northern Israel, and estimate the worth of each component separately, as well as in the context of a total restoration. We use revealed and stated preferences valuation methods and derive insight into the impact of different pricing options on both the visitation and the welfare of existing and potential visitors.

The article continues as follows. The next section describes the issue of valuation of non-market benefits of river restoration. The following section describes the study area of the Kishon River. We then continue to describe the methods applied. This is followed by the results, discussion and conclusions.

Valuation of river restoration

The two main kinds of values that determine a healthy river or stream are use and non-use values. Use values are the actual uses of the river, such as fishing or hiking. They also include option value, which is the value people place on the option for a future visit. Non-use values include a bequest value given by individuals to provide cultural assets for future generations (Kerna, Colby, & Zamora, 2017; Kolstad, 2000), and existence value, which is a value people place on things they know they exist without an intention to visit them. Non-use values have been shown to be significant for aquatic systems like streams and rivers (Barbier, 1994, 1995; Simon, 2016).

The total monetary value of river restoration is the sum of its different values. Several tools have been developed for ecosystem service valuation (Chen, Li, & Wang, 2009), including direct methods to estimate non-use values (OECD 2004; Alam, 2008; Ghosh & Mondal, 2013; Kotchen & Reiling, 2000).

A key component in the economic assessment is the non-market valuation of benefits from river rehabilitation. The fact that many of the benefits of rehabilitation do not have a price that is determined by the dynamics of supply and demand often engenders the misconception that rehabilitation is not worthwhile. This can lead to misjudgements by decision makers, and to insufficient allocation of funds to rehabilitation. This 'free-rider problem' (Ozono, Jin, Watabe, & Shimizu, 2016) reflects undervaluation of the benefit of the restored river. Solving it requires applying non-market value assessment models. These values, together with the valuation of the ecosystem services provided by the river, are important tools for decision makers who oversee river rehabilitation projects. In other words, they can help society allocate public resources more efficiently, resulting in greater overall public benefits.

The general population's willingness to pay (WTP) for improved river quality has been studied in many locations, including Bangladesh (Alam, 2008), Canada (Douglas & Taylor, 1999), India (Imandoust & Gadam, 2007), the US (Kramer & Eisen-Hecht, 2002), Denmark (Atkins, Burdon, & Allen, 2007), Belgium (Chen et al. 2017), and the Baltic states (Monarchova & Gudas, 2009). In all these studies, the sole goal of the rehabilitation was water quality. Brouwer and Sheremet (2017), also considering water quality, estimated the average WTP for improved water quality in rivers across Europe, Asia, and the US at USD 81.2 per household per year.

In Israel, Garcia and Pargament (2015) and Garcia, Corominas, Pargament, and Acuña (2016) estimated the net benefit of restoring the Yarkon River in Tel Aviv using both market and non-market benefits. Becker et al. (2014) estimated the net benefit of rehabilitation of the Jordan River. Becker and Friedler (2013) analyzed the hydro-economic aspects of the Alexander-Zeimar River (Israel–Palestine Authority). Asaf, Negaoker, Tal, Laronne, and El Khateeb (2007) laid the foundation for effective river restoration for Israel and the Palestinian Authority, also dealt with by Maruani and Amit-Cohen (2009). Barak and Katz (2015) estimated WTP for the 14 main rivers and streams in Israel, also based on the number of people living within a certain distance of each of them. Most of the studies in Israel deal with cross-boundary issues. The Kishon River is not an exception, as can be clearly be seen from the map (Figure 1). However, unlike the cases above, the main issue in the Kishon is the downstream effects of pollution by the heavy industry located there, versus the potential recreational options. These two effects are completely within Israel's responsibility.

The high costs of a complete river restoration project highlight the importance of considering an alternative, 'partial restoration' scheme. In partial restoration, the maximal ecosystem rehabilitation and public benefit are compromised for a more affordable combination of restoration elements, such as cleaning the riverbed without treating the banks. The question of whether to insist on complete restoration or compromise on partial restoration is a complex one, involving the assessment of interactions between its components (McMillan & Noe, 2017; Wohl, Lane, & Wilcox, 2015), and beyond the scope of this study. This study focused on the economic aspects of partial restoration. Values attributed by the public to different aspects of restoring the Kishon River in Israel were defined, and different options for funding such a project were considered.

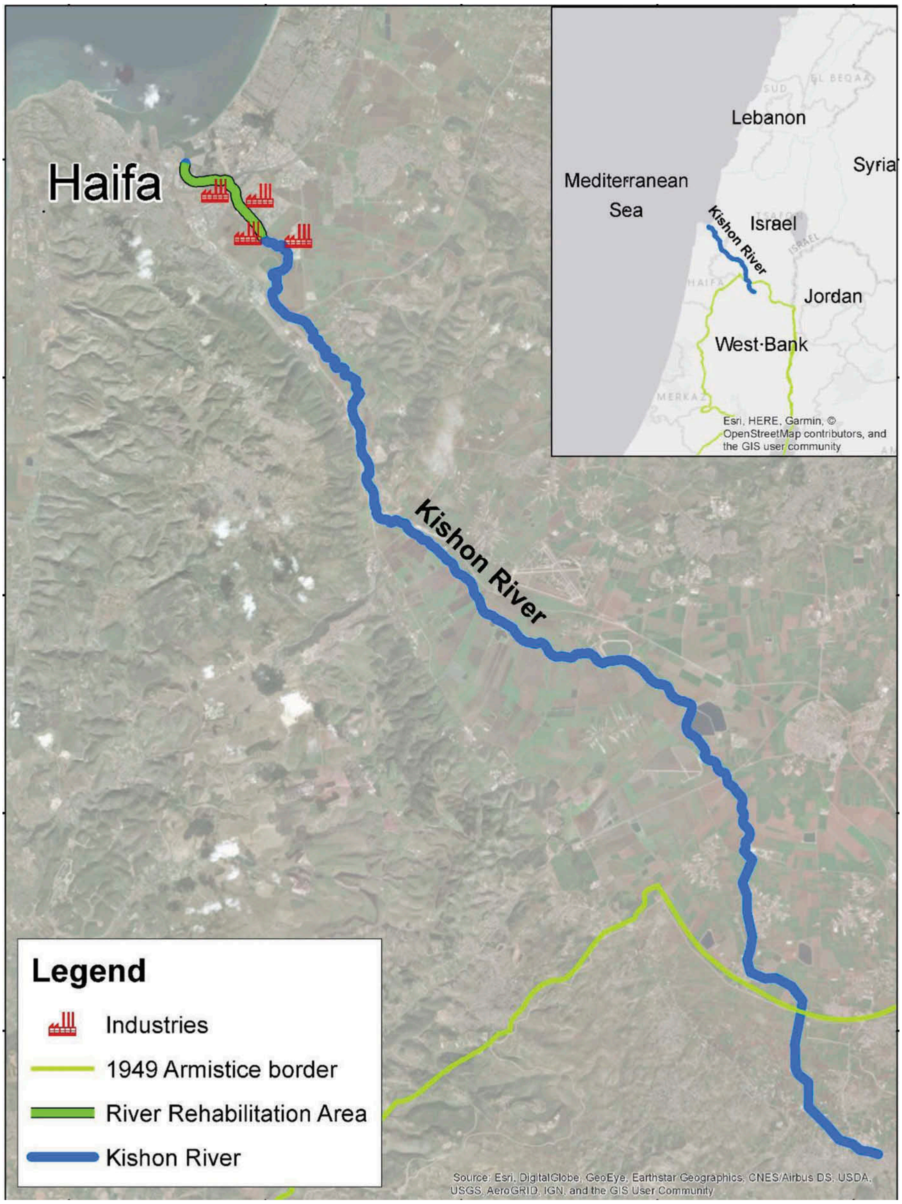

Figure 1. Map of the Kishon River basin.

Study area

We chose the Kishon River in the north of Israel for a case study because it represents a river that is intensively managed in different ways in a complex rehabilitation process. This river has undergone severe pollution and degradation with the growth of the Haifa metropolis and its surrounding industry. Within a century, decline of biodiversity and ecological function and services transformed the Kishon River from a natural resource to a neglected, and even harmful, element. The initiation of the rehabilitation process and

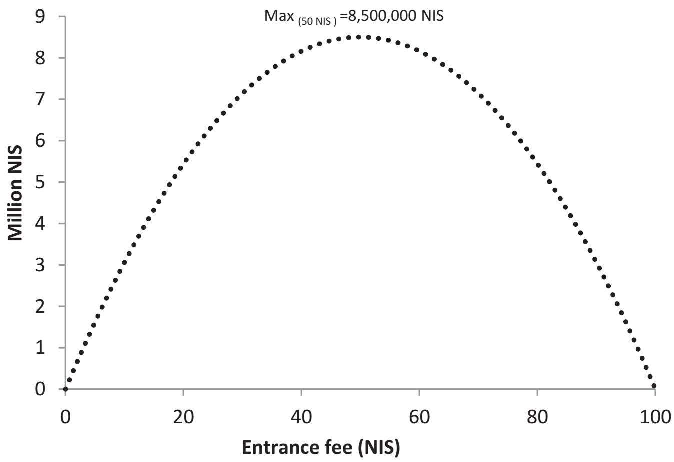

Figure 2. Potential revenue from entrance fees.

establishment of the Kishon River Authority in 1994 was supported by increasing public awareness of the benefits of successful rehabilitation using public funds (Kishon River Authority, 2003).

The Kishon River is one of the longest coastal rivers in Israel (Oren, Aizenshtat, & Chefetz, 2006), stretching approximately 70 km from its origin in the Samaria Mountains to the Mediterranean Sea in Haifa Bay (Figure 1). It is fed by springs and the high water table of the Jezreel Valley and carries an average of 2.5 million m^3 annually, with high variability between peak years (165 million m^3 in 1991–92) and drought years (1.5 million m^3 in 1981–82) (Tamari, 2000).

The original flora included typical Mediterranean vegetation such as bay laurel (*Laurus nobilis*), oleander (*Nerium oleander*) and bulrush (*Scirpus*). The fauna included indigenous fish, many water birds, softshell turtles (*Trionyx triunguis*) and, until the end of the nineteenth century, even crocodiles (*Crocodylus niloticus*).

In a comprehensive review of its environmental history, Golan (2016) uses the story of the Kishon River to demonstrate the political-cultural shift in Israel's attitude to its natural resources. In Israel's early years, the Kishon's natural flow was captured to support the National Water Carrier project (in 1953), and regional sewage was directed to the river via a treatment plant (in 1961). This domestic contamination added to industrial and agricultural waste throughout the river system, with detrimental effects on the wildlife as well as on humans exposed to the water, who were harmed directly or affected by secondary contamination. According to Golan (2016), Israeli society sacrificed the most important waterway in the north of the country to support the building of the state. This ethos continued to prevail throughout the 1970s and '80s, despite accumulating public unease with the river's physical condition. It was only towards the end of the twentieth century that the tide turned. This happened due to increasing environmental awareness, supported by public concern regarding the incidence of cancer in naval commando unit veterans who had done extensive diving training in the Kishon River for years (Avishai, Rabinowits, Moiseeva, & Rinkvich, 2002; Shoshana, 2013). The shift in public opinion led to a decision by the Israeli government to engage in the rehabilitation of all its coastal streams, and particularly the Kishon River (O'Sullivan, 2001; Shoshana, 2013).

The Kishon River Authority, established in 1994, oversees 25 km of the river and its banks. Its stated missions are: to clean the riverbed, to manage the rehabilitation of the natural ecosystems, and to develop recreational parks for the benefit of the public. It was more than nine years before a solution for removing toxic water from the factories and preventing it from contaminating the river was implemented in 2002. Ecosystems have recovered gradually since work began in the mid-1990s, and by 2003, over 20 species of animals and indigenous plants were reintroduced or reappeared in the Kishon River (Kishon River Authority, 2003).

Since 2003, a steady increase in ecosystem functions has been realized, and with it an increase in the public use of the Kishon River for recreation within the limited facilities available. But even years after the main sources of pollution were treated, the recreational potential was not realized, ecosystems were not fully restored, and biodiversity was unstable (Kishon River Authority, 2003, 2015). This was the context for the decision, in 2013, to allocate ILS 220 million (ILS 1 = USD 0.275) to a three-year action plan for the rehabilitation of the water and environment of the Kishon River (Shoshana, 2013). This budget was to include four different restoration elements: clearing the riverbed of contaminated sludge, and land development that will reduce the risk of future contamination; ecological restoration, including management of invasive species and reintroduction of riparian and aquatic plants and wildlife in the river and its surroundings; improved accessibility for the public, by creating a network of paths and roads connecting both natural habitat and developed facilities to the urban matrix; and recreational development on the river banks and creation of sports facilities near the river for economic development. Most of the river park was to be made available for free public use, with the option to collect entrance fees for selected facilities.

Methods

To assess the value of the Kishon River's rehabilitation, the benefits derived from the project need to be identified: the direct values of increased provision of goods and services, improvement in water quality, and use of river water for tourism and recreation (Alam, 2008); the indirect value of its existence; and the optional values of its future uses. Combined use of both the travel cost method (TCM) and the contingent valuation method (CVM) was chosen since they complement each other (Eom & Larson, 2006; Whitehead, Haab, & Huang, 2000). Both these methods have been used to assess the benefits of river restoration in many places around the world (e.g. Hsu & Li, 1990; Imandoust & Gadam, 2007; Monarchova & Gudas, 2009). Assessments of river restoration projects often use non-market valuation, like hedonic value, using land and property values adjacent to the natural resource (Garcia et al., 2016). But this method is not feasible in the Kishon River surroundings, as no residential areas have developed there.

The contingent valuation method

CVM is the leading method for learning individuals' WTP for non-market goods (Carson, 2011), and for existence values and option values. The method involves asking respondents what they would be willing to pay for a given quality change. As noted below, our specific question asks potential visitors about their WTP for different restoration options.

Payment card (PC) and discrete choice are the most popular formats in the literature (Carson, 2011). Initial results from focus groups convinced us that, in this case, PC might be more suitable to how respondents perceive the situation. Discrete choice is more popular, but discrete-choice answers reveal less information about a given respondent compared to PC. Covey, Loomes, and Bateman (2007) stated that *by that year* PC was the most popular method. It is still very common in health economics (Ryan & Watson, 2009). Since Mitchell and Carson (1989) initially developed the PC approach to address survey bias in assessing WTP for public environmental and resource projects, many studies have used this method to measure WTP for public goods in general, and for rivers and marine resources in particular (e.g. Alam, 2008; Brox, Kumar, & Stollery, 2003; Douglas & Taylor, 1999; Huhtala, 2004; Pan, Zeng, & Zhang, 2012; Ressurreição et al., 2011).

Unlike referendum-type questions, the PC approach allows respondents to choose the amount that best reflects the price they would like to pay for a service. Since the number of values offered in a PC survey is limited, this approach does not face the boundary issue associated with some prior knowledge of the value of the resource, which is one of weaknesses of open-ended WTP questions.

In the past, a straightforward analysis approach was to simply regress the WTP values on various explanatory factors. Cameron and Huppert (1989) showed that this type of analysis of the chosen card values reflects the true WTP, but only the lower bound of a respondent's WTP. An alternative approach is to use a random utility framework. In a PC question, if individual i chose a card value C_K as the highest acceptable price, the true WTP lies between C_K and the next card value, C_{K+1} ($C_{K+1} > C_K$) (Becker, Lavee, & Tavor, 2012). Under these conditions, an interval regression procedure should be used (Cameron & Huppert, 1989).

The travel cost method recreation demand model

TCM is a revealed-preference technique used to value non-market goods or specific value changes in the services they provide (Loomis & McTernan, 2014). Revealed preference means that we rely on the different visit frequencies of visitors living at different distances from the river. This, in turn, is used to estimate a demand function. The net benefit is the area under this function when taking all variables except price at their mean value and tracing the curve only as a function of price (travel cost).

Shechter and Freeman (1994) argued that three issues must be addressed for the results to be valid. First, the assumption is that visitors relate to travel cost as they would relate to an entrance fee. Second, the only product that contributes to the utility is the site itself and not the way to and from the site. Third, the time-cost of travel should be included in the trip cost. There are several ways to deal with travel cost, which are discussed by Amoako-Tuffour and Martínez-Espiñeira (2012).

Since recreation trips must occur as integers, count data models have become common compared to OLS (Heberling & Templeton, 2009; Loomis & McTernan, 2014; Mendes & Proença, 2011). A potential problem relates to on-site collection of surveys. This is denoted by endogenous stratification and truncation. Truncation means that with sampling on site, the data are limited to people already there (number of visits at least 1). Since no zero-trip responses are observed, this truncates the dependent variable. Endogenous stratification means that not only are all the surveys performed on-site, the probability of surveying a frequent visitor is higher. Shaw (1988) demonstrated that both these issues can be corrected for by subtracting 1 from the reported number of trips. Otherwise, results may overestimate the WTP (Loomis, 2003; Martínez-Espiñeira, Amoako-Tuffour, & Hilbe, 2006).

When dealing with a change in the value of the river due to a change in the quality of one of its characteristics, this should be reflected in changes in the number of visits. In this case, the WTP per day trip is simply the reciprocal of the travel cost coefficient, $-1/\beta_{tc}$) (Englin & Shonkwiler, 1995). The change in the value of the river can be estimated either through the change in the benefit per visit under the two scenarios or in a pooled model in which each respondent is treated twice (before and after the change) and a dummy variable is added for the 'after' scenario.

Survey design

The survey was designed using Dillman's (2000) method. A pre-test was performed to uncover any sections that lent themselves to misunderstandings or were unclear. Twelve pre-test surveys were completed in each of two rounds (24 respondents). In view of the replies of the interviewed respondents, several aspects of the questionnaire were revised: the sequence of some questions became more logical, some specific terms were changed into spoken language for better understanding, and more incentive and comparable mechanisms were incorporated to reduce respondents' antipathy or sensitivity to key questions in the survey. Respondents also helped us choose the payment intervals on the card and the payment format.

We collected data on individual preferences using a survey of 300 potential visitors in the surrounding area. This was done in major shopping centres and along the train lines that stretch 60 km to the north and south. This is nearly the entire touristic potential of the river (Barak & Katz, 2015).

Part A of the survey was intended to collect information about the respondent's trip habits. This included their primary activity, how far they travelled, and what their expenditures were for the trip on which they were intercepted. It also asked respondents their current trip frequency to the Kishon River. The point of origin for that trip was noted. The time taken to drive to the river and back was estimated using Google Maps. Travel cost (amount spent on petrol and other variable costs) was estimated using ILS 1.2/km (Becker & Friedler, 2013). For the cost of travel time, Cesario's (1976) estimate of one-third of hourly income was used. The issue of the value of time has been raised in previous researches, and values range between 0.14 and 0.5 of hourly wage (Haab & McConnell, 2002). The chosen adjusted value was multiplied by the travel time and added to the travel cost.

Part B was dedicated to assessing the value of the site using contingent behaviour. Participants were asked to predict how much more they would visit if one of the following components were improved, as well as if all of them were implemented: cleaning and management of the riverbed; ecological restoration (reintroduction and management of plants and wildlife); accessibility for the public and connectivity to the urban matrix; and recreational development and sports facilities.

Part C asked participants to assess the value of different restoration components by indicating how much they would be willing to contribute to a designated fund for each component. Following Arrow et al. (1993), participants were specifically instructed to consider their other expenses and, although asked hypothetically, indicate their actual willingness and ability to pay, to avoid the 'cheap talk' effect. The WTP section was worded as follows:

If a fund were to be established dedicated solely to the restoration of the Kishon River, and all its resources were put towards the following activities, we would like to know how much you would be willing to contribute ***annually*** *to this cause. Before you answer, please consider the following two points*:

(a) *Take into consideration your budget constraints, including other causes to which you are committed to contribute. Please see the contribution as an additional monthly expense.*
(b) *Although this survey is hypothetical, try to answer as if you were* ***actually*** *asked to donate the money. Your well-thought-out answers will help us support informed decision making.*

You can use the following cards for your convenience. Please choose a sum you are ready to pay for:

Restoration of the riverbed (water purification and resolving bad odours)

Payment:_____

(a) *Restoring flora and fauna to the river (by reintroducing species of plants and wildlife from other rivers to the Kishon River)*

Payment:_____

(a) *Creating paths connecting different areas of the Kishon Park (providing access for both cyclists and family hiking)*

Payment:_____

(a) *Establishing recreational facilities, e.g. aquatic sports such as boating (paddle-boating or rowing), and family-friendly sports activities*

Payment:_____

(a) *Complete restoration of the Kishon River area (including all four of the components mentioned above)*

Payment:_____

After indicating a sum between zero and ILS 150 (from a payment card), participants selected one or more explanations for their selected contribution: (1) I identify with the goals of river restoration and want to help life return to the rivers; (2) I practise fishing/boating and would benefit from the opportunity to do so in the Kishon River; (3) restoration is not important enough for me to spend money on it; (4) I am willing to pay to ensure that my descendants will have the option to enjoy the Kishon River; (5) river restoration is not my responsibility; (6) I want to have the option to benefit from the Kishon River in the future; (7) I currently cannot afford to invest in river restoration; (8) other. This selection allows us to divide the stated funds into use values (motives 2 and 6) and non-use values (motives 1 and 4). It also allows us to distinguish valid zero responses (motives 3 and 7) from zero-bid protesters (motive 5) to be disqualified from the sample (Mitchell & Carson, 1989).

Part D was used for collection of socio-demographic features of the respondents, to be used in the analysis of their responses. Besides their age, household size and gender, respondents also indicated, on a scale from 1 to 5, their monthly net income compared to the Israeli mean of ILS 9700 (1, way below; 2, slightly below; 3, close to average; 4, slightly higher; 5, way above) and their education (1, high school; 2, post high school professional diploma; 3, undergraduate; 4, master's; 5, PhD).

Results

Descriptive statistics

The demographic data indicate that our sample represents a profile similar to that of the general population means in terms of age (39), household size (3.86), income (3.01 out of 5), and education (2.43 out of 5, slightly less than average). These, as well as other data regarding the current visitation habits of the local population, are presented in Table 1.

Table 1. Descriptive statistics for most of the survey questions.

Variable	Average	Median	Most frequent answer	Standard deviation
Distance from home (km)	16.68	10	10	15.37
Travel duration (min)	23.59	20	15	17.20
Distance of preferred alternative recreational site (km)	39.71	30	30	31.75
Income (on a scale of 1–5)	3.01	3	3	0.94
Members in the household	3.86	4	4	1.45
Age	38.69	37.5	40	11.28
Willingness to pay (WTP) for the whole restoration project (ILS/y)	55.56	40	0	96.55
WTP for riverbed restoration (ILS/y)	17.56	10	0	40.74
WTP for Ecological restoration (ILS/y)	16.22	10	0	38.72
WTP for Accessibility and connectivity (ILS/y)	8.78	3	0	16.62
WTP for sport facilities (ILS/y)	13.11	10	0	20.29
Current number of visits (per year)	0.81	0.31	0	2.02
Visits after full restoration (per year)	1.81	0.7	0	4.52
Increase in number of visits (per year) following riverbed restoration	0.43	0.25	0.17	0.56
Increase in number of visits (per year) following ecological restoration	0.48	0.25	0.25	0.59
Increase in number of visits (per year) following improvements in accessibility and connectivity	0.42	0.25	0.17	0.57
Increase in number of visits (per year) following improvement of sports facilities	0.45	0.25	0.25	0.51

The average travel distance from a participant's home to the Kishon River was approximately 17 km, for about 24 minutes of travel time. In its current state, the river was not found to be the first choice for recreation for most of the population. Most people preferred to go further (40 km total, on average). These figures suggest economic viability for the river restoration, since 78% of current visitors would prefer to come to the Kishon River if it were more appealing. And visiting the river would save the average visitor 23 km per visit, compared to the current alternatives 40 km away.

Current visit frequency per household was 0.81 per year. Further restoration of the river is predicted by the survey to increase this frequency to 1.81 per year. When referring to the different components of the restoration project, the frequency increase was between 0.42 (due to improved accessibility and connectivity) and 0.48 (due to ecological restoration).

Benefits of restoration using contingent valuation

The overall WTP for all the different restoration components was on average ILS 56 per year. When divided into the different components, WTP was 18, 16, 13, and 9 Israeli shekels for riverbed restoration, ecosystem restoration, park connectivity and accessibility, and sports facilities, respectively. The fact that riverbed restoration elicited the highest WTP, even though it is not associated with direct benefit for most people, is in line with the high non-use value given by the public to the Kishon River. As seen in Table 2, the motivation of most people to pay identifies the value attributed to the river as mostly non-use, with 51% of the population willing to contribute, plus 36.7% that refers to the use for future generations. Only ILS 1.15 million (12.4%) out of the total annual WTP of ILS 9.07 million refers to current (3%) or optional (9.4%) use (Table 2). This has an impact on long-term visit management and planning, as it indicates a potential expansion of visitors from 3% of the area's population to 12%, or from 57,000 to 237,000 visits annually. By multiplying these numbers by the number of households in the Haifa District (as of 2015, from Israel's Central Bureau of Statistics) and assuming a discount rate of 5%, the Kishon River restoration project can be valued at ILS 181.4 million.

The effect of socio-demographic parameters on WTP was assessed by running interval regression on the answers to the five different projects (Table 3). Most parameters had a significant effect on WTP in all models, except for sports facilities. A first visit to the river and a higher income were positively correlated with WTP, and age and average visit

Table 2. Breakdown of the Kishon River restoration benefits to the Haifa District by restoration components and type of value (ILS millions).

Restoration component		Riverbed restoration	Ecological restoration	Connectivity and accessibility	Sports facilities	Complete restoration project (total)
Use value	Annual use value	0.09	0.08	0.04	0.06	0.30
	Annual optional use value	0.27	0.24	0.14	0.20	0.85
Non-use value	Annual inheritance value	1.07	0.95	0.53	0.77	3.33
	Annual existence value	1.48	1.32	0.74	1.07	4.62
	Total annual value	2.92	2.60	1.46	2.11	9.07
	Total value	58.32	51.84	29.16	42.12	181.44

Note: District population used was 534,000 (162,000 households). Discount factor is 5% per year.

Table 3. Interval regressions for different restoration projects.

Model	Complete restoration project	Riverbed restoration	Ecological restoration	Connectivity and accessibility	Sports facilities
Intercept	73.48*	33.61*	24.28	5.02	12.93
	(1.81)	(1.94)	(1.47)	(0.71)	(1.46)
Income level	20.05*	6.70*	7.04*	2.30*	2.77**
	(2.58)	(2.01)	(2.22)	(2.21)	(1.62)
Education	−4.67	−2.47	−2.69	−0.53	1.31
	(−0.66)	(−0.81)	(−0.93)	(−0.43)	(0.85)
Size of household	3.58	1.07	2.07	0.41	−0.30
	(0.76)	(0.53)	(1.08)	(0.50)	(−0.30)
Age	−1.08*	−0.40**	−0.43*	−0.05	−0.20
	(−1.78)	(−1.55)	(−1.73)	(−0.46)	(−1.47)
Gender	−0.39	−0.62	−0.73	−0.43	−0.09
	(−0.94)	(−0.57)	(−1.05)	(−1.13)	(−0.78)
Preferred site?	13.52	3.53	0.48	4.04	3.68
	(0.79)	(0.48)	(0.07)	(1.34)	(0.98)
Is it the first visit?	26.92*	8.04	7.88	6.20*	2.99
	(1.75)	(1.22)	(1.26)	(2.31)	(0.89)
Visiting frequency	31.32**	11.70	13.58*	5.17	1.30
	(1.60)	(1.40)	(1.70)	(1.52)	(0.30)
Visit length	−9.05*	−3.99*	−3.26*	−1.06*	−0.55
	(−2.72)	(−2.80)	(−2.40)	(−1.83)	(−0.75)
Distance from site	−0.54	−0.20	−0.12	−0.12**	−0.10
	(−1.21)	(−1.04)	(−0.67)	(−1.58)	(−1.03)
R^2	0.12	0.10	0.05	0.10	0.06
F	2.99	2.28	2.23	2.40	1.22

Note: t values in brackets. p values < 0.05 and < 0.10 are marked by * and ** respectively.

Table 4. Benefits and costs of restoring the Kishon River according to the CVM.

	Riverbed restoration	Ecological restoration	Connectivity and accessibility	Sports facilities	Total restoration
WTP per respondent (ILS)	17.56	16.22	8.78	13.11	55.56
Use value (ILS)	2.16	2	1.08	0.01	7.04
Non-Use value (ILS)	15.4	14.22	7.7	13.1	48.52
Public Benefit (Based on 162 HH. In mill. ILS)	2.845	2.628	1.422	2.124	9.001
PV of public benefits (5% discount rate, Mill. ILS)	58.32	51.84	29.16	42.48	181.44
Restoration cost – PV of fixed value (mill. ILS)	93.14	5.11	26.35	105.42	229.35
Restoration cost – Yearly value of maintenance (PV in parenthesis In mill. ILS)			5.9 (118.00)		
Net benefit (without maintenance cost. In mill. ILS)	−45.45	46.95	−0.52	−73.87	−49.33

length were negatively correlated. No strong correlation was found with education, distance from the site or with being a preferred visiting site.

Table 4 presents the total benefit derived from the CVM both as a whole and the relative shares of use and non-use values. Based on an estimated 162,000 households in Haifa, the annual value and present value are presented as well.

Table 5. Poisson distribution analysis of the current and anticipated visiting frequency following restoration scenarios.

Model	Current visits	Riverbed restoration	Ecological restoration	Connectivity and accessibility	Sport facilities	Total restoration
Income level	−0.40**	−0.21	−0.24**	−0.199*	−0.199*	0.300**
	(−2.05)	(0.068)	(−2.19)	(−1.71)	(−1.74)	(−1.85)
Education	−0.23	.020	.100	.1250	.080(0.81)	−0.19
	(−1.20)	(0.23)	(1.05)	(1.20)	(−0.92)	
Size of household	.060	.080	0.08	0.03	.080	0.07
	(0.50)	(1.17)	(1.24)	(0.44)	(1.17)	(1.06)
Age	.03**0	0.01	0.01*	.010	0.01	0.02*
	(1.83)	(1.57)	(1.68)	(1.38)	(1.52)	(1.72)
Gender	−0.20	−0.17	−0.28	−0.25	−0.22	−0.21
	(−0.58)	(−0.84)	(−1.41)	(−1.20)	(−1.09)	(−0.98)
Travel cost	−0.025*	−0.018**	−0.018**	−0.015**	−0.017*	0.010**
	(−1.74)	(−2.60)	(−2.73)	(−2.28)	(−2.57)	(−2.46)
Intercept	−1.20	−0.90*	−0.88*	−0.95*	−1.00**	−1.11
	(−1.20)	(−1.60)	(−1.66)	(−1.70)	(−1.83)	(−1.31)
LR $\chi^2_{(6)}$	20.29	16.87	19.14	12.29	15.24	19.18
χ^2	< 0.01	< 0.01	< 0.01	< 0.06	< 0.02	< 0.01
Log likelihood	−97.94	−198.78	−209.75	−201.46	−200.78	−191.67

Z-test results in parentheses. $*p < 0.1$, $**p < 0.05$.

Benefits of restoration using the travel cost model

Five models of travel frequency were analyzed (the current one, plus four anticipated frequencies following different types of restoration). Travel cost was used as an explanatory variable along with income, education, size of household, age and gender. The Poisson distribution model results are presented in Table 5. The travel cost parameter was significant in all five models, and income and age were correlated with travel frequency in some of them. Using the TCM model, with travel cost coefficient to calculate the consumer surplus, values are shown together with the calculated benefit of each type of restoration. This was done by multiplying the individual benefit by the number of new visitors anticipated by the model and reporting the difference between that number and the benchmark value. The benefit per visit of the complete restoration scheme is almost ILS 75, which is about ILS 40 more than the current benefit. Using the inverse of the price coefficient and multiplying it by the change in visit numbers, the benefit to the public can be estimated at ILS 17 million per year, or a current value of ILS 333 million. The table also presents the partial restoration projects, which range from ILS 113 million (for riverbed restoration) to ILS 164 million (for connectivity and accessibility).

Discussion

The total benefit from the full restoration scheme was valued at ILS 181 million by CVM, and ILS 333 million using TCM. This is a ratio of 0.54. Based on 83 studies, Carson, Flores, Martin, and Wright (1996) found a ratio of 0.77. Later studies (e.g. Amirnejad, Solout, Jahanifar, & Zarandian, 2014; Armbrecht, 2014; Mayor, Scott, & Tol, 2007) found ratios in the range of 0.29–0.54. Our results fall within the range of such comparisons. Reasons for this difference include unwillingness to pay for various reasons but willingness to visit. That, in turn, means that people do not take into account their true travel cost, and/or that the protest-bid issue is more serious than indicated by respondents who were excluded from the sample (Carson et al., 1996).

Here are two other explanations for this difference. First, respondents of the TCM survey were not asked how complete restoration would affect their visits, so the total value presented assumes an additive effect which might not be there. But the total benefit cannot be less than the value of any partial restoration project. In our case, connectivity and accessibility are estimated at ILS 164 million. The second explanation could be the counting of option values as added visits, which might not occur in the near future. If only half of the option value contributing to the increase in number of visits is assumed, the increase will be only by 0.89 visits per year. That would mean 2.7 instead of 3.59 visits × persons per year, or 147,000 visits per year, for a benefit of ILS 219 million. It is unlikely that both reasons would fully apply, but an average of their effects relative to the original estimate of ILS 333 million, and taking an average between the two averages, can be used to sum up to ILS 262 million.

It should be noted that a natural reason that may be valid is that people did not respond logically to one of the sections of the survey. However, since the river is a destination for urban recreation, the touristic value is the legitimate one to take, even if it is larger than the one from the CVM.

Almost 90% of the total value derived from the CVM corresponded to non-use motives. To compare the benefits revealed by analyzing the survey with the cost of these types of restoration, the financial report from 2003 (Oved, 2003), adjusted to 2015 prices (Tables 4 and 6), is used. Costs mentioned in a report submitted to the Kishon River Authority (Gobi 2003), of components such as flood prevention are ignored, since their benefit was not assessed. Other costs that were not mentioned explicitly in this report (e.g., paths and connectivity) were assumed as fractions of existing figures (20% of park development, based on personal communication with the river authority engineer). A separate line was added for yearly maintenance cost, estimated by Oved (2003) at ILS 5.9 million per year, or ILS 118 million in present value.

As indicated in Table 6, when using the recreational benefits derived from the TCM, the Kishon River restoration project has a negative value of ILS 14 million. However, taking the non-use portion from the CVM results of the highest-valued partial

Table 6. Cost and benefit of different restoration projects, travel cost method.

	Current situation	Riverbed restoration	Ecological restoration	Connectivity and accessibility	Sport facilities	Total restoration
Visits (thousands)	131.22	200.88	208.98	199.26	204.12	293.22
Benefit per visit (ILS)	39.67	54.13	54.2	67.37	57.51	74.51
Δ(Benefit) per visit (ILS)		14.46	14.52	27.7	17.84	34.85
Public benefit (ILS millions)	5.205	10.874	11.327	13.424	11.739	21.848
Δ (Public benefit) (ILS millions)		5.669	6.132	8.219	6.534	16.643
Δ (PV of public benefits) (5% discount rate, ILS millions)		113.38	122.44	164.38	130.68	332.86
Restoration cost – PV of fixed value (ILS millions)		93.14	5.11	26.35	105.42	229.35
Restoration cost – Yearly value of maintenance (PV in parenthesis, ILS millions)				5.9 (118)		
Net benefit (without maintenance cost, ILS millions)		11.03	116.83	135.42	14.83	103.51

restoration plan, riverbed restoration, adds 56.9×0.88 = ILS 50 million. This makes the net benefit ILS 36 million.

Higher net benefits can be achieved by partial restoration options, assuming that they are separable and that the benefits of one component are not substantially reduced by the absence of another component. Both riverbed restoration and ecological restoration pass the cost–benefit test. Ecological restoration has the highest net value, at 122.44 – 5.11 = ILS 117.33 million. Adding riverbed restoration incurs more costs and has a benefit of ILS 113.38 million, but this is questionable because it is unknown whether the added benefit of riverbed restoration should be added fully or only partially, due to non-additivity. The most important point is that with partial restoration there is no need to justify the project partially on non-use motives.

Finally, the alternatives of financing the project by visitors or taxpayers can be considered. To assess the trade-off in financing the project by raising entrance fees and reducing the number of visitors, the possible scenario of an entrance fee for the total restoration scenario was analyzed. The travel cost coefficient is – 0.01 (Table 5); that is, every increase of ILS 1 in the visit cost (whether in fuel or entrance fee) will deter 1% of visitors from coming. The revenue function is thus given by (Figure 1):

$$TR = P \times Q = P \times \ [340,000 - (1 - 0.01P)]$$

Simple revenue maximization suggests that a household should be charged ILS 50 per visit, which would result in only 170,000 visitors, contributing ILS 8.5 million annually; or, in present value terms, ILS 170 million. This is 74% of the fixed cost (ILS 229 million) and 49% of the total cost (fixed plus maintenance). On the negative side, if there are less than 170,000 visitors, the net benefit of a recreational day of ILS 40 (as shown in Table 6) would cause an annual welfare loss of ILS 6.8 million, or ILS 136 million in present value. Another option, which is not analyzed here, would be to combine partial restoration and entrance fees. The loss of visitors might be greater if the travel cost coefficient is lower, but it might allow financing the whole project without public funds. This can be considered for urban rivers where public funding for restoration is limited. The decision whether to give up a large proportion of visitors, with the associated welfare loss, versus the opportunity to collect about half of the cost from them, is a normative social issue, although from an economic perspective, the entrance fee should be zero and cost should fall on the taxpayers.

Conclusions

River restoration is a costly project that uses public funds and needs to benefit the public in return. The option of only partial restoration needs to be addressed by considering many physical and ecological consequences and considering its economic value to both the users and non-users of the restored environment (Wohl et al., 2015).

This study aims to assess the benefits of the different restoration components of the Kishon River, as a supporting tool for decision-making when planning river restoration. The overall value of the full restoration plan was estimated to be as high as ILS 333 million. Different types of values – use, optional, bequest, and existence – were presented separately. This separation is revealing when dealing with projects on a national scale, where existence value is shared beyond the local urban residents who are the main users of the park.

Finally, the benefit and the estimated cost of the restoration project were compared. This reduced the net benefit of the project to about ILS 100 million. Subtracting annual maintenance costs from the net benefit, an annual deficit of ILS 8.2 million is reached. But adopting a partial restoration scheme, the project can still be net-beneficial despite maintenance costs. Important benefits that could compensate for this are public benefits from private entrepreneurship and added benefits from other aquatic ecosystem services, such as flood damage prevention (Yitzhak, 2005). Moreover, benefits from the reintroduction of biodiversity to the river and preservation or maintenance of biodiversity were not considered. The economic valuation of the Kishon River is partly based on emotional responses, because of the history of the river and its pollution.

Future research and policy implications of such studies should take extra caution in adding up the benefits of partial restoration projects. As shown in our analysis, respondents considered each different partial restoration scenario as if this were the only policy on the table. When there is one plan on the table and we add a second one, we may get a smaller change in the visit frequency or WTP for the new option.

Although it is one of the longest rivers in northern Israel, and it runs through the Haifa metropolis, its distance from urban and residential centres limits the popularity of the Kishon River as a local urban park. Thus, an adequate financing model for the restoration project could be a combination of tax money and entrance fees. Using the Kishon River as a study case, an assessment method considering partial restoration schemes was demonstrated.

Note

1. Senior authorship is not assigned. Authors are listed alphabetically.

Disclosure statement

No potential conflict of interest was reported by the authors.

Funding

This work was supported by the Kishon River Authority, Israel [05-07-2011].

References

Alam, K. (2008). Cost–Benefit analysis of restoring Buriganga River, Bangladesh. *International Journal of Water Resources Development*, *24*(4), 593–607. doi:10.1080/07900620802224486

Amirnejad, H., Solout, K. A., Jahanifar, K., & Zarandian, A. (2014). The comparison of contingent valuation and travel cost method in estimation of economic value of recreational, tourism and Aesthetic functions. Unpublished manuscript.Retreived 17 Febuary-2018 from.http://www.webmeets.com/files/papers/wcere/2014/1101/Bamu.pdf

Amoako-Tuffour, J., & Martínez-Espiñeira, R. (2012). Leisure and the net opportunity cost of travel time in recreation demand analysis: An application to Gros Morne National Park. *Journal of Applied Economics*, *15*(1), 25–49. doi:10.1016/S1514-0326(12)60002-6

Angelopoulos, N. V., Cowx, I. G., & Buijse, A. D. (2017). Integrated planning framework for successful river restoration projects: Upscaling lessons learnt from European case studies. *Environmental Science and Policy*, *76*, 12–22. doi:10.1016/j.envsci.2017.06.005

Armbrecht, J. (2014). Use value of cultural experiences: A comparison of contingent valuation and travel cost. *Tourism Management*, *42*, 141–148. doi:10.1016/j.tourman.2013.11.010

Arrow, K., Solow, R., Portney, P., Leamer, E., Radner, R., & Schuman, H. (1993). Report of the NOAA panel on contingent valuation. *Federal Register*, *58*(10), 4602–4614. Washington DC.

Asaf, L., Negaoker, N., Tal, A., Laronne, J., & El Khateeb, N. (2007). Transboundary stream restoration in Israel and the Palestinian Authority. In C. Lipchin, E. Pallant, D. Sranga, & A. Amster (eds.) *Integrated water resources management and security in the Middle East* (pp. 285–295). Dordrecht: Springer.

Atkins, J. P., Burdon, D., & Allen, J. H. (2007). An application of contingent valuation and decision tree analysis to water quality improvements. *Marine Pollution Bulletin*, *55(10–12)*, 591–602. doi:10.1016/j.marpolbul.2007.09.018

Avishai, N., Rabinowits, C., Moiseeva, E., & Rinkvich, B. (2002). Genotoxity of the Kishon River, Israel: The application of an in vitro cellular assay. *Mutation Research/Genetic Toxicology and Environmental Mutagenesis*, *518*(1), 21–37. doi:10.1016/S1383-5718(02)00069-4

Barak, B., & Katz, D. (2015). Valuing instream and riparian aspects of stream restoration–A willingness to tax approach. *Land Use Policy*, *45*, 204–212. doi:10.1016/j.landusepol.2015.01.023

Barbier, E. B. (1994). Valuing environmental functions: Tropical wetlands. *Land Economics*, *70*(2), 155–173. doi:10.2307/3146319

Barbier, E. B. (1995). Tropical wetland values and environmental functions. In C. A. Perrings, K.-G. Mäler, C. Folke, C. S. Holling, & B.-O. Jansson (eds), *Biodiversity conservation; Problems and policies* (pp. 147–169). Dordrecht-Boston-London: Kluwer Academic Publishers.

Becker, N., & Friedler, E. (2013). Integrated hydro-economic assessment of restoration of the Alexander-Zeimar River (Israel-Palestinian Authority). *Regional Environmental Change*, *13*(1), 103–114. doi:10.1007/s10113-012-0318-1

Becker, N., Helgeson, J., & Katz, D. (2014). Once there was a river: A benefit–Cost analysis of rehabilitation of the Jordan River. *Reg Environ Change*, *14*(4), 1303–1314. doi:10.1007/s10113-013-0578-4

Becker, N., Lavee, D., & Tavor, T. (2012). Desalinate or divert? Coastal non-market values as a decision tool for an integrated water management policy: The case of the Jordan River basin. *Ocean & Coastal Management*, *64*, 27–36. doi:10.2166/wp.2006.050

Bergstrom, J. C., & Loomis, J. B. (2017). Economic valuation of river restoration: An analysis of the valuation literature and its uses in decision – Making. *Water Resources and Economics*, *17*, 9–19. doi:10.1016/j.wre.2016.12.001

Bernhardt, E. S., Palmer, M. A., Allan, J. D., Alexander, G., Barnas, K., Brooks, S., … Galat, D. (2005). *Synthesizing US river restoration efforts*. Washington DC: Science/AAAS.

Boon, P. J., Calow, P., & Petts, G. E. (1992). *River conservation and management*. New York, NY (United States): John Wiley Sons.

Brouwer, R., & Sheremet, O. (2017). The economic value of river restoration. *Water Resources and Economics*, *17*, 1–8. doi:10.1016/j.wre.2017.02.005

Brox, J. A., Kumar, R. C., & Stollery, K. R. (2003). Estimating willingness to pay for improved water quality in the presence of item Nonresponse Bias. *American Journal of Agricultural Economics*, *85*, 414–428. doi:10.1111/ajae.2003.85.issue-2

Cameron, T. A., & Huppert, D. D. (1989). OLS versus ML estimation of non-market resource values with payment card interval data. *Journal of Environmental Economics and Management*, *17*, 230–246. doi:10.1016/0095-0696(89)90018-1

Carson, R. (2011). *Contingent valuation, a comprehensive bibliography and history*. Northampton: Edward Elgar.

Carson, R., Flores, N., Martin, K., & Wright, J. (1996). Contingent valuation and revealed preference methodologies: Comparing estimates for quasi-public goods. *Land Economics*, *72*, 434–445. doi:10.2307/3147159

Cesario, F. J. (1976). Value of time in recreation benefit studies. *Land Economics*, *51*, 32–41.

Chen, N., Li, H., & Wang, L. (2009). A GIS-based approach for mapping direct use value of ecosystem services at a county scale: Management implications. *Ecological Economics*, *68*(11), 2768–2776. doi:10.1016/j.ecolecon.2008.12.001

Clarke, S. J., Bruce-Burgess, L., & Wharton, G. (2003). Linking form and function: Towards an eco-hydromorphic approach to sustainable river restoration. *Aquatic Conservation: Marine and Freshwater Ecosystems*, *13*, 439–450. doi:10.1002/(ISSN)1099-0755

Costanza, R., de Groot, R., Sutton, P., Van der Ploeg, S., Anderson, S. J., Kubiszewski, I., ... Turner, R. K. (2014). Changes in the global value of ecosystem services. *Global Environmental Change*, *26*, 152–158. doi:10.1016/j.gloenvcha.2014.04.002

Covey, J., Loomes, G., & Bateman, I. J. (2007). Valuing risk reductions: Testing for range biases in payment card and random card sorting methods. *Journal of Environmental Planning and Management*, *50*(4), 467–482. doi:10.1080/09640560701401986

Dallimer, M., Irvine, K. N., Skinner, A. M., Davies, Z. G., Rouquette, J. R., Maltby, L. L., ... Gaston, K. J. (2012). Biodiversity and the feel-good factor: Understanding associations between self-reported human well-being and species richness. *BioScience*, *62*(1), 47–55. doi:10.1525/bio.2012.62.1.9

Dillman, D. A. (2000). *Mail and internet surveys: The tailored design method* (Vol. 2). New York: Wiley.

Douglas, A. J., & Taylor, J. G. (1999). The economic value of Trinity River water. *International Journal of Water Resources Development*, *15*(3), 309–322. doi:10.1080/07900629948835

Englin, J., & Shonkwiler, J. S. (1995). Estimating social welfare using count data models: An application to long-run recreation demand under conditions of endogenous stratification or counting. *The Review of Economics and Statistics*, *77*(2), 104–112. doi:10.2307/2109996

Eom, Y., & Larson, D. M. (2006). Improving environmental valuation estimates through consistent use of revealed and stated preference information. *Journal of Environmental Economics and Management*, *52*, 501–516. doi:10.1016/j.jeem.2005.11.001

Garcia, X., Corominas, L., Pargament, D., & Acuña, V. (2016). *Is River Rehabilitation Economically Viable in Water-Scarce Basins?*, *Environmental Science & Policy 61*, 154–164.

Garcia, X., & Pargament, D. (2015). Rehabilitating rivers and enhancing ecosystem services in a water-scarcity context: The Yarqon River. *International Journal of Water Resources Development*, *31*(1), 73–87. doi:10.1080/07900627.2014.911147

Ghosh, P. K., & Mondal, M. S. (2013). Economic valuation of the non-use attributes of a south-western coastal wetland in Bangladesh. *Journal of Environmental Planning and Management*, *56*(9), 1403–1418. doi:10.1080/09640568.2012.724667

Gobi, O. (2003). Financial analysis for restoration of the Kishon River.Report submitted to the Kishon River Authority. (in Hebrew).

Golan, T. (2016). The fall and Rise of the Kishon River. *Water*, *8*, 7. doi:10.3390/w8070283

Haab, T. C., & McConnell, K. E. (2002). Valuing Environmental and Natural Resources. In *Edward – Elgar publishing*. UK: Cheltenham.

Heberling, M. T., & Templeton, J. J. (2009). Estimating the economic value of national parks with count data models using on-site, secondary data: The case of the Great Sand Dunes National Park and Preserve. *Environmental Management*, *43*(4), 619–627. doi:10.1007/s00267-008-9149-8

Hsu, G. J., & Li, W. Y. (1990). Application of the contingent valuation method to the Keelung river, Taipei. *International Journal of Water Resources Development*, *6*(3), 218–221. doi:10.1080/07900629008722474

Huhtala, A. (2004). What price recreation in Finland?—A contingent valuation study of non-market benefits of public outdoor recreation areas. *Journal of Leisure Research*, *36*(1), 23–44. doi:10.1080/00222216.2004.11950009

Imandoust, S. B., & Gadam, S. N. (2007). Are people willing to pay for river water quality, contingent valuation. *Journal of Environmental Science and Technology*, *4*(3), 401–408. Israel annual statistics report (2015).

Kerna, A., Colby, B., & Zamora, F. (2017). Cultural and recreational values for environmental flows in Mexico's Colorado River Delta. *Water Economics and Policy*, *3*, 2. doi:10.1142/S2382624X16500351

Kishon River Authority. (2003). Retrieved July 2017 from). http://kishon.org.il/kishon-river-authority/Last

Kishon River Authority. (2015). Kishon river authoritywebsite. Retrieved from http://kishon.org.il/kishon-river-authority/

Kolstad, C. D. (2000). *Environmental Economics*. Oxford, UK: Oxford University Press.

Kotchen, M. J., & Reiling, S. D. (2000). Environmental attitudes, motivations, and contingent valuation of non use values: A case study involving endangered species. *Journal of Ecological Economics*, *32*, 93–107. doi:10.1016/S0921-8009(99)00069-5

Kramer, R. A., & Eisen-Hecht, J. I. (2002). Estimating the economic value of water quality protection in the Catawba River basin. *Water resources*. *Research*, *38*(9), 1182. doi:10.1029/2001WR000755

Kristensen, P. (1994). European rivers and lakes: Assessment of their environmental state. http://www.forskningsdatabasen.dk/en/catalog/2389310842 (Retrieved 8 June, 2018 from).

Loomis, J. (2003). Travel cost demand model based river recreation benefit estimates with on-site and household surveys: Comparative results and a correction procedure. *Water Resources Research*, *39*, 4. doi:10.1029/2002WR001832

Loomis, J., & McTernan, J. (2014). Economic value of instream flow for non-commercial whitewater boating using recreation demand and contingent valuation methods. *Environmental Management*, *53*(3), 510–519. doi:10.1007/s00267-014-0232-z

Martínez-Espiñeira, R., Amoako-Tuffour, J., & Hilbe, J. M. (2006). Travel cost demand model based river recreation benefit estimates with on-site and household surveys: Comparative results and a correction procedure—Reevaluation. *Water Resources Research*, *42*, 10. doi:10.1029/2005WR004798

Maruani, T., & Amit-Cohen, I. (2009). The effectiveness of the protection of riparian landscapes in Israel. *Land Use Policy*, *26*, 911–918. doi:10.1016/j.landusepol.2008.11.002

Mayor, K., Scott, S., & Tol, R. S. (2007). *Comparing the travel cost method and the contingent valuation method: An application of convergent validity theory to the recreational value of Irish forests* (No. 190). Working Paper, The Economic and Social Research Institute (ESRI), Dublin.

McMillan, S. K., & Noe, G. B. (2017). Increasing floodplain connectivity through urban stream restoration increases nutrient and sediment retention. *Ecological Engineering*, *108*, 284–295. doi:10.1016/j.ecoleng.2017.08.006

Mendes, I., & Proença, I. (2011). Measuring the social recreation per-day net benefit of the wildlife amenities of a national park: A count-data travel-cost approach. *Environmental Management*, *48*(5), 920. doi:10.1007/s00267-011-9733-1

Mitchell, R. C., & Carson, R. T. (1989). *Using surveys to value public goods: The contingent valuation method*. Washington, D.C: Resources for the Future.

Monarchova, J., & Gudas, M. (2009). Contingent valuation approach for estimating the benefits of water quality improvement in the Baltic states. *Environmental Research, Engineering and Management*, *1*(47), 5–12.

Morison, P. J., & Brown, R. R. (2011). Understanding the nature of publics and local policy commitment to water sensitive urban design. *Landscape and Urban Planning*, *99*(2), 83–92. doi:10.1016/j.landurbplan.2010.08.019

Muhar, S., Schmutz, S., & Jungwirth, M. (1995). River restoration concepts - goals and perspectives. *Hydrobiologia*, *303*, 183–194. doi:10.1007/BF00034055

O'Sullivan, A., Stop all navy diving in Kishon River, The Jerusalem post (26 July, 2001), http://www.jpost.co.il/

OECD. (2004). Recommendation of the Council on Use of Economic Instruments in Promoting the Conservation and Sustainable Use of Biodiversity. Paris: OECD.

Oren, A., Aizenshtat, Z., & Chefetz, B. (2006). *Persistent Organic Pollutants and Sedimentary Organic Matter Properties: A Case Study in the Kishon River, Israel*, *Environmental Pollution*, *141*(2), 265–274.

Ozono, H., Jin, N., Watabe, M., & Shimizu, K. (2016). Solving the second-order free rider problem in a public goods game: An experiment using a leader support system. *Scientific Reports*, *6*, 38349. doi:10.1038/srep38349

Pan, J., Zeng, W., & Zhang, W. (2012). the willingness to pay for the ecological compensation of min river basin–based on the survey of Chengdu 282 Households. *Environment and Pollution*, *1*(2), 14. doi:10.5539/ep.v1n2p14

Pedroli, B., de Blust, G., van Looy, K., & Van Rooij, S. (2002). *Landscape Ecology*, *17*(1), 5–8.

Ressurreição, A., Gibbons, J., Dentinho, T. P., Kaiser, M., Santos, R. S., & Edwards-Jones, G. (2011). Economic valuation of species loss in the open sea. *Ecological Economics*, *70*(4), 729–739. doi:10.1016/j.ecolecon.2010.11.009

Ryan, M., & Watson, V. (2009). Comparing welfare estimates from payment card contingent valuation and discrete choice experiments. *Health Economics*, *18*(4), 389–401. doi:10.1002/hec.1364

Shaw, D. (1988). On-site samples' regression: Problems of non-negative integers, truncation, and endogenous stratification. *Journal of Econometrics*, *37*(2), 211–223. doi:10.1016/0304-4076(88)90003-6

Shechter, M., & Freeman, S. (1994). Some reflections on the definition and measurement of non-use Value. In R. Pethig (ed.), *Valuing the environment: methodological and measurement issues*. Amsterdam: Kluwer.

Shoshana, G. (2013). Israel ministry of environmental protection. Dredging and Sediment Remediation in the Kishon River. *Israel Environment Bulletin*, *39*, 21–26.

Simon, J. (2016). On the existence of altruistic value and utility functions. *Theory and Decision*, *81*(3), 371–391. doi:10.1007/s11238-016-9537-0

Skinner, K. S., & Bruce-Burgess, L. (2005). Strategic and project level river restoration protocols — Key components for meeting the requirements of the water framework directive (wfd). *Water and Environment Journal*, *19*, 135–142. doi:10.1111/j.1747-6593.2005.tb00561.x

Tamari, A. 2000. Chronicle of a known ahead death. *Green Blue and White*, *32*, (Hebrew). Retrieved from: http://lib.cet.ac.il/pages/item.asp?item=974.

Vermaat, J. E., Wagtendonk, A. J., Brouwer, R., Sheremet, O., Ansink, E., Brockhoff, T., … Giełczewski, M. (2016). Assessing the societal benefits of river restoration using the ecosystem services approach. *Hydrobiologia*, *769*(1), 121–135. doi:10.1007/s10750-015-2482-z

Whitehead, T. C., Haab, T. C., & Huang, J. C. (2000). Measuring recreational benefits of quality improvements with revealed and stated behaviour data. *Resource and Energy Economics*, *22*, 339–354. doi:10.1016/S0928-7655(00)00023-3

Wohl, E., Lane, S. N., & Wilcox, A. C. (2015) The science and practice of river restoration, *Water Resources Research*. *51*, 5974–5997. www.yarok.org.ilhttp://www.reformrivers.eu/home

Yitzhak, Y. (2005). The big floods in the Kishon River between 1990 and 1995. *Horizons in Geography*, *63*, 77–93. (Hebrew).