

# The Application of Choice Experiment Methodology to the Freshwater Ecosystem Services: A Review

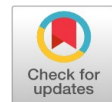
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**Abstract:** Evaluating ecosystem services is difficult due to the complexity of ecosystem processes and the ambiguity around the size and timing of any threshold impact associated with an ecological disturbance. The finest methods for measuring values in the context of ecological non-linearity among economic valuation methodologies are said to be stated preference (S.P) methods. This is because the stated preference approach does not use revealed preference (R.P) techniques to deduce preferences from people's behavior in actual market settings. Thus, it seems acceptable to construct the valuation approach of interest to value several hypothetical ecological situations to demonstrate the sensitivity of the created values to each potential outcome. Due to its design specifications, which call for the creation of various choice sets with a specific number of distinct scenarios (i.e., alternatives) to be presented to respondents so they may choose their most preferred one from each option set, the choice experiment could play a significant role in this regard.

**Keywords:** Ecosystem services, Economic evaluation, Stated preferences, Choice sets, Water-ecosystems

Received: 02 February 2023 / Accepted: 18 April 2023 / Published: 23 May 2023



## INTRODUCTION

The goods and services produced by the earth's natural processes are essential to human life and the entire human economy (Daily, 1997). However, the impact of a growing human population on the environment is significantly modifying natural systems, leading to a significant decrease in the availability of such services. In the past 50 years, more than at any other time in human history, people have changed their habitats at a quicker and more organized rate. To meet the growing demand for food, fresh water, timber, fibrils, firewood, and energy, this was done (Summers et al., 2012).

The rapid economic development human exploitation and alteration of global ecosystems are generally responsible for biodiversity losses and ecosystem conditions degradations, leading to a decreased supply of ecosystem services (Bullock et al., 2011). To counter these impacts on an international basis, the Convention on Biological Diversity (CBD), the Millennium Development Goals (MDG), and the Inter-government Science Policy Platform (ISPP) on biodiversity and ecosystem services explicitly connect biodiversity conservation to the provision of ecosystem services to promote sustainable development and poverty reduction (TEEB, 2010). It is becoming more and more obvious that at least some of the world's "natural capital" or "ecological infrastructure" must be actively repaired to preserve biological variety and the provision of important services. (TEEB, 2011; Groot et al., 2013).

The 2003 and 2005 MEA (Millennium Ecosystem Assessment) were the first systematic international effort to provide scientific evidence to decision-makers on the effects of changes in ecosystems and their related services on human well-being (Ureta et al., 2022). It showed the possibility of including ecological resources in environmental planning, allowing biodiversity to be protected. The fundamental idea of ecosystem services is an appropriate instrument to show how people and nature are interconnected. It demonstrates how biodiversity and ecosystem health support a variety of advantages for people. It is possible to manage ecosystems more successfully and in the long term by considering the connections between natural and socioeconomic systems. (Guerry et al., 2015; Khan & Zaho, 2018).

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A recent classification of the Millennium Ecosystem Assessment (2003, 2005) identified four types of ecosystem services: provisioning, regulating, supporting, and cultural (de Groot et al., 2002). Provisioning services offer food, fuel, and wood. Two instances of regulating services are environmental and flood control. Supporting services include pollination, population control, soil formation, and other critical ecological qualities that are required for biodiversity and other ecosystem activities or services. Cultural services provide people with recreational, spiritual, and aesthetic benefits (Kremen & Ostfeld, 2005).

Ecosystem services evaluations such as MA, TEEB, MAES, and national assessments have covered a wide range of ecosystem services. However, in the current study, we are interested in studying ecosystem services related to water and aquatic ecosystems (Grizzetti et al., 2015). Water is required for all living circumstances in all ecosystems; hence, human activities that support society rely largely on water. As a result, one of the conditions for humanity's secure working space is the availability of water. The global demand for freshwater has escalated to the point that clean, pure water is a critically rare resource. Many non-human species have become scarce in areas where water is scarce and endanger people's health, affecting biodiversity (Kaval & Belt, 2017). The notion of ecosystem services has immediate and immediate consequences for the protection and management of freshwater ecosystem biodiversity (Hoeinghaus et al., 2009; Ali et al., 2020). Globally, human disruption of freshwater ecosystems is at an all-time high. Since 1960, worldwide freshwater withdrawals have roughly doubled, with humans currently using more than half of all available freshwater discharge. Increased water demands for agriculture, industry, and domestic usage are already affecting freshwater resources in numerous parts of the world. The world's major rivers, including Egypt's Nile, South Asia's Ganges, Central Asia's Amu Darya and Syr Darya, China's Yellow River, and North America's Colorado River, have been dammed, drained, and overused to the point where little or no fresh water enters the sea for parts of the year (Saunders et al., 2002). Water scarcity is expected to affect two-thirds of the world's population by 2025 (Szöllosi-Nagy et al., 1998). These stresses have, predictably, destroyed many freshwater ecosystems (Loh et al., 1998; Khan et al., 2022). The Growing human population and increased demand for agricultural commodities place immense pressure on scarce freshwater resources (Khan et al., 2022; Ureta et al., 2022; Nie et al., 2022). To deal with the complex ecosystem services of water resources, a balance must be maintained between the inherent functions of the river ecosystem and the changing aspects of the system (Khan et al., 2018a; Suendarti, 2023).

As a result, the purpose of this research is to thoroughly evaluate previous studies in which researchers employed choice experiment methodology for water resource conservation and management. And conduct a critical study of the literature on environmental resources (i.e., water resources) to better understand public perception of them. Finally, to conclude this study findings keeping in view the importance of choice experiment methodology in the economic evolution of environmental goods.

## **CRITICAL REVIEW OF SIGNIFICANT PUBLISHED LITERATURE ON A CHOICE EXPERIMENT MYTHOLOGY APPLICATION**

### **From 2000 to 2010**

Loomis et al. (2000) used a building block method designed by an integrated team of interdisciplinary departments to address the restoration of five ecosystem services of the Platte-river. And further classified them into dilution of waste water, purification of natural water, soil erosion protection, natural habitat for wildlife and fishes, and recreational services. A survey was undertaken in the research region to record individual decisions related to the restoration of these services to obtain information of interest on the services of the Platte River ecosystem. A dichotomous choice format was presented to the households and documented their willingness to pay behavior for an increase in the price of the water bill. According to the results of an econometric model, on average, households are ready to pay \$21 per month or \$252 yearly for an improvement in ecosystem services. Keeping in mind the interviewer's zero or no response, the value given by a resident along the riverbank ranged from \$19 million to \$70 million.

Alpizar (2001) conducted a study on choice experiments used to value non-market commodities and the most recent findings in that field. Choice experiments, along with the well-known contingent valuation approach, are crucial instruments for pricing non-market commodities, and the results are applied to cost-benefit assessments and legal actions involving damage computations. They found that for the reader to make an informed conclusion about

the outcomes, the article should give the tools needed to do a choice experiment as well as a full critical review of how it performed. The underlying economic model of the choice experiment is explained, and econometric models that are consistent with economic theory are offered. A detailed description of how to create a choice experiment is also provided.

De-Groot (2002) conducted a study on the ecological and economic value of the products and services provided by natural and semi-natural ecosystems, and more data is being collected. However, most of this information is available online and in unpublished publications from governmental organizations and other scholarly journals. Furthermore, information on ecosystem products and services is usually presented at multiple analytical scales and is classified differently by different authors. To make comparative ecological economic analysis feasible, a single framework for comprehensive assessment of ecosystem functions, goods, and services is necessary. In response to this difficulty, their research provides a conceptual framework and typology for characterizing, categorizing, and assigning explicit and consistent values to ecosystem processes, goods, and services. The following study categorizes the greatest possible range of 23 ecosystem functions, which offer a significantly broader diversity of products and services. In the second phase of the study, the main ecological, sociocultural, and economic valuation approaches are linked to these ecosystem functions via a matrix and checklist.

Hanley et al. (2003) conducted a study in South-West Scotland to investigate the impact of beach visits and bathing on water quality, taking into account the European Union's (EU) stringent water quality legislation. A survey was done to get accurate information on the number of trips taken to the seaside as well as individual characteristics. To capture respondents' real reactions to the EU's new water policy, they merged information on stated preferences with revealed preferences and used random effects, a negative binomial panel model. The statistical analysis of the model showed that the number of trips would result in a 1.3% increase in water quality. As a result, it is an important estimate for predicting any potential shift in consumer surplus connected to improved water quality; it is projected to be £0.48 per trip or £5.81/person. The anticipated advantages from the number of trips a person takes to the beach per year were 2.6 million trips, with an estimated aggregate benefit of £1.25 million per year. Their model also took into account the availability of funds for the existence of substitute venues as well as behavioral variation caused by the beach visit associated with the recreational facility.

Dietz et al. (2005) discussed how to have a more sustainable relationship with the environment and frequently bring up values. According to them, values are the subject of a substantial body of literature that spans various academic disciplines. They claimed that values are relatively solid philosophical notions that guide our judgments when our preferences collide and give us a sense of what is right in our sight. In economics, the term "values" is commonly used in discussions of social choice, where a utilitarian ethic serves as a guide to the best decision through an assessment of the social worth of various alternatives. Environmental values have been the focus of two major lines of research in sociology, social psychology, and political science. They also claim One focussed on four value clusters: self-interest, benevolence, traditionalism, and openness to change.

Hanley et al. (2006) investigated people's preferences for improving water resources in the UK under the directive of the Water Framework Directive (WFD). Three ecological criteria (river ecology, aesthetics, and bankside quality) were chosen to signify the state of 'excellent ecology' for this purpose. Primary data was acquired from the sample region using a well-structured questionnaire to determine people's preferences for specific features. The stated preferences (SF) approach was utilized, as well as the choice experiment (CE) method and logistic regression analysis, to determine the degree of improvement in the status of selected ecological component qualities. The advantages of transferability between the two rivers were investigated using choice experiments. According to the findings, poor inhabitants residing near Clyde were ready to pay more for improvements in environmental qualities than affluent persons living near the Wear. Finally, they completed their research by stating that, due to the higher costs associated with valuation approaches, the benefits transfer method is recommended for the Directive's implementation.

Daily et al. (2009) researched recently emerging examples from Hawaii, presenting a conceptual framework and outlining a strategic strategy for delivering on the promise of ecosystem services. They emphasized major advances in the theory and practice of natural disaster accounting. And stated that many people have emphasized the necessity of recognizing and maintaining ecosystem services over the last ten years. They proposed that the best opportunity for popularising, enticing, and widespread conservation. In theory, increasing conservation spending while also promoting human well-being should occur if we can help people and institutions recognize the value

of nature. However, neither the scientific foundation nor the political will exist on a global scale to successfully incorporate natural capital into resource and land-use decisions.

### **From 2011 to 2020**

Johnston et al. (2011) conducted a study to dig out methods that dealt with the comprehensive measurement of spatial patterns in the WTP for ecosystem services restoration and improvement of other non-marketed ecological benefits, which stressed local patterns instead of distance decay standard assumptions. These strategies used indicators of spatial connection developed in other areas to detect hot spots and welfare patchiness. Such heterogeneity resulted in econometrically important patterns in non-marketed asset WTP patterns. Relevant to both cost-benefit analysis and traditional techniques to welfare analysis dealing with spatial heterogeneity. Although typical approaches (e.g., distance decay models) are still essential, the findings here imply that researchers should explore augmenting existing methods with spatial analysis that analyses otherwise undetectable, but similarly relevant local patterns.

Latinopoulos (2014) evaluated the welfare analysis of improving coast water attributes, and their findings functioned as a policy instrument to solve the problem of water quality and quantity. A well-structured questionnaire was used to collect primary data, and a face-to-face interview was undertaken. Customers were informed about the nature of the questions and the goal of the study. The respondents' choices for improving the status of water attributes were obtained using the choice experiment design. The estimated WTP coefficients indicated that families are prepared to pay more for improved coastal water quality in the Municipality of New Proponitida, Greece. These findings were significant in water policy formulation and can also be used as a guideline.

Aheropoulos et al. (2015) investigated the economic consequences of climate change on river uses in Greece's Aaos basin, as well as the critical role of mountains as a world-class source of freshwater reservoirs. However, rising global temperatures and changes in precipitation rates represent a major danger to natural water ecosystem functions and biodiversity. As a result, climate change not only harmed the social and economic aspects of the freshwater environment, but it also harmed the natural ecosystem services provided by water, affecting the overall well-being associated with them. A choice experiment survey was created and performed to capture such changes in the value of attributes connected with freshwater resources, and changes in the level of both economic and environmental services were estimated. Despite the presence of variation in respondents' preferences for option selection, the estimated result from the econometric model suggested a positive and significant welfare effect in favor of climate change adoption policy. The expected results could also be used for other research aimed at improving similar degraded environmental conditions around the world, as well as aid in the adaptation of planning for the Aaos River basin restoration.

Aregay et al. (2016) investigated preference heterogeneity in integrated river basin management (IRBM) in the Shiyang River Basin, China, and used the willingness to pay method to restore river basin features. A survey was undertaken to collect primary data, and a total of 1012 respondents were chosen from across the basin. They measured the most important restoration properties using discrete choice measuring. According to the projected results, respondents favored the integrated restoration program for the ecological qualities in the research region on average. Furthermore, the location of the households affects the attribute preference heterogeneity. It was also shown that, as compared to the upper basin, the willingness to pay (WTP) for the restoration of environmental features was lower. The variation in the respondents' ecological and socioeconomic variables explains a portion of the disparity in the associated utility. Finally, they conclude their research by stating that the marginal willingness analysis of IRBM projects in a certain basin either overstated or underestimated the advantages linked with environmental variables.

Chen et al. (2017) investigated the public preference and related heterogeneity in the choice set of attributes improvement to alternative policy options in Zenne River, Brussels, Belgium. A Discrete Choice Experiment (DCE) design was used to choose a representative sample from the Brussels population and five different qualities were defined. According to the Mixed Logit Model (MLM) results, people generally preferred to increase water quality and were more likely to have more neutral water sources. According to the survey results, non-Belgian male citizens favored the status quo choice. While those who were Belgian citizens and active members of environmental organizations chose to save biodiversity and enhance the status of water quality. These findings have important implications for freshwater restoration methods in rural, peri-urban, and densely inhabited areas under the European

Water Framework Directive (WFD). These findings have important implications for freshwater restoration methods in rural, peri-urban, and densely inhabited areas under the European Water Framework Directive (WFD).

Khan et al. (2018a), while focusing on the spatial variability of preferences across households for environmental qualities, investigated the distance decay effect of the public's willingness to pay attitude for improvements in river basin features. They reported that spatial variability exists among respondents concerning their favored qualities. According to the findings, when the ecological attributes improved by one unit, households in Liangzhou County in general preferred to pay 491.89, 369.32, and 338.37 yuan per year, respectively, for an increase in the value of the natural landscape, forest coverage protection, and eco-tourism. Respondents in Jinchang County, on the other hand, were willing to spend 447.60, 431.81, and 318.18 yuan per year for a unit rise in the values of these qualities. According to their findings, parameters generated using the RPL model demonstrate a considerable distance decay effect of the individual WTP for environmental factors. This meant that households residing near the river basin (within a 5km radius) were willing to pay more than those living elsewhere. Their reported yearly payment for improving the natural landscape, water quality, and grass cover is 832.61, 365.62, and 353.05 yuan per year, respectively.

Khan et al. (2018b) compared the improvements in the river basin's attributes to the welfare estimate for modifications in the river's conservation. They also looked at the transfer error to see if it was feasible to transfer benefits between the population and the study sites. They also demonstrate the impact of regional variability on welfare estimates. According to the study's estimated parameters, the upper basin has the lowest benefit transfer of the three basins and the largest benefit transfer of the three basins. According to their findings, the pace of improvement for ecological features depending on respondents' choices varies among basins. To estimate the transfer error while taking into account the geographical. According to the computed coefficients of the RPL model, including taste variation in the model not only minimizes transfer error but also increases the applicability of benefit transfer. When advantages are transferred between the upper and lower basins, the rate of transferability is predicted to be 15%, while it is calculated to be 16%. Their research also shows that the flow of non-marketed benefits for river restoration flows from the upper to the middle and upper to lower basins, respectively. Their findings have practical implications for programs aimed at restoring ecological services.

Khan and Zhao (2018) stated that ecosystem services provide an excellent source of linkage between nature and humanity, as well as a good source of preservation policy for the restoration and support of natural ecosystems. Water services not only influence the health and daily activities of local people, but they also bring ecological and social advantages. Nonetheless, China's growing urbanization and industrialization have severely harmed river networks and the services they supply. He also represents the significance of public preferences in decision-making related to river restoration and efficient management. His study's major goal was to use the choice experiment approach with mixed logit and multinomial logit models to investigate families' willingness to pay. This method was used to evaluate respondents' preferences for water service variables such as water quality, water distribution in the higher, middle, and lower basins, and any potential preference heterogeneity. The likelihood ratios test demonstrated that the RPL model's estimated results are statistically more powerful than MNL models. Furthermore, the RPL-II findings were considered to be the most significant and strong among all estimated models, confirming the model's importance in the respondents' decisions. Water quality was the most desired attribute, according to the anticipated findings, and households were willing to spend more money to restore water quality. The primary factors impacting the respondent's willingness to pay decision were determined to be income, education, residence location, and respondent sex. His research findings assisted researchers and served as a reference for them, as well as providing guidelines for policymakers to enhance and improve the current river water state in the future.

Wing et al. (2018) investigated the supply and demand situation of urban water supply safety (WSS), a contentious subject, particularly in developing nations. They wanted to measure WTP and consumer preferences to improve WSS in China. In this way, they assisted the government in policy formulation and regulation design, as well as assessing those who intended to invest in water. They calculated customers' WTP and preferences for improving WSS in China using a choice experiment method. They also used attitudinal and demographic factors, as well as WSS water properties. According to the results of the WSS choice experiment approach, urban inhabitants are more willing to pay a high price for convenience. The reported marginal means for modifying attributes range from 0.18 RMB/m<sup>3</sup> (0.03 USD/m<sup>3</sup>) for reducing water supply disruption to (2.33 Yuan RMB/m<sup>3</sup> (0.35 USD/m<sup>3</sup>) for improving water quality for drinking. They recommended investments in processing facilities

that increase water quality, an efficient water distribution network, and cross-subsidization in different districts based on their development level. Their study contributes to the field of WTP by introducing attitudinal variables in a choice experiment. In addition, the implications of choice experiment methodologies in the field of WSS program enhancement were investigated.

Feyisa and Bersisa (2019) undertook a study to assess the transmission of benefits from Lake Koka and to analyze the elements that pose major concerns to the Lake Koka ecosystem. They recognized that, among other things, inefficient management, unstoppable irrigation, extensive agriculture, and human-oriented activities (such as waste disposal in wetlands, intensive grazing, etc.) posed a threat to the depletion of the wetland's environmental assets. They surveyed the research area, collecting data from a sample size of 200 randomly selected respondents, and a random parameter logit model was used. Five lake qualities were determined based on the choice experiment design: fish stock, water quality, biodiversity of the lake, water quantity, and the corresponding payment. For economic interpretation, monetary factors were attributed to the various benefits of lake ecological services. According to the statistical analysis, water availability is significant at the 1% level of significance, and its computed willingness to pay value was birr 55, which is statistically significant. While all other variables were held constant, the individual projected annual values of WTP for Lake Koka's water quality and biodiversity were birr 42 and birr 12, respectively. According to these findings, respondents placed a higher monetary value on water availability restoration than on biodiversity restoration.

Khan et al. (2019) stated that the ecosystem provides many important services with socioeconomic significance for the well-being of humans. They also emphasized the importance of protecting ecosystem services that have deteriorated due to increased land use and other significant changes in river ecosystems in their study. They evaluated people's awareness, attitude, and perception of ecological and water resource concerns to determine their willingness to pay for the development of specific river Wei basin attributes. To collect data from respondents, multistage sampling approaches were used, and 900 people were chosen at random from the study area. During the survey, it was discovered that the majority of families were concerned about the management of environmental and water resource issues rather than social and economic qualities. According to the results of the random parameter logit model, 83.32 percent and 50.50 percent of respondents, respectively, favored enhanced water quality and irrigation conditions. Furthermore, the correlations for both ecological and monetary parameters were statistically significant, as expected. The coefficient of the alternative specific constant, which was statistically significant and had a positive sign, indicated that households preferred the restoration policy scenario over the status quo scenario. The highest WTP is for water quality (91.99 RMB), followed by erosion intensity (23.59 RMB), and water quantity (23.59 RMB) (11.79 RMB), according to the data.

Burton et al. (2020) conducted a study to explore farmers' preferences and attitudes toward various irrigation fees utilizing various payment devices. They indicated the need for the intended model of good governance water at the local level based on the study's findings. Their research made an essential contribution to the growing body of knowledge on the efficient functioning of participatory irrigation systems, particularly in Pakistan and India. It was proposed to integrate the farmers' preferences pattern with local water administration to reduce the barriers to participatory irrigation and the requirements to pay for water costs. They also stated that no other study had ever addressed the subject of direct feedback from farmers and that they were the first to investigate this aspect.

### **From 2021 to up to Date**

Dai et al. (2021) estimated the advantages of rehabilitating different segments of the Yongding River in Beijing, China (DCE) using a discrete choice experiment. River rehabilitation expenditures are expensive, they claim, because rivers are in dire danger all around the world. The advantages of river restoration are far more difficult to quantify than the costs. Residents upstream and downstream are sampled to determine place attachment and river segments are employed in the DCE as labeled alternatives. All river basin residents, as expected, place a high value on enhanced water quality, and place attachment and spatial preference heterogeneity have a major influence on the public's willingness to pay (WTP) for river restoration. Even though respondents are only ready to spend a small fraction of their disposable income, the public WTP for improved river water quality is two to four times that of the average household water bill. These findings provide critical guidance for recouping the river restoration project's investment expenditures.

Nie et al. (2022) used a spatial choice experiment to determine if residents in the upper, middle, and lower

reaches of China's Xijiang River Basin would be willing to pay for ecological restoration. Their research looks into whether variances in perceived environmental quality cause various degrees of perceived environmental quality. According to their research, river basin eco-environmental preservation, and damage reimbursement have been important concerns for scholars all over the world for a long time. Numerous research have been conducted to investigate the links between individual socioeconomic features, ecological cognition, and variations in willingness to pay. However, no research has been conducted from the standpoint of perceived environmental quality. According to the Broken Windows Theory, prior perceptions of environmental quality play a crucial effect in determining the public's desire and actions regarding environmental conservation.

Khan et al. (2022) conducted a study in which they examined how the elevation of the study region, a spatial attribute, affects people's willingness to pay for environmental characteristic restoration. The study considers six ecological variables to assess differences in people's willingness to pay at various elevation levels. A total of 33 surrounding villages and townships, as well as four cities, were surveyed. To conduct a study survey across the river basin, a choice experiment method was adopted. Their findings revealed that effective river basin management is dependent on examining the river basin as well as the preferences of the population. Improving the environmental quality of the river can have major non-market advantages. As a result, the study analyses the variation in people's preferences and rankings of river ecosystem services based on their willingness to Pay (WTP) to improve these services.

Ureta et al., (2022) investigated the possibility of constructing a PES by examining the potential community benefits from ES augmentation using a choice modeling approach. They polled 1560 South Carolina residents to establish residents' monthly willingness-to-Pay (WTP) for ES improvement. Their findings revealed that WTP estimates differed depending on the type of intervention, the geography of the dwellings, and the priority ES for improvement. The anticipated mean WTP for increasing water quality ranged from zero to three dollars. The average WTP for increasing animal habitat, on the other hand, ranged from \$0 to \$6.39. Finally, with a mean WTP of \$0.31, only people of the Upstate region responded that they are willing to support an increase in water supply. The overall expected community benefits range from \$4.6 million to \$6.2 million per month, suggesting that PES is a successful program that might provide a significant source of money for conservation activities.

Johnston et al. (2023) calculated the economic value of households' willingness to pay (WTP) for better water quality based on the location of the improvements. Households usually place a higher value on improvements located near their houses or in well-known areas. Are there others? Do the impacts on WTP differ depending on the type of change, and can these regions be detected even if researchers do not foresee them? Are there any areas where improvements could be beneficial to certain households? To address these concerns, they coupled a map-based, interactive choice experiment with a water quality model to estimate households' WTP for improved water quality over a river network spanning six New England states. The choice experiment was carried out using a push-to-web poll among a sample of New England families.

## **CONCEPTUAL FRAMEWORK**

Most of the environmental goods are public goods, cost and benefit analysis of such projects or policies involving public goods is a complex process. It is therefore difficult to trade public goods in the market as private goods are. As a result, public goods are either under-produced or misappropriated by the market. This is referred to as market failure in economics (Koundouri, 2000). To make these failures correct it is important to capture the benefits delivered by environmental resources. Environmental economists who lead the conservation campaign believe that people derive benefits from these resources either from their direct consumption or through indirect consumption. They accurately convey the importance of Total Economic Worth when estimating the value of natural resources, Total Economic Value includes both use values and non-use values (Khan and Zhao, 2018).

Many economic valuation methodologies have been developed to capture the TEV of natural resources. Speaking of two such techniques are the revealed presences approach and the stated preferences approach, also named as an indirect valuation method. The most essential aspect of these survey-based approaches is that, unlike revealed preference methods, they account for non-use values as well as use values of environmental resources, allowing them to estimate all components of total economic value (TEV). The SPM can be used for the economic valuation of water resources as many of the water functioning and services cannot be traded directly in the market as normal goods do. Two such prominent techniques being in use are the contingent valuation method and the

choice experiment method (Khan et al., 2018).

This paper however used choice experiment methodology the choice experiment method, a new addition to the assortment of stated preference methods (SPM). A choice experiment is therefore a well-developed data generation experimental design that is carefully structured to extract the factor that affects the choice. The characteristics of environmental resources are specified, as well as the various degrees to which they might go with or without sustainable resource management.

## **CONCLUDED REMARKS**

Adamowicz et al. reported the first application of the Choice Experiment to environmental management challenges in 1994. Environmental economists' interest in using choice experiments can be explained by their view of the technique as a good way to collect data for resource allocation in settings where there is no market. The choice experiments may be utilized as inputs in a CBA of alternative policies since they can elicit respondents' WTP to transition from one status quo scenario to another demonstrating the result of a policy about which people's preferences desire to be approximated. Since the 1990s, however, choice experiments have been increasingly employed in environmental value research because of the several benefits the methodology has over other stated preference methodologies, notably the commonly used CVM. One of the most notable advantages of the choice experiments over the CVM, it has been noted, is the method's ability to estimate a financial indicator of the WTP for one extra unit of a non-monetary feature (i.e., implicit pricing or attribute value). Likewise, choice experiments can be used to adjust environmental quality levels, enable their extension beyond existing ones, and define the value for any particular change, making them not only an ideal way to generate passive use value because they allow respondents to ask about their environmental settings for environmental quality, but also to estimate use values because choice experiments can be used to adjust environmental quality levels, enable their extension beyond existing ones, and define the value for any particular change. Yet another advantage of choice experiment over CVM is that it can accomplish any potential result when attribute levels are ambiguous, whereas CVM only permits one value for an expected quality increase.

In light of the above discussion, the choice experiment method was deemed the most appropriate approach for the restoration or improvement of the ecosystem services of freshwater resources utilizing the willingness to pay estimations. Several studies such as (Johnston et al., 2023; Khan et al., 2022; Nie et al., 2022; Ali et al., 2020; Burton et al., 2020; Khan et al., 2019; Khan et al., 2019; Feyisa and Bersisa, 2019; Khan and Zhao, 2018; Chen et al., 2017; Aregay et al., 2016; Dias and Belcher, 2015; Halko and SMatsiori, 2014; Halkos, 2013; Shang et al., 2012; Brander et al., 2006; Boyer and Polasky, 2004; Carlsson et al., 2003; and Loomis et al., 2000) had used choice experiment technique to evaluate the public preferences pattern and willingness to pay attitude to elicit the general behavior associated with the improvement of the freshwater resources from the status quo to alternative policy options. As a result of the previous literature analysis, it is determined that the CE approach is the most appropriate and well-supported strategy to be employed for the WTP to improve the status of freshwater water ecosystem services.

## **Recommendations**

This kind of research needs to be taken into account when developing strategies for managing water resources in natural ecosystems such as wetlands, lakes, rivers, and coastal. Water resource conservation policies and their implementation may eventually benefit from a greater understanding of the fragility of water, the amount of WTP, and their affecting factors.

## **Limitations of the Study**

Choice experiment outcomes are site-specific and have a narrow geographic scope. Any inferences about the broad application will need more research to validate these results elsewhere due to the spatial variability of preferences for water ecosystem services and heterogeneity in the population (e.g., urban vs. rural). Additionally, a thorough cost-benefit analysis is necessary before any firm conclusions can be made about the effectiveness of any specific strategy, including those for enhancing ecosystem services.



## Future Studies

Further research is needed to explore and broaden the scope of the current study by encompassing more literature on spatial variability and distance decay. These findings need to be confirmed by more research, which should also look into the variables affecting the diverse preferences of those who reside in different water ecosystems.

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