Evaluating the Economic Benefits of Water Quality in Florida: Literature Synthesis and Study Recommendations

Final Report

Prepared for the Florida Department of Environmental Protection

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EXECUTIVE SUMMARY

This report was prepared for the Florida Department of Environmental Protection to guide the agency's decision on conducting an economic analysis of the benefits of clean water in Florida. It offers a comprehensive review and synthesis of over 130 papers spanning 35 years of economic research, highlighting the substantial economic returns associated with clean water. The report summarizes current knowledge on the economic benefits of clean water in Florida and the United States and provides recommendations for further study to address existing gaps.

The studies reviewed consistently demonstrate significant economic benefits from water quality improvements across various sectors. In tourism and recreation, cleaner water enhances the attractiveness of water bodies, leading to increased tourist visits and recreational use, which in turn boosts local economies. Improved water quality also has a direct and substantial positive impact on property values, with multiple studies showing a clear link between cleaner water and increased real estate market values.

Most of the literature focuses on the economic benefits of water quality improvements on a small scale, such as individual regions or watersheds, with only a few studies offering nationwide analyses. There is no consensus on the optimal water quality indicators to use in such analyses; some studies rely on a single indicator like Secchi disk depth, while others use composite indices combining several water quality measures. However, recent research has developed more sophisticated water quality metrics that capture both direct use values (e.g., fishing) and non-use values (e.g., aesthetic value).

The methodologies employed in the reviewed studies, including stated preferences (and revealed preferences methods, provide valuable insights into the economic valuation of water quality improvements. However, each method has inherent strengths and limitations, which are discussed in the report.

A handful of studies have estimated the economic value of water quality in Florida's waters. However, most of these studies cover limited temporal and geographic scales and rely on small samples. This makes it difficult to generalize the findings at the state level and limits the understanding of more recent changes in water quality and their economic impacts.

Future research on the economic benefits of clean water in Florida should focus on comprehensive studies that cover a wider range of regions, including both coastal and inland areas, to capture the statewide economic impacts. Long-term analyses using recent data are necessary to assess trends in water quality and the effectiveness of regulations over time. It is also important to consider the impact on both waterfront and non-waterfront properties, especially in urban areas where properties are influenced by regional water quality. Study options to address these gaps are outlined in section 7 of the report.

1. STUDY INCLUSION CRITERIA

The literature review for this report was conducted through comprehensive searches of peer-reviewed studies on economic benefits of clean water, using Google Scholar. The main objective was to identify and synthesize research relevant to the economic valuation of clean water.

Over 130 articles, listed in section 8, were selected from a range of respected academic journals to ensure both foundational and recent insights were included. The selected research spans the past 35 years, capturing early economic valuation methods from the 1980s as well as the most recent advancements. This broad timeframe helps to reflect the evolving understanding of clean water's economic significance across different sectors and regions.

Our search protocol included studies employing non-market valuation approaches, such as stated-preference and revealed-preference methods, and those focusing on various economic benefits derived from clean water, including contributions to the tourism and recreation industry and real estate markets. Additionally, studies identifying methodological advancements in the economic valuation of water quality were included in this review. Keywords used in the literature search included combinations of terms such as: *economic benefits/social benefits, clean water, water quality, water quality improvement, economic valuation, economic impact, recreation/tourism, Florida water resources, use and non-use values, willingness to pay, housing prices, hedonic analysis, health outcomes, choice experiment, stated-preference, as well as terms such as water clarity, harmful algal blooms, Secchi disk, pH, aquatic, and sediment.*

The literature search focused exclusively on peer-reviewed studies, primarily from highly respected academic journals in environmental economics and policy analysis. Key journals included the *Proceedings of the National Academy of Sciences*, *Journal of Environmental Economics and Management, Land Economics, Journal of Public Economics, Ecological Economics, Environmental and Resource Economics*, *Marine Resource Economics*, and the *American Journal of Agricultural Economics*, among others. While the review was not confined to studies from these journals alone, articles from these sources were prioritized due to their rigorous evaluation standards. This approach ensures that the research included in this report is credible, adheres to high peer-review standards, and has a broad impact across multiple fields.

2. Economic Methods to Value the Benefits of Clean Water

Estimating the economic benefits of clean water requires nonmarket valuation techniques because water quality and related ecosystem services are not traded in conventional markets. Non-market valuation allows researchers to estimate the economic value, in dollar terms, that individuals derive from uses of water resources that are not allocated through markets. Benefits from direct use of water bodies, such as fishing or living near a lake, can be inferred through the money people spend to access and enjoy these resources (*use values*). However, there are also benefits unrelated to direct use. For example, individuals may value clean water because it supports wildlife, ensures the resource's availability for future generations, or stems from a sense of responsibility toward environmental preservation. There are two broad classes of non-market valuation methods used by economists to quantify the economic benefits of environmental amenities without explicit markets, such as clean water – attitudinal (*stated-preference*) methods and behavioral (*revealed-preference)* methods (Mendelsohn and Olmstead 2009).

2.1 Stated Preference Methods

Stated preference methods, such as *contingent valuation* and *choice experiments*, are widely employed to estimate individuals' *willingness to pay* for specific environmental benefits, particularly water quality. By gathering data on individuals' preferences and willingness to pay, these methods quantify the economic value of clean water, even when no direct market for the resource exists (Bateman et al. 2023). *Willingness to pay* aggregated across individuals or households represents the economic benefits of water quality improvements to society.

Choice experiments, in particular, allow individuals to evaluate different sets of alternatives with varying attributes, providing insights into the trade-offs they are willing to make for water quality improvements (Carson and Hanemann 2005). These methods involve presenting respondents with hypothetical scenarios—such as cleaner lakes or rivers—and then asking them how much they would be willing to pay for those improvements. By offering different combinations of attributes, choice experiments provide a deeper understanding of how individuals prioritize various aspects of water quality.

In the context of clean water, stated preference methods, have played an important role in valuing water quality because they can capture both *use values* (e.g., recreational benefits) and *non-use values* (e.g., the value of knowing clean water exists for future generations). It is important to understand the value that individuals place on water quality even in bodies of water that they never visit. For instance, the water quality damage caused by the 2010 Deepwater Horizon/Macondo disaster in the Gulf of Mexico and the 1989 Exxon Valdez oil spill in Prince William Sound, Alaska, impacted individuals across the United States. Research shows that people felt a loss from these events, even if they were not directly affected through recreational, commercial, or other uses of the impacted waters (Carson et al. 2003; Bishop et al. 2017). Since these *nonuse values* cannot be observed through market behavior, economists use survey methods to assess people's *willingness to pay* for better environmental quality. Stated preference methods are the only way to estimate non-use values. Given that water quality policies have considerable nonuse benefits, these methods are critical valuation techniques.

2.2 Revealed Preference Methods

Revealed-preference methods are founded on the idea that, while there are no direct markets for environmental goods like clean water, people engage with the environment in various observable ways. Therefore, individual valuations of clean water/water quality can be derived from their actual behavior. *The travel cost method* (TCM) and *hedonic valuation method* are two examples of revealed preference approaches to estimating the value of environmental amenities, such as clean water. The underlying principle of TCM in valuing non-market goods is that the travel cost represents the implicit price visitors pay for their trips to access recreational sites or engage in recreational activities. In the case of clean water, TCM can be used to assess the economic benefits by analyzing how travel costs influence the number of visits to water-related recreational sites like beaches, lakes, or rivers. By examining the relationship between travel costs (price) associated with accessing a recreational site and the number of visits per year to that site (demand) for beach visitors, we can establish a demand curve that reflects the value people place on clean water and the recreational opportunities it provides.

The hedonic valuation method is another revealed preference approach used to estimate the value of environmental amenities, such as clean water. This method is based on the idea that the price of a good, such as a home, is influenced by a variety of attributes, including environmental factors. In the context of clean water, the hedonic method can be used to evaluate economic benefits by analyzing how water quality affects property values near water bodies like lakes, rivers, or beaches. By examining the relationship between property prices and water quality, along with other relevant characteristics, we can estimate the implicit value that homeowners place on clean water. This method helps to quantify the premium people are willing to pay for better water quality, revealing its economic significance through property market data.

2.3 Comparison of Stated and Revealed Preference Methods

Stated and revealed preference methods each have advantages and limitations. S*tated preference methods* can capture both use and non-use values by directly asking individuals their willingness to pay for hypothetical scenarios, making them flexible and able to value goods that don't directly influence markets. However, they are prone to *hypothetical bias*, as responses may not reflect real-world behavior, and the results may be less reliable than those from revealed preferences due to strategic or emotional responses.

In contrast, *revealed preference methods* rely on actual market behavior, offering more reliable and realistic data based on how people interact with environmental goods. This makes them well-suited for valuing amenities linked to observable behavior, such as clean water or recreational sites. However, they are data-intensive, limited to market-related actions, and do not capture non-use values, like the intrinsic or future value of clean water, nor can they be used to value hypothetical changes in environmental quality.

The choice between these methods depends on the specific research question, the availability of data, and the type of values being estimated. In contexts where actual behavior can be observed, revealed preference methods are appropriate. For non-market goods or when exploring hypothetical changes, stated preference methods are more suitable. Ideally, a combination of both methods can provide a more comprehensive understanding of the value of environmental goods and services.

3. Important Issues in Non-Market Valuation Research

3.1 Identification of Spatial Extent

Spatial extent is important when evaluating the economic benefits of clean water using both stated and revealed preference methods. In revealed preference methods, spatial factors can significantly influence valuation. For example, the distance people travel to access a water body affects their costs and thus their willingness to pay for clean water at that site. Similarly, property values often vary based on proximity to clean water bodies, with closer properties generally commanding higher prices. Research shows that homeowners are willing to pay a premium for properties near water bodies with high water quality, and those with waterfront access tend to pay an even higher price (Nicholls and Crompton 2018; Shortle et al. 2021; Mamun et al. 2023). Therefore, proximity to the water body is a key factor influencing residential decisions and property values.

In stated preference methods, spatial extent also plays a critical role. Willingness to pay for water quality improvements may depend on how far respondents live from the water body in question or the perceived geographic reach of the benefits. Individuals may value local water quality improvements more than those in distant areas. In both cases, accounting for spatial factors ensures more accurate and meaningful estimates of the economic benefits of clean water across different regions (Johnston et al. 2023).

3.2 Advancements in Valuation Methodology

Recent advancements in economic valuation methods have significantly improved our ability to assess the economic benefits of clean water. The integration of spatial analysis and Geographic Information Systems (GIS) allows for more accurate consideration of geographic context, enhancing both revealed and stated preference methods. The use of big data and machine learning enables more precise identification of relationships between water quality and economic outcomes. Big data are characterized by high-frequency and high-number of observations, such as property transactions, social media data, cell-phone data and satellite imagery that provide both a spatial and temporal resolution. Satellite imagery has also become a valuable tool for extracting water quality indicators such as clarity, vegetation cover, and pollution levels, providing real-time and large-scale data for more detailed analysis. On the other hand, hybrid approaches combining revealed and stated preferences capture a wider range of values, including ecological and non-use benefits (Kuwayama and Olmstead 2015).

The ecosystem services framework, which focuses on the benefits that humans derive from ecosystems, is increasingly integrated into economic valuation. This approach recognizes the broader ecological and social contributions of clean water, beyond just recreational or property value impacts. Dynamic modeling can help account for temporal variations, reflecting changes in water quality over time, while behavioral economics insights offer a deeper understanding of how people perceive and value environmental goods. Additionally, mobile data collection and crowdsourcing have made it easier to gather information from diverse populations, further enriching the valuation process.

3.2 Selection of Water Quality Metrics for Economic Valuation

The selection of water quality metrics is critical because it can either narrow or expand the suite of values to be valued and can either lead to under- or overvaluing of water quality with significant policy implications. Advancements in integrated assessment models, remote sensing technology, and real-time water quality monitoring have significantly enhanced the researchers’ ability to forecast how human actions impact water quality (Kling et al. 2017; Carey et a al. 2022). Despite these improvements, economic valuation of water quality continues to be an evolving area of research, as the complex and changing interactions among biophysical, social, and economic factors play a key role in determining water values, and water quality issues remain persistent (Bateman et al. 2023).

Various water quality metrics have been utilized in valuation studies that assess economic benefits of water quality and its improvements. Water quality can be expressed in biophysical terms (such as nitrogen levels), as a single score derived from multiple factors, or through a set of qualitative or quantitative indicators. While simplified metrics help reduce the complexity for respondents, they may overlook key aspects of water quality. On the other hand, water quality expressed in biophysical terms may not always align with what is relevant or observable to individuals or reflect the aspects of water quality they value (Keeler et al. 2012). In addition, it is challenging to create water quality metrics that effectively capture both use and nonuse values.

No single water quality measure can fully capture all values and uses, and not every metric will be suitable for all situations. Customized local metrics based on specific biophysical data are useful for evaluating local policies but may not be easily applicable to other regions or contexts. Understanding the link between water quality measures and the range of human uses and values remains a challenge. Water quality science is intricate and continually evolving, uncovering new insights about how ecological interactions and gradients shape outcomes.

4. SYNTHESIS OF KEY FINDINGS ACROSS STUDIES

The studies reviewed for this report consistently show that water quality improvements lead to substantial economic benefits. The literature synthesis provided below is organized by research method, starting with stated preference studies and then moving on to revealed preference approaches, such as the travel cost method and hedonic analysis.

4.1 Stated Preferences Studies

A substantial body of research using stated preference valuation methods, such as contingent valuation surveys and choice experiments, has demonstrated that improvements in water quality result in significant economic benefits. In the past twenty years, research methods have advanced considerably (Bateman et al. 2023), including enhancements in survey development, value elicitation, and data analysis techniques (Kling et al. 2012; Artell et al. 2013; Johnston et al. 2017b). Moreover, methodological progress has been made in designing incentive-compatible surveys and reducing hypothetical bias, leading to more accurate survey responses (Carson and Groves 2007; Vossler et al. 2012; Carson et al. 2014; Pen and Hu 2018). Additionally, researchers have developed more effective ways to communicate complex ecological concepts, such as water quality measures, within surveys (Bateman et al. 2011).

A clear and careful definition of environmental goods and services is crucial when applying stated preference methods to ensure consistent interpretation among respondents and to enable analysts to make accurate quantitative evaluations. However, there is no standardized approach for defining the good being valued (Boyd and Krupnick 2013; Moore et al. 2023), leading to a variety of approaches in water quality valuation research (Johnston et al. 2012). Early studies typically relied on expert opinions to link measurable water quality parameters, such as fecal coliform, total nitrogen, and dissolved oxygen, with designated uses like boating, fishing, swimming, and drinking (McClelland 1974; Mitchell and Carson 1981). More recent research has built on these methods by introducing new measures. For example, Lupi et al. (2023) developed scores for fishing biomass to represent game fishing conditions and a water contact score for other recreational activities like swimming and kayaking, along with a biological condition index to capture nonuse values of aquatic wildlife. They presented respondents with policy scenarios that altered these water quality scores across different regions.

Taking a different approach, von Haefen et al. (2023) combined six water quality parameters—biotic integrity, fecal coliform, specific conductance, total nitrogen, total phosphorus, and turbidity—into three categories: "ecosystem condition," "human health risk," and "murky water days." Changes in water quality were then communicated to respondents by displaying the percentage of stream miles rated as "high, medium, or low" for each category. Vossler et al. (2023) utilized the Biological Condition Gradient (BCG) developed by the Environmental Protection Agency (EPA), which assesses the diversity and relative abundance of freshwater species compared to an "undisturbed" state. They conveyed changes in BCG through visual representations of biological diversity and survey narratives that connected the health of aquatic ecosystems to attributes that people can recognize, comprehend, and value.

Hill et al. (2023) aimed to create a metric applicable on a national scale to measure aquatic biodiversity and capture nonuse values related to improved water quality. In a similar vein, Johnston et al. (2023) presented respondents with changes in three key water quality indicators: water safety based on fecal coliform levels, support for aquatic life through chloride concentrations, and overall water pollution.

Despite the diverse approaches to defining water quality, this research has consistently revealed substantial economic benefits from clean water (Carson and Mitchell 1993; Viscusi et al. 2008; Van Houtven et al. 2014). Carson and Mitchell (1993), for instance, used a contingent valuation survey with a national random sample to measure the public's willingness to pay for cleaner water in recreational activities, estimating that improving water quality to "swimmable" conditions would generate $29.2 billion in national benefits. More recent studies, such as von Haefen et al. (2023), have shown that even regional improvements, like those in the Upper Neuse River Watershed in North Carolina, can lead to $54 million annually in economic benefits. Vossler et al. (2023) found that water quality improvements in river basins in the Upper Mississippi, Ohio, and Tennessee could generate $10.5 billion in economic benefits for the study population over a five-year period.

Most research using stated preference methods to value the economic benefits of water quality has concentrated on small geographic areas, such individual water bodies, river basins and watersheds, highlighting the public's willingness to pay for improvements in local water quality. For example, Viscusi et al. (2008) found that individuals are willing to pay $32 for each percentage increase in lakes and rivers rated as "good" quality by the EPA's National Water Quality Inventory. Similarly, Lipton (2004) estimated that Chesapeake Bay boaters were willing to pay approximately $7.3 million per year to achieve water quality improvements.

Loomis and Santiago (2013) demonstrated that improvements in beach water quality led to an increased economic value per visitor day, with estimates of $54 using the contingent valuation method and $51 using the choice experiment, showing that the values derived from both techniques are statistically equivalent. Additionally, Parthum and Ando (2020) estimated an annual household willingness to pay for meeting nutrient reduction goals in the Upper Sangamon River Basin to be between $62 and $85 per household. Meyer (2013) found an average willingness to pay of $89 per year over five years for improvements in water quality to achieve swimmable conditions in the Minnesota River Basin. Tyner and Boyer (2020) ranked water quality improvements as one of the top benefits of restoration efforts in the Great Lakes. Their analysis found that the most preferred reason for Great Lakes restoration is promoting human health, followed by protecting native species and preventing new invasive species from entering the lakes.

Bergstrom and Loomis (2017) reviewed 38 studies on the economic benefits of river restoration, finding that annual household willingness to pay for such improvements ranges from $4 to $190 (in 2015 USD) and that the economic value increases with the number of miles restored. Vossler et al. (2023) further advanced the valuation of water quality improvements by using the Biological Condition Gradient to measure the economic value of water quality, including both direct use values (e.g., boating, fishing, swimming) and non-use values (e.g., aesthetic value). Their survey of 2,000 households in the Upper Mississippi, Ohio, and Tennessee river basins revealed that an average household is willing to pay $463 per year for five years to improve water quality to a condition “close to the natural state.”

Zhang and Sohngen (2018) were among the first to estimate the economic impact of harmful algal blooms (HABs) on U.S. recreational anglers, showing a significant willingness to pay for reducing HABs beyond conventional water quality measures. Their study found that anglers are willing to pay an additional $8 to $10 per trip for one less mile of boating through HABs and $40 to $60 per trip for policies that reduce phosphorus loadings by 40%.

Research also indicates that the distance to the waterbody is a crucial factor in willingness to pay estimates (Rolfe and Windle 2012; Moore et al. 2018). Vossler et al. (2023) found that households were willing to pay twice as much for water quality improvements in their local watershed compared to those further away. While empirical models can estimate spatial aspects of willingness to pay, their accuracy is limited by the data available. Traditional survey designs often restrict respondents' ability to engage with maps or specific water quality conditions that may be most relevant to them. To address this gap, Johnston et al. (2023) used an interactive map-based choice experiment, demonstrating that allowing individuals to interact with water quality change maps can uncover personalized areas where improvements are highly valued. Such improvements were linked to significant increases in households' willingness to pay, indicating that ignoring these factors could lead to an underestimation of the value of certain water quality changes.

4.2 Revealed Preference Studies

4.2.1 Recreation Demand & Travel Cost Method

Recreation demand models, particularly the travel cost method, are widely used to estimate the economic value of water quality improvements. This method assesses the relationship between the travel costs incurred by visitors and the number of visits to a recreational site, operating under the assumption that the time and money spent traveling to the site reflect the "price" of access. By analyzing how travel costs influence visitation rates, the travel cost method can estimate both the demand for recreational sites and the economic value of improvements in water quality. This approach is particularly valuable for quantifying the benefits of clean water in activities such as fishing, boating, and swimming, where water quality directly affects the overall recreational experience.

Various measures have been used to assess water quality within these models. Fish catch rates are commonly utilized as an indirect measure of water quality (e.g., Morey et al. 1993; Chen et al. 1999), but they can be influenced by factors like fishing pressure and angler skill. Physical measures, such as Secchi transparency and bacteria levels, provide more direct assessments but are less frequently used due to data limitations. Some studies have incorporated more nuanced water quality indicators; for example, Phaneuf et al. (2000) included fish toxin levels in their model for Great Lakes fishing, while Parsons and Kealy (1992) and Parsons et al. (2003) used dissolved oxygen, Secchi transparency, and pollution loading data to create dummy variables for water quality levels in their analyses of Wisconsin lakes and six northeastern states. Despite their significance in affecting recreation demand, these physical indicators offer only a partial view of the value associated with water quality improvements.

Building on some of this research, Egan et al. (2009) analyzed the economic value of water quality improvements in 129 of Iowa's principal lakes. They emphasized the importance of specific water quality measures and found that individuals are responsive to metrics commonly used by biologists, such as water clarity and nutrient levels. This finding underscores the relevance of using precise water quality indicators in understanding and valuing recreational behavior.

Several studies have specifically evaluated the benefits of water quality improvements in various regions. In the Chesapeake Bay, for example, recreational fishing benefits of water pollution abatement have been assessed at multiple sites (Bockstael et al. 1989; Bockstael et al. 1993; Massey et al. 2006; Montgomery and Needelman 1997). Morgan and Owens (2001) estimated that aggregate benefits from a 60% improvement in Chesapeake Bay water quality range from $357.9 million to $1.8 billion, while Bockstael and McConnell (1993) estimated an annual aggregate willingness to pay between $10 and $100 million for moderate water quality improvements in the Bay (in 1984 dollars).

In the Great Lakes region, numerous studies have evaluated the economic impact of water quality improvements (Wolf and Klaiber 2017; Awondo et al. 2011; Murray et al. 2001; Tyner and Boyer 2020). For instance, Yeh et al. (2006) utilized recreation data from Great Lakes visitors in travel cost models to estimate welfare gains and losses due to water quality changes. A reduction of just one advisory day along the Lake Erie shoreline was estimated to generate $28 in benefits per visitor during the summer season (Murray et al. 2001). On a broader scale, a one-day beach closure along the Michigan shoreline could cost between $130,000 and $24 million, depending on the location of the closure (Song et al. 2010). However, estimates vary significantly due to uncertainties about the total affected population size. Further building on this research, Wolf et al. (2017) found that a summer-long harmful algal bloom on Lake Erie leads to a $5.6 million loss in fishing expenditures.

Keeler et al. (2015) offered strong empirical evidence on the economic impact of clean water by analyzing geotagged photographs from visitors to over 1,000 lakes in Minnesota and Iowa. Their study demonstrated that cleaner water bodies attract more visitors, boosting local economies through increased tourism and recreational spending. Lake users were willing to travel an additional 56 minutes, or $22 in travel costs, for every one-meter increase in water clarity, illustrating a direct link between water quality and economic gains.

Bi et al. (2019) examined the economic benefits and regional contributions of recreation at both the reservoir and the upstream free-flowing Ocklawaha River in Florida, finding that river-based recreation offers greater benefits than the reservoir. The research suggests that the trade-off between restoring the river ecosystem and the loss of economic value from reservoir-related recreation can potentially be mitigated.

More recent work by Dalvand and Parsons (2024) examined the economic impact of water quality on recreational fishing in Delaware. They used a recreation demand model focusing on three main water quality variables: fish catch rates, species diversity, and water clarity. The study found that anglers place a significant value on water clarity, with welfare estimates ranging from $5 to $16 million per year for statewide improvements. This further underscores the importance of water quality in driving economic gains through recreational activities.

4.2.2 Property Values

Clean water is an important environmental amenity that influences property values, often commanding a significant premium (Lansford and Jones 1995; Palmquist and Fulcher 2006; Bin et al. 2008; Hazen and Sawyer 2008; Nicholls and Crompton 2018). As a result, there is a substantial body of literature that uses hedonic property analysis to demonstrate the economic benefits of cleaner water on real estate markets, and this research continues to grow as the data required for these models become more readily available (Bishop et al. 2020; Guignet and Lee 2021; Petrolia et al. 2021; Heberling et al. 2024). Because individuals often choose to live close to a waterbody to enjoy the amenities that it provides, hedonic studies have evaluated water quality levels and individual willingness to pay for water quality attributes (Artell 2014; Artell et al. 2013; Bin and Czajkowski 2013; Boyle et al. 1999; Gibbs et al. 2002; Leggett and Bockstael 2000; Michael et al. 2000; Netusil et al. 2014; Poor et al. 2001, 2007; Walsh et al. 2011b). This literature shows that clean water and improvements in different water quality indicators have a significant economic benefit as can be derived from the positive effect on property values (Nicholls and Crompton 2018; Guignet et al. 2022).

Studies can be categorized by the extent of impacts they consider (waterfront properties versus both waterfront and non-waterfront properties), the types of water pollution/water quality indicators they analyze, the scale of their analysis, and their identification assumptions. Properties located closer to water bodies are more sensitive to changes in water quality (Bin and Czajkowski 2013), making it essential to understand the spatial extent of this proximity premium to gauge how property values respond to water quality variations. While earlier research primarily concentrated on waterfront properties (Leggett and Bockstael 2000; Boyle and Taylor 2001; Poor et al. 2001; Gibbs et al. 2002), more recent studies have demonstrated that the effects can also extend to non-waterfront properties (Walsh et al. 2011b; Netusil et al. 2014). Walsh et al. (2011b) analyzed the property impacts of water clarity for both waterfront and non-waterfront properties surrounding 146 lakes in Orange County, Florida, demonstrating that water clarity has a statistically significant effect on non-waterfront homes up to 1,000 meters from the lake.

Much like in research that employes stated preference methods, the estimation of property value impacts due to variation in water quality largely depends on the indicators of water quality used in hedonic models. This presents challenges due to the gradual nature of ecological changes in water bodies, coupled with seasonal variations and unique conditions at the time of measurement (Zhang et al. 2022). Additionally, the timing and duration of water quality changes can have important impacts on property values, as historical trends in water quality indicators shape expectations for future conditions, which in turn may affect property prices (Michael et al. 2000). Water quality monitoring data often show considerable variation because of seasonal changes and unique conditions at the time of measurement, but the fundamental ecological conditions in water bodies tend to change gradually. Consequently, most research leverages differences across locations and the timing of home sales, using various fixed effects models to account for potentially correlated unobserved factors (Zhang et al. 2022).

The most widely used measure of water quality in hedonic property value models is clarity and visibility, as these factors are easily noticeable and understandable to homebuyers. However, the literature covers a wide range of water quality indicators and their effects on property values, including:

(1) *water clarity and transparency* as measured by Secchi disk depth (Boyle et al., 1999; Boyle and Taylor 2001; Gibbs et al. 2002; Horsch and Lewis 2009; Kashian et al. 2006; Liao et al. 2016; Liu et al. 2014; Michael et al. 2000; Olden and Tamayo 2014; Poor et al. 2001; Walsh et al. 2011a; Zhang et al. 2015);
(2) *percent water visibility* (Bin and Czajkowski 2013);
(3) *nutrients*, such as Chlorophyll a (Liu et al. 2017; Walsh and Milon 2016; Walsh et al. 2011b), nitrogen (Liu et al. 2014; Poor et al. 2007; Walsh and Milon 2016; Walsh et al. 2011b), and phosphorus (Liu et al. 2014; Walsh and Milon 2016; Walsh et al. 2011b),
(4) *trophic state/lake tropic state index* (Walsh and Milon 2016; Walsh et al. 2011b);
(5) *sediment* (Bejranonda et al. 1999; Poor et al. 2007; Netusil et al. 2014; Liu et al. 2014; Yoo et al. 2014);
(6) bacteria, such as fecal coliform or E.coli (Brashares 1985; Leggett and Bockstael 2000; Netusil et al. 2014); and
(7) *salinity, dissolved oxygen, and temperature* (Bin and Czajkowski 2013; Netusil et al., 2014).

The choice of water quality indicator included in a hedonic model can significantly influence the results, with different measures of water clarity leading to notable variations in implicit prices (Heberling et al. 2024). For example, a study of lakefront properties in Maine found that varying the water clarity measures used in the analysis resulted in differing implicit prices, which could in turn affect policy decisions. This underscores the importance of selecting appropriate water quality indicators, as the choice can substantially impact the estimated economic benefits of water quality improvements (Michael et al. 2000).

The majority of the hedonic literature is comprised of case studies focusing on a single watershed (e.g., Poor et al., 2007) or specific counties with multiple water bodies (Walsh et al., 2017; Wolf and Klaiber, 2017). For example, Braden and Kolstad (1991) applied the hedonic pricing method to urban rivers, revealing that improved water quality significantly increased residential land prices in urban areas. They estimated that a 1% improvement in water quality resulted in a 0.6% increase in property values, demonstrating that improvements yield economic benefits even in non-coastal urban environments. Similarly, Poor and Boyle (1997) and Poor et al. (2007) found that ambient water quality improvements in local watersheds led to higher property values, reinforcing the economic importance of maintaining clean water in urban and rural areas. Swedberg et al. (2023, 2024) provided further insights by showing that the impact of water quality improvements on property values varies by location and market conditions. Several studies have focused on water bodies in Florida (Walsh et al. 2011a, Walsh et al. 2011b, Bin and Czajkowski 2013), Oregon (Netusil et al. 2014) and the Chesapeake Bay watershed (Leggett and Bockstael 2000; Poor et al. 2007; Walsh et al. 2017) and the Great Lakes (Cassidy et al. 2023).

These studies show positive impacts of water quality on nearby property values. For example, Klemick et al. (2018) estimate that reducing nutrient and sediment pollution in the Chesapeake Bay could result in aggregate increases in near-waterfront property values ranging from $400 million to $700 million. Cassidy et al. (2023) show large increases in property values associated with the clean up of water in the Great Lakes –property values went up by an average of $27,295 per house.

There is a growing literature evaluating the adverse effects of declining water quality, particularly related to the impacts of harmful algal blooms (HABs) on property values. Wolf and Klaiber (2017) showed that blue-green algae caused property value losses between 11% and 17% across four lakes in Ohio. Wolf et al. (2022) analyzed property values in seven counties surrounding Lake Erie and found that each 1 µg/L increase in algae cell abundance led to an average property price reduction of 1.7%. Zhang et al. (2022) showed that HABs' impacts are very localized, resulting in a 3% to 4% decrease in property values, which is in line with other studies that have reported similar negative impacts of freshwater HABs on lakefront properties across the U.S. (Gibbs et al., 2002; Tuttle and Heintzelman, 2015; Papenfus, 2019).

There are a handful of studies that estimate national scale models. Moore et al. (2020) assessed the impact of water clarity on 113 lakes across the United States, showing that water clarity is valued in the housing market. Keiser and Shapiro (2019a, 2019b) analyzed the effect of Clean Water Act investments on national property values by examining average home values in census tracts located within 25 miles of rivers and Zhang et al. (2022) used satellite-derived measure of water quality with respect to the presence of cyanobacterial harmful algal blooms in over 2,000 lakes across the United States during the 2008-2012 time period. Using spatially explicit data on property values and lake water quality, Mamun et al. (2023) offers the most comprehensive nationwide estimates of the benefits of water quality as reflected in property values. The findings suggest that a 10% improvement in water quality across the United States could lead to an increase in property values ranging from $6 billion to $9 billion.

In sum, these studies show that water quality improvements can yield substantial economic benefits by enhancing property values. These results are sensitive to the variation in the local real estate markets, the types of waterbodies examined, the model specifications estimated, and the water quality metrics used.

4.2.3 Meta Analyses and Benefit Transfer

Meta-analysis studies provide valuable insights into the use of benefit transfer in the context of water quality. Benefit transfer is a method for estimating economic benefits by applying valuation results from one location or context to another, making it especially useful when time or resources are limited for conducting original studies. This approach is practical for large-scale environmental assessments, offering a cost-effective way to estimate the economic benefits of environmental improvements like water quality.

Meta-analysis plays a crucial role in this process by aggregating the findings of multiple studies to draw broader conclusions about the economic benefits of water quality improvements. It helps identify patterns, generalize findings across different contexts, and enhance the robustness of economic valuations. By generating parameterized functions for use in benefit transfer, meta-analyses have become invaluable tools for water quality policy analysis at the federal level (Griffiths et al. 2012; Corona et al. 2020; Guignet et al., 2022). Several studies have utilized meta-analysis to synthesize the impacts of water quality improvements on property values across various studies (e.g., Van Houtven et al., 2007; Fleming and Manning, 2015; Klemick et al. 2018; Johnston et al. 2017; Newbold et al 2018; Johnston et al. 2019; Guignet et al., 2022; Heberling et al., 2024). These works collectively demonstrate how meta-analysis can provide policymakers with robust and comprehensive insights into the economic benefits of water quality improvements, thereby improving the accuracy of environmental economic assessments. Furthermore, Heberling et al. (2024) meta-analysis of 29 hedonic studies published between 1985 and 2017 shows that modeling decisions, data and water quality metrics used in analysis have an important impact on detecting the impact of water quality improvements on housing prices and finding a theoretically expected result.

Recent applications of benefit transfer illustrate its practicality. For example, Burlingame et al. (2024) estimated housing value increases from improved water clarity in Indiana lakes, showing that cleaner water significantly boosts property values. This underscores the importance of maintaining good water quality for economic growth in real estate markets. Moeltner et al. (2019) further advanced benefit transfer methodology by applying it to wetland valuation across the United States, demonstrating its versatility in valuing complex environmental assets like flood protection, biodiversity conservation, and water quality enhancement. These studies highlight that, when applied correctly, benefit transfer offers a cost-effective and practical approach to understanding how cleaner water enhances property values, ecosystem services, recreational opportunities, and public health outcomes across diverse geographical areas.

5. Valuation of Florida's Water Resources

Several studies have evaluated water quality and its improvements with a focus on Florida's water resources. We highlight the findings and limitations of the most notable studies in this section.

5.1 Water Quality and Coastal Properties

Kuwayama et al. (2022) contribute methodologically to estimating water quality improvements by applying a more comprehensive economic valuation framework to the case of nutrient pollution in Tampa Bay, Florida. The authors argue that the traditional hedonic property model underestimates water quality improvements by not accounting for recreational benefits. Their central idea is that while property owners are willing to pay for pollution reduction in nearby waterbodies, their willingness to pay is also influenced by how water quality impacts regional recreational opportunities.

In a novel application, the authors integrated a recreation demand model with the hedonic approach, capturing both local and regional recreational benefits, and found a significant willingness to pay among homeowners. The study used data from 1998 to 2014, including property sales, water quality information from the EPA's STORET system, and NOAA's recreational fishing data, offering a more comprehensive valuation of water quality improvements. The analysis showed that a 10% increase in dissolved oxygen, the primary measure of good water quality used in this study, resulted in an estimated $454 per home for local water quality improvements, totaling $366 million for the Tampa metro area. For regional recreational improvements, the value was $980 per household, aggregating to $789 million. These findings indicate that excluding the significant recreational benefits of reducing water pollution leads to a serious underestimation of overall benefits.

While the authors propose a novel and more comprehensive valuation framework, this study has limitations, including its focus on only one coastal city and the inclusion of only recreational fishing in their demand model. Consequently, other activities such as boating, beach attendance, swimming, and other aquatic activities that may be correlated with fishing are not included in the analysis. Additionally, the study's period is limited to 2014, so any water quality improvements since then are not captured in the model.

Two other studies also used hedonic modeling to focus on the impacts of water quality on coastal property values in Martin County, Florida. Bin et al. (2013) utilized a unique water quality dataset for an urban coastal housing market in Martin County to determine how different water quality measures affected waterfront housing prices. Using a hedonic property price model with a spatial autoregressive approach, the study analyzed 510 single-family waterfront home sales in Martin County from 2000 to 2004. The authors used weekly water quality data collected by the Florida Oceanographic Society to compare hedonic property value model outcomes using technical measures—such as water visibility (clarity), pH, salinity, and dissolved oxygen —against a more simplified, non-technical measure called "location grade." The findings showed that water quality significantly impacted waterfront homebuyers in South Florida. When comparing technical to non-technical measures, the technical ones were more effective in predicting housing prices. The authors found that mean willingness to pay values for water quality improvements ranged from \$7,531 to \$43,158, and a 1% increase in water visibility corresponded to a \$36,070 increase in average property value. These results suggest that waterfront homebuyers place a significant value on technical water quality attributes, demonstrating the substantial economic benefits of water quality improvements.

However, this study has several limitations. First, it focuses on a single coastal area, Martin County, Florida, which limits the generalizability of its findings to other regions. Second, the analysis is restricted to a small number of waterfront properties, potentially excluding the impact of water quality on non-waterfront homes. Third, the study uses data from 2000 to 2004, so it does not account for changes in water quality or housing market dynamics that have occurred since then. Finally, the estimated willingness to pay values for water quality improvements are higher than the nominal value estimates typically found in the literature (Boyle et al. 1999; Gibbs et al. 2002; Leggett and Bockstael 2000; Michael et al. 2000; Poor et al. 2007).

In another study, Bin et al. (2017) investigated how changes in water quality affected property values in Martin County, also using a hedonic property price model. The study examined waterfront home sales from 2001 to 2010, a period that included significant real estate market fluctuations. Specifically, the authors were interested in demonstrating whether the value of water quality varied with fluctuations in the housing market (i.e., housing market recession and expansion). They combined weekly water quality measures from the Florida Oceanographic Society, including pH, water visibility (Secchi depth), salinity, and dissolved oxygen metrics, into an overall "location grade," expressed as a percentage score and a letter grade (A to F). These measures were linked to coastal properties defined as houses located within 125 feet of the waterbodies. This location grade served as a comprehensive indicator of water quality, making it easier to analyze its impact on property values. By applying a segmented regression methodology and spatial fixed effect model, the authors assessed the relationship between water quality and housing prices over time.

Key findings from Bin et al. (2017) showed that water quality improvements were associated with higher property values, and even during the economic downturn, the value of water quality did not diminish. Specifically, the study estimated that each 1% point increase in water quality was worth, on average, $2,614 to homebuyers during the 2001-2010 period. This suggests that improved water quality had a significant positive impact on property values, highlighting its importance even during periods of market instability. However, this study focused on a small, single coastal county in Florida and used data spanning only from 2001 to 2010, which excludes any water quality improvements or market changes that occurred after this period.

5.2 Red Tide in Florida

Harmful algal blooms caused by Karenia brevis, often called red tide, have increased in frequency and severity, negatively impacting water quality in the Gulf of Mexico. Research has highlighted the significant economic impacts of red tide on Florida's tourism sector. For example, during red tide events in northwest Florida, restaurants and lodging experienced an estimated 29% to 35% decline in average monthly revenue (Larkin and Adams, 2007). In Sarasota County, ongoing red tide was associated with a 5% to 7% decrease in monthly hotel sales and a 1.25% to 2.5% reduction in restaurant sales (Bechard, 2019). Additionally, each extra day of red tide presence was linked to a 1% to 2% decrease in growth rates for the lodging sector and a 0.5% to 1% drop for food services (Bechard, 2020b). The cumulative effect of concurrent red tide events led to $318 million in lost sales revenue within Florida's Airbnb market (Ferreira et al., 2022).

Furthermore, two studies evaluated the property impacts of red tide in Florida. Bechard (2020a) demonstrated that a prolonged red tide event caused a 10% decrease in property values within a five-mile radius of the coast. In a later study, Bechard (2021) found that continuous red tide occurrences resulted in a 17% to 20% reduction in property values in counties adjacent to the Gulf of Mexico, with properties nearer to the coastline suffering more significant value drops.

5.3 Water Quality in Florida Lakes

Walsh et al. (2011a, 2011b) conducted a study in Orange County, Florida, involving 146 lakes and 54,712 properties (1,496 lakefront and 53,216 non-lakefront) to assess the effects of water quality, proximity, and lake size on property values using Secchi depth as a measure of water quality. A one-unit increase in Secchi depth increased lakefront property values by about $5,500 (1.24%) and non-lakefront properties by $700 (0.36%). The impact diminished with distance from the waterfront, decreasing by one-fourth at 200 m and by five-sixths at 1,000 m. Additionally, larger lakes were valued higher, with a tenfold increase in lake size resulting in a $1,000 (20%) increase in the marginal implicit price for lakefront properties and a $700 (300%) increase for non-lakefront properties. This result has significant implications for urban watersheds, where non-lakefront properties are more common.

Using single-family residential sales data from Orange County, Florida, between 1996 and 2004, Walsh et al. (2016) investigated the economic benefits of water quality improvements, focusing on the use of different water quality indicators in the context of regulatory programs. Specifically, the study compared singular indicators such as total nitrogen (TN), total phosphorus (TP), and chlorophyll-a (CHLA) with composite indicators like the Trophic State Index (TSI) and a one-out, all-out (OOAO) indicator.

The study identified significant differences in the estimated economic benefits of water quality improvements depending on the measurement method. For instance, reducing TN in Lake Copeland was valued at $860,062 when using the TN model, whereas the TSI model estimated the benefit at only $8,493. Similarly, the improvement of Lake Olive to meet the TP criterion was valued at $22 million using the TP model, but just $5,445 with the TSI model. These findings highlight how singular parameters can result in substantially larger economic impact estimates than composite measures like TSI.

In addition to the studies described above, it is important to acknowledge a series of UF EDIS publications that explore various aspects of water valuation in Florida (Borisova et al. 2019a, 2019b, 2019c; Borisova et al. 2020; He et al. 2012). These articles are aimed at the general public and lay audiences and undergo a less rigorous review process compared to the peer-reviewed articles considered in this report. Therefore, we do not include these articles in our synthesis.

7. Recommendations for Conducting a Study in Florida

Surrounded by the Gulf of Mexico and the Atlantic Ocean, Florida encompasses approximately three million acres of freshwater systems, making water a defining feature of the state's natural ecosystems and a crucial source of economic revenue, including a thriving multimillion-dollar tourism industry. Understanding the economic benefits of clean water in Florida is essential.

Existing studies on the economic benefits of clean water in Florida have several limitations, primarily focusing on a few geographic areas like Tampa Bay, Martin County, and Orange County. This narrow scope makes it difficult to generalize findings across the state. The data used in these studies are also dated, limiting the understanding of more recent changes in water quality and their economic impacts. Additionally, some of these studies rely on a small sample of waterfront properties to evaluate the impact of water quality (Bin 2015), overlooking the impacts generated to non-waterfront homes and other economic sectors like tourism and public health. Lastly, the use of different water quality indicators across studies can result in varying economic valuations and leads to inconsistencies in evaluating water quality statewide. This leaves significant gaps in understanding the value of clean water and the economic benefits it provides to the state.

Consequently, there are significant opportunities for a more comprehensive analysis of the economic benefits of clean water in Florida. This includes research that expands the geographic scope to encompass a broader range of regions in Florida. Studies that incorporate longer timer periods and more recent data would help to capture trends over time, while a more standardized approach to using water quality indicators could provide a better understanding of economic benefits of clean water at the state level. Addressing these gaps would offer a more complete picture of the economic value of clean water in Florida.

Below, there are several proposed options to evaluate economic benefits of clean water in Florida. Options can be combined or modified depending on FDEPs interests and objectives.

Option 1: Statewide Analysis of Lake Water Quality in Florida

Study Objective: Evaluate the economic benefits of lake water quality across nearly 8,000 lakes in Florida, quantifying how improvements in water quality affect property values and providing insights for policymakers on cost-effective environmental management strategies.

Background: To date, only one study has assessed the economic benefits of lake water quality in Orange County, Florida, focusing on 146 lakes (Walsh et al., 2011b). This study used Secchi depth as a measure of water clarity and identified a substantial property value premium associated with each one-unit increase in this metric. However, this research covers only a small subset of Florida's extensive network of lakes and is limited to data over the 1996-2004 period.

A broader study can offer a comprehensive understanding of the economic value of lake water quality, aiding policymakers in cost-benefit analyses for water quality improvement initiatives. By evaluating a diverse range of lakes, the study can also identify regional variations in the economic impact, allowing for more targeted and effective policy interventions.

Proposed Method: This study will use a hedonic property analysis to identify the capitalization effects of lake water quality on housing prices. The analysis will control for other factors influencing property values to isolate the impact of water quality.

Data requirements: This analysis will require data on water quality indicators (e.g., Secchi depth/ dissolved oxygen/chlorophyll-a) and property sale transactions in Florida. Potential data sources include:

- **Property data:** There are several companies that provide housing datasets that include property sale transactions and characteristics. While the price of such datasets varies, as an example, the cost for statewide data for 2014-2024 obtained from CoreLogic was approximately $8,000 in May of 2024.
- **Water Quality Data:** Water quality data can be sourced from the U.S. Geological Survey's NWIS, EPA's STORET, Florida's LAKEWATCH reports, and other relevant state agencies. Some indicators may also be extracted from NASA's satellite data.

Expected outcomes: The study will quantify the value of water quality in Florida lakes, reflected in property prices. Results will include both the premium for an average property located near cleaner lakes and an aggregated value for the study area.

Potential challenges: Identifying a consistent water quality indicator across all Florida lakes will be the primary challenge. Additionally, the project involves handling large datasets, which may require access to advanced computing resources like the University of Florida's supercomputer for efficient data processing.

Option 2: Evaluating Water Quality in the Gulf of Mexico

Study Objective: This study aims to evaluate the economic benefits of water quality improvements in the Gulf of Mexico, focusing on how water quality affects property values, tourism, and recreational activities. The goal is to provide insights that can guide policymakers in developing strategies for effective coastal management and pollution mitigation.

Background: The Gulf of Mexico plays a crucial role in the regional economy, supporting tourism, recreation, and property markets. However, it faces significant water quality challenges, including nutrient pollution and harmful algal blooms (HABs), which can negatively impact coastal communities. Previous research, such as that by Kuwayama et al. (2022), has explored the economic impact of water quality on property values in Tampa Bay, Florida. However, comprehensive studies covering the broader Gulf of Mexico region and incorporating multiple aspects of economic value, including recreation and tourism, are limited. This research seeks to fill that gap by providing a holistic assessment of the economic benefits of water quality in the Gulf.

Proposed Method: This study will employ a two-pronged approach:

1. **Hedonic Property Analysis:** This will assess the capitalization effects of water quality on coastal property values. By analyzing property sales data along the Gulf Coast, the study will quantify how changes in water quality indicators, such as nutrient levels and HAB occurrences, affect property prices.
2. **Recreation Demand and Travel Cost Method:** To capture the value of water quality improvements on recreational activities, the travel cost method will be used. This involves surveying visitors to coastal sites along Florida's Gulf Coast via an online survey to determine their willingness to pay for access, considering the time and expenses incurred in traveling to these locations. By analyzing visitation rates in relation to water quality measures, the study will estimate the economic value of clean water for activities such as swimming, fishing, and boating.
3. **Integration of hedonic property analysis with the recreation demand model.** Following Kuwayama et al. (2022), this model would integrate a recreation demand model with the hedonic approach, capturing both local and regional recreational benefits.

Data Requirements:

- **Property Transactions:** Data on property sales and characteristics along the Gulf Coast will be sourced from providers such as CoreLogic. The dataset should cover multiple years to account for temporal variations in water quality and property market dynamics.
- **Water Quality Indicators:** Water quality data, including measures of nutrient levels, chlorophyll-a, dissolved oxygen, and occurrences of HABs, can be obtained from the U.S. Geological Survey, the National Oceanic and Atmospheric Administration, and Florida Fish and Wildlife Conservation Commission. Additionally, remote sensing data from NASA satellites can be used to provide spatially explicit measures of water quality.
- **Recreation and Tourism Data:** Visitor data from coastal sites, including visitation rates and expenditures, will be collected through online surveys administered via Qualtrics and

supplemented with existing databases such as Marine Recreational Fisheries Statistics Survey (MRFSS) and the Marine Recreational Information Program (MRIP) produced by NOAA and local tourism boards. Qualtrics is a leading provider of data collection and sample recruitment services, widely used by researchers at top U.S. academic institutions. The cost of sample recruitment varies based on sample specifications, but it is reasonable to expect an approximate cost between $7-$10 per respondent.

Expected Outcomes: The study will provide a comprehensive valuation of water quality in the Gulf of Mexico, including:

- The impact of water quality on coastal property values.
- The economic value of water quality improvements for recreational activities.
- An aggregate estimate of the economic benefits of maintaining and improving water quality in the Gulf region.

Potential Challenges: Key challenges include acquiring consistent and comprehensive water quality data across the Florida's Gulf region and ensuring the representativeness of visitor surveys for recreational valuation. Additionally, the study will need to control for confounding factors that may affect property values and visitation rates, such as economic conditions and natural disasters. The project may also require access to advanced computing resources for data processing and analysis, given the large-scale nature of the dataset.

Option 3: Economic Evaluation of Water Quality in a Specific Florida Water Body or Region

Study Objective: This study aims to evaluate the economic benefits of water quality improvements in either a specific water body or a region within Florida, as identified by the Florida Department of Environmental Protection. The analysis will examine how water quality influences property values, recreational activities, and public perceptions, providing insights for local policymakers to guide targeted water quality management efforts.

Background: Florida's water bodies and regions are essential to the state's economy, supporting recreational activities, tourism, and real estate markets. These areas face challenges such as nutrient pollution, harmful algal blooms (HABs), and other environmental stressors. Despite the demand, estimated economic value of clean water is often not available at the relevant scale necessary for specific interventions.

Proposed Methodology: The study will adopt one of the following approaches: a hedonic property analysis, a choice experiment survey, or a combination of choice experiment and travel cost method to evaluate the economic benefits of water quality improvements.

Option A: Choice Experiment Survey with Travel Cost Method

- **Approach:** A choice experiment survey will be conducted to assess public preferences and willingness to pay for water quality improvements in the selected water body or region.

The survey will include a travel cost component to capture the economic value of recreation associated with water quality.

- **Data Requirements:**
  - **Survey Design and Implementation:** The survey will present respondents with hypothetical scenarios involving different levels of water quality and associated costs. It will include travel cost data by asking about visitation rates, travel distance, and expenditures. The survey will be administered to a representative sample of residents and visitors using online platforms, mail surveys, or in-person intercepts at recreational sites.
  - **Water Quality Scenarios:** Information on current water quality conditions and potential improvement scenarios will be developed.
- **Expected Outcomes:** The survey will estimate the public's willingness to pay for water quality improvements and the associated travel costs for recreational activities. This will provide insights into how different water quality attributes are valued by residents and visitors, aiding in understanding the economic benefits of specific water quality management actions. Importantly, this approach allows for estimation of both use and non-use values.
- **Potential Challenges:** Designing a survey that accurately captures respondents' preferences and trade-offs, ensuring a representative sample, and linking survey responses to actual water quality indicators can be complex.

Option B: Hedonic Property Analysis

- **Approach:** This method will assess how water quality influences property values around the chosen water body or within the selected region of Florida. By analyzing property sales data, the study will determine the price premium associated with water quality indicators such as clarity or nutrient levels.
- **Data Requirements:**
  - **Property Transactions:** Data on property sales and characteristics within a defined radius around the water body or region will be obtained from sources like CoreLogic. The dataset should cover multiple years to account for changes in water quality and housing market dynamics.
  - **Water Quality Data:** Historical and current data on water quality indicators will be sourced from FDEP, U.S. Geological Survey (USGS), and local state agencies.
- **Expected Outcomes:** The study will quantify the impact of water quality on property values, estimating the willingness to pay for improvements. Results will provide an aggregate economic value for clean water in the selected water body or region.
- **Potential Challenges:** Acquiring consistent, high-resolution water quality data and controlling for other factors that may influence property prices, such as proximity to amenities or market trends, will be essential.

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