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Systematic Review

Ecosystem Services: A Systematic Review of Provisioning and Cultural Ecosystem Services in Estuaries

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Abstract: It is widely argued that humans deteriorate and vandalize ecosystems, yet little is known about the advantages they receive from the same. The study employs the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) approach to identify studies on the value of ecosystems, with a focus on estuaries between the years 2000 to 2021. The review included a total of 61 studies, which highlighted: (a) the importance of estuarine ecosystem services; (b) the stress placed on estuaries as a result of human activity; and (c) the importance of ecosystem services to human well-being. These studies aid in our understanding of the provisioning and cultural services that ecosystems provide to humans, as well as how the ecosystem services assist individuals in diversifying their livelihoods. Our systematic review revealed that: (a) estuaries provide benefits to humans and are used for survival, (b) cultural ecosystem services are important and valuable; however, (c) as a result of human activities and climate change, ecosystem services face numerous threats such as pollution, overexploitation of resources, and poor water quality, among others. Future research should focus on how estuary users perceive the ecosystem services that estuaries provide, and there should be more publications and studies on the benefits that estuaries provide. The systematic review highlighted that most studies are outdated, there are few to no new studies on ecosystem services and estuaries, and those that are available do not directly address the importance of estuaries.

Keywords: provisioning ecosystem services; estuaries; cultural ecosystem services; fishing

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1. Introduction

Estuaries are well-known for being breeding grounds for many fish, crabs, and reptile species, and they also provide ecosystem services such as provisioning, cultural, regulating, and supporting services to humans, all of which help humans survive and live better lives while also promoting economic progress. Ecosystem services are both material (provisioning ecosystem services) and nonmaterial (cultural ecosystem services). The benefits humans receive from estuaries include the following; ref. [1] nonmaterial benefits include (1) recreation, (2) aesthetic enjoyment, (3) spiritual experiences, and (4) physical and mental benefits, ref. [2] material benefits also include (1) food, (2) freshwater, and (3) genetic resources [3]. They also protect and provide buffers for species and people living near estuaries and the sea during natural disasters [4]. This makes estuaries important to coastal communities and local government [5].

Fishing occurs in estuaries and sustains local economies, and traditions as well as providing basic foodstuffs [6]. Estuaries also generate employment through tourists who are drawn to the estuaries because of the aesthetics and the water sporting activities that they offer [5].

Even in developing nations, estuaries are growing in recreational use as well as work and food for subsistence anglers [7]. In Bangladesh, for example, marine and estuarine

resources play an important role in supporting lives and providing income to about 36 million people [8]. People in the Amazon estuary region also consume estuarine resources and rely on them for survival. These cultural activities are also attractive for tourists [9].

However, subsistence fishermen find it difficult to be identified in developing nations since they are almost always fishing illegally [10] or do not even have fishing licenses. In developing countries, the majority of subsistence fishermen are poor [11], and they sell their catch illegally in local markets to supplement their income and support their families [12].

In South Africa with 250 estuaries, these may be beneficial from both subsistence and recreational fishing, but little is known about these areas beyond basic species assessments. They are, however, important to humans since they are used for both subsistence fishing [13] and leisure activities [14]. Subsistence fishing is considered a method of surviving, particularly by the poor, who harvest for consumption [15]. Recreational fishing is considered a sport by those who harvest for fun in their spare time. This study is a precursor to a more in-depth investigation into the benefits of estuaries to the community of Algoa Bay in South Africa's Eastern Cape. Given the scarcity of literature, this study systematically sources and reviews existing literature globally, and zooms into the work done in South Africa's Eastern Cape province where Algoa bay is located.

Despite the fact that humans benefit from estuarine ecosystem services, it is important to note that individuals usually overlook the ecosystems because they do not pay for them directly [16]. As a result, humans can easily disrupt and overexploit the ecosystems, leaving them impoverished and unable to offer resources as efficiently as they previously did [17]. Human involvement has a negative impact on the ecosystems, preventing them from growing or even evolving [18]. Human actions not only harm the environment, but they also endanger the economy by making it impossible to convert natural ecosystems into finished economic products. It also instructive to add that the damage to the ecosystems has a destructive impact on the economy because some ecosystem services are important to human well-being [19].

Climate change has an impact on ecosystems through influencing water quality, migration patterns, and plant development [20]. Climate change reduces the ecosystem productivity and makes it more difficult for the ecosystems to improve water quality and control freshwater flows, and it has a direct impact on humanity, livelihoods, and culture [21].

However, regardless of the rising harm caused by human activities and climate change to the estuarine ecosystem services, there is still a dearth of information about what estuarine ecosystem services give to humans, owing to a scarcity of publications that have critically investigated the benefits offered by estuaries. The study reviews research conducted between 2000 and 2021 to assess the value of ecosystem services and the benefits that estuaries bring to humans. The study begins with a description of how the literature review was carried out. Secondly, it summarizes the review's findings. Finally, it discusses (1) the relevance of existing studies, (2) what is missing from existing studies (ecosystem service value and risks), and (3) future research challenges.

2. Materials and Methods

2.1. Literature Selection Criteria

When selecting papers for inclusion in the systematic literature review, the study used both external and internal criteria. Among the criteria are studies that are (i) written in English, (ii) focused on ecosystems, (iii) published between 2000 and 2021, and (iv) available in full text. However, during the screening, some articles were excluded if they were (i) not written in English, (ii) not focusing on ecosystems, (iii) not available in full text, or (iv) published before the year 2000. Moreover, as shown in Figure 1, half of the papers were rejected as a result of this.

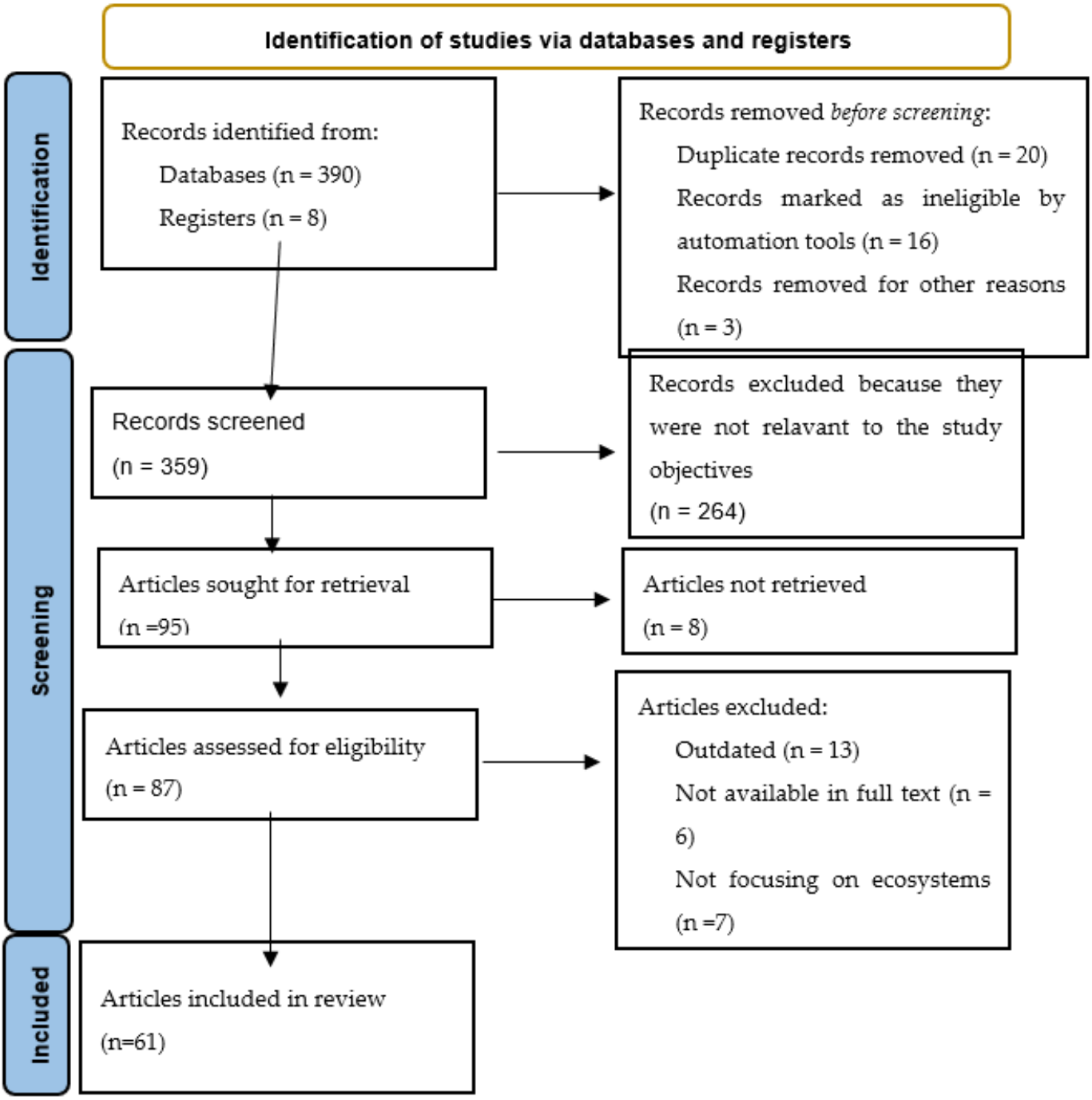

Figure 1. PRISMA literature search diagram.

2.2. Literature Search Strategy

To ensure transparency and clarity when reporting systematic reviews, the Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) methodology was adopted for this literature study [22–24] (Supplementary Materials). The data for this systematic review was collected from peer-reviewed papers in several databases with a high level of academic integrity, including Google Scholar, Science Direct, Research Gate, World Cat, and Web of Science [25–27]. These articles were discovered by searching: ecosystem services, cultural ecosystem services, provisioning ecosystem services, ecosystem benefits, and estuaries depending on the database searching options. The search was conducted using articles published between 2000 and 2021. Table 1 explains why these phrases were chosen.

Table 1. Search phrases and justifications.

Phrases	Justifications
Ecosystem services	This phrase is the major keyword in the study, which is focused on ecosystem services.
Provisioning ecosystem services	This term was used to identify existing literature dealing specifically with provisioning ecosystem services.
Cultural ecosystem services	This phrase was used to broaden the scope of the ecosystem services search.
Estuaries	The keyword "estuaries" was used to avoid studies that focused on other ecosystems.

In total, 398 records were identified as potential records from various databases, and after removing duplicates, 359 records were screened, with 255 being rejected because they were not relevant to the study objectives (Figure 1). Only 96 articles were assessed for eligibility, with 26 articles rejected because they did not focus on ecosystems (7), were not available in full text (6), and were outdated (13). Finally, 61 articles were included in the review to assess the value of estuarine ecosystem services.

The findings are divided into different themes that emerged from the literature. The four themes that emerged are: the importance of ecosystems, threats to estuaries, methodological approaches to estuarine valuation, and localized evidence; a case study of the Eastern Cape of South Africa, and they all contribute to a thorough description and content of the studies included. After reading studies on ecosystems, the theme "importance of ecosystems" emerged, which helps to get a broad picture of the benefits and value of the eco-system services. The related subthemes "provisioning ecosystem services" or "cultural ecosystem services," arose after getting a better understanding of the benefits people get from estuaries and the value people place on these types of ecosystem services.

The theme, threats to the estuary, was inspired by the fact that many studies criticized human involvement in ecosystems and are based on threats and challenges that estuaries face, with the majority of them reporting that these threats are caused by human activities.

The localized evidence theme and subthemes emerged as a result of the global search, which revealed South African studies, some of which were about Eastern Cape estuaries.

During the research on threats and challenges posed by human activities, illegalities in estuaries emerged as a new concern that presented a new theme. The theme of valuation methods used to evaluate the value of ecosystem services also developed after reading studies on the value of ecosystem services and learning that there are numerous approaches to estimate the value of ecosystem services. The localized evidence theme came from the studies.

3. Results

3.1. Importance of Ecosystems

Ecosystems offer a variety of services to humans such as provisioning, cultural, regulating, and supporting ecosystem services. Boyd and Banzhaf [28] and Mowat [29] have similar definitions of ecosystem services, and they have defined them in such a manner that they do not lose sight of the Millennium Ecosystem Assessment's original definition, which is that ecosystem services are benefits provided to humans by estuaries. According to Jacobs et al. [30], ecosystem services are outputs that link nature with human well-being, and the study further mentions that "the economy, health, and survival depend upon natural resources". These services are important for human well-being, as they make life possible for humans [14] and make human progress attainable, meaning that it helps people achieve things for themselves.

3.1.1. Provisioning Ecosystem Services

Estuaries help people survive and thrive by delivering a variety of ecosystem goods and services [31]. They provide benefits such as food, organic raw materials, and water, which people value because they rely on them to survive [32]. Some people rely only on fishing as a source of income, and it is the only way they can make ends meet. They keep their catch if they do not sell it for their own consumption. They also assist members of their communities with the fish they catch in the estuaries [33].

Bait collectors also use the services provided by the estuarine ecosystem for their survival, and some have a license to gather bait while others do not. They sell their catch to tourists, recreational line fishers, or local households, and according to Nsubuga [34], the majority of bait collectors do not have formal employment, and some do not even have a matric certificate. Some bait collectors use the income that they get from their sales to feed their families and put their children at school.

Most people, especially in rural households, turn to provisioning ecosystem services for a living, and the availability and accessibility of estuarine ecosystem services are fundamental to their economic existence [35]. Ecosystem services also assist people in maintaining their livelihoods, and according to findings presented by Martin et al. [36], people value the qualities of estuaries and believe they contribute to their well-being. However, Munang et al. [37] pointed out that ecosystem degradation should be recognized, and something must be done about it as it weakens food production, which results in several people dying from hunger.

Humans also value domestic water, which is one of the reasons why ecosystem services are valued, as they offer water for drinking, cooking, and bathing [32]. Even the evidence presented by Ayodele and Oyelowo [38] also agrees that ecosystem services are an important source of freshwater and that people enjoy using these resources.

Furthermore, people in rural areas rely on the ecosystems for wood and timber when building houses and making furniture [39]. People value ecosystem services for organic raw materials and handicrafts, which are the most typically used when people build, furnish, and fence their homes [32].

The ecosystems also act as a shield that protects society against the effect of climate change and natural hazards. They play a significant and cost-effective role in reducing vulnerability induced by disasters and climate change [40].

When there is a storm, estuaries help protect inland areas by absorbing the storm's water before it reaches upland areas, preventing floods and storm surges [41]. Estuaries also protect fish and other marine species because they serve as a nursery, providing them with breeding grounds and food, and they spend the majority of their lives living in estuaries [42]. They are also regarded as one of the most productive ecosystems because fish species rely on them during their early stages. However, further investigation revealed that estuaries are dominated by threats, and these threats are also harming the ecosystem services, making it impossible for humans to fully enjoy these benefits [32,39,43].

3.1.2. Cultural Ecosystem Services

Estuaries provide cultural ecosystem services such as recreation, aesthetic enjoyment, physical and mental health benefits, and spiritual experiences that are valuable to human society. Hartel et al. [44] view these ecosystem services as services that play a significant role in associating human beings with ecological systems, and they help people express and reflect the values and histories that they share as well as places that they occupy. People who live near estuaries associate these services with a sense of belonging because they have had the experience of feeling attached (place attachment) to them, and the majority of them have lived near these estuaries for a long time [44]. These services are irreplaceable, and they help individuals create cultural landscapes [44].

Estuaries help people escape real-life problems by providing them with recreational activities. A report by Cooper et al. [40] pointed out that visual beauty around ecosystems brings joy and comfort to people and it is life-enhancing. Figueroa [45] is in agreement with Cooper et al. [40] and the author states that cultural ecosystem services provide a pleasant place to rest, and they always leave people amazed by the beauty of nature. Even though the study by Golivets [46] focuses on forests, the author agrees that ecosystems provide people with high aesthetic quality and that is what attracts visitors to visit for outdoor activities while also attracting nature-based tourism.

Estuaries are also valuable recreational sites where people can engage in a variety of activities. They enable people to engage in recreational activities that allow them to spend time with their families, provide spiritual experiences, and leave them satisfied since the estuaries are aesthetically pleasing [40]. In South Africa, estuaries also contribute to the economy, and they contribute through recreational fishing, which generates ZAR 32.6 billion (US$2.2 billion) in annual economic activity and supports 94,070 full-time jobs [47].

Cultural ecosystem services are important to understand because they are one of the values people associate with nature, cultural identity, and spiritual experiences [48]. Boafo et al. [49] also pointed out cultural ecosystem services are also used by people to perform rituals and religious ceremonies. Humans especially in rural areas also use the plants that are provided by ecosystems to make traditional medicines or rituals, and they know which plants are dangerous and which plants can be eaten [50]. However, Small et al. [51], on the other hand, believe that the value people place on cultural ecosystem services is not straightforward because if they had to choose between income and cultural identity, they would choose income.

In most cases, cultural ecosystem services are hardly marketable, and their value is always allocated based on their contribution to human well-being [48]. Even though they contribute to the ease and welfare of individuals, the value of cultural ecosystem services is neglected and only a few studies focus on the value of these services, especially in South Africa [29]. A study by Bostrom et al. [52] also agrees that cultural ecosystem services are not valued in many decision-making contexts because they are intangible and nonmaterial, and the focus is always on economic valuation.

3.2. Threats to the Estuaries

In as much as ecosystems help human society, human activities are also damaging and degrading. A study by Rao [53] proves that an increase in population is one of the reasons for environmental change, as it increases the demand for land and overconsumption of water for watering. Berakhi [54] also agrees that population growth has put ecosystems on the spot and has caused a serious loss of biodiversity. In addition to that, the more people settle close to estuaries, the more freshwater is being disconnected from rivers and the ecological integrity of estuaries are being compromised [55]. Extensive use of water for agricultural purposes in a river, for example, will reduce the river's natural flow downstream. One effect could be that estuaries become isolated from the sea during periods of low water flow, obstructing fish's ability to migrate between sea and river during these low water flow periods.

Increasing human activity poses a danger to ecosystems, particularly in estuaries where development and industrial activity are taking place, as these activities cause damage to the land and deterioration due to dredging and vessel traffic [56]. Due to human activities, estuaries are being polluted in direct and indirect ways. Human activities, according to Fianko et al. [57], regularly pose health issues to numerous communities in catchments areas, that rely on the estuary, primarily for domestic production without treatment. Zhou et al. [58] also added that some human activities result in overexploitation of water resources, which often leads to a deterioration in the ecosystem stability.

Ecosystems are always negatively affected by human interference. According to Preez [15], human activities leave ecosystems in South Africa dredged and unable to yield any resources as they once did; these human activities do not allow for recharging development or a new turn of events for the ecosystems that have already been exploited. An increase in the human population has placed ecosystems under a lot of pressure, and based on a report by Guo et al. [59] the connection between ecosystems and human beings is not perceived adequately. Furthermore, Davies et al. [60] strongly argue that humans are not only damaging the environment, but their acts are also threatening the economy because now it will be difficult to transform natural ecosystems into finished economic products. The damage to ecosystems has a destructive impact on the economy because some ecosystem services are important to human well-being. Some human impacts lead to pollution, which also impacts productivity and crop yields and all that results in an economic loss [61].

Industrialization has increased in South Africa and has a negative impact on estuarine water quality. The water quality of the uMvoti estuary has deteriorated significantly as a result of people settling near the estuary and industrialization [62]. Olisah, Adams, and Rubidge [63] also discussed the effects of pollution on estuaries as a result of increased industrialization, which will have an impact on human health if pollution is not reduced because humans consume fish from these estuaries. Increased industrialization has also led to significant environmental pollution in the Eastern Cape estuaries, which has major implications for human health as well as the social and economic development [64].

Richards Bay estuary in Kwazulu Natal is also suffering from habitat loss as a result of ongoing projects such as dredged shipping channels, a dry dock, a container terminal, and associated port infrastructure [65]. The Richards Bay Estuary is also experiencing environmental issues as a result of heavy rains and seasonal changes, all of which are having an impact on the estuary's functionality [66].

South African estuaries have invasive alien species with a wide range of negative effects. Increased flooding and fires, deterioration, river destruction, and estuarine siltation are just a few of these effects [67]. Mangroves in the Mzimvubu and Xhora estuaries have also been destroyed by invasive alien species [68].

3.3. Methodological Approaches to Estuaries Valuation

The value of estuaries can be measured using a variety of methods (see Figure 2), which are divided into two categories: stated preference methods and revealed preference methods. The stated preference method, which includes the Choice Experiment (CE) method and Contingent Valuation Method (CVM), is used to estimate the value of goods that are not sold in the markets by using individuals' stated behavior to estimate utility functions [69]. The choice experiment method is useful for evaluating and assessing the market and non-market valuation techniques, as well as for decision-making because it presents various options [70]. This method involves asking respondents to choose between two or more alternatives, each of which is described by several attributes, which aids in determining the value of each attribute [71]. It is also worth noting that the choice experiment method is inexpensive and provides a wealth of information.

The choice experiment was also used by Lee et al. [72] to assess the economic value of ecosystem services at the Sundays estuary. Recreational users from the Sundays estuary were given questionnaires with four choice sets, each with two options labeled option A and option B. A study by Ntshangase [69] also used the choice experiment method to assess beach users' preferences for beach management at different beaches in Nelson Mandela Bay in a study. The study employed focus group discussions in which participants were given alternatives to choose from, including the status quo, and the findings revealed that beach users in Nelson Mandela Bay (NMB) were prepared to pay for improved water quality, an increase in the number of lifeguards, and improved public safety.

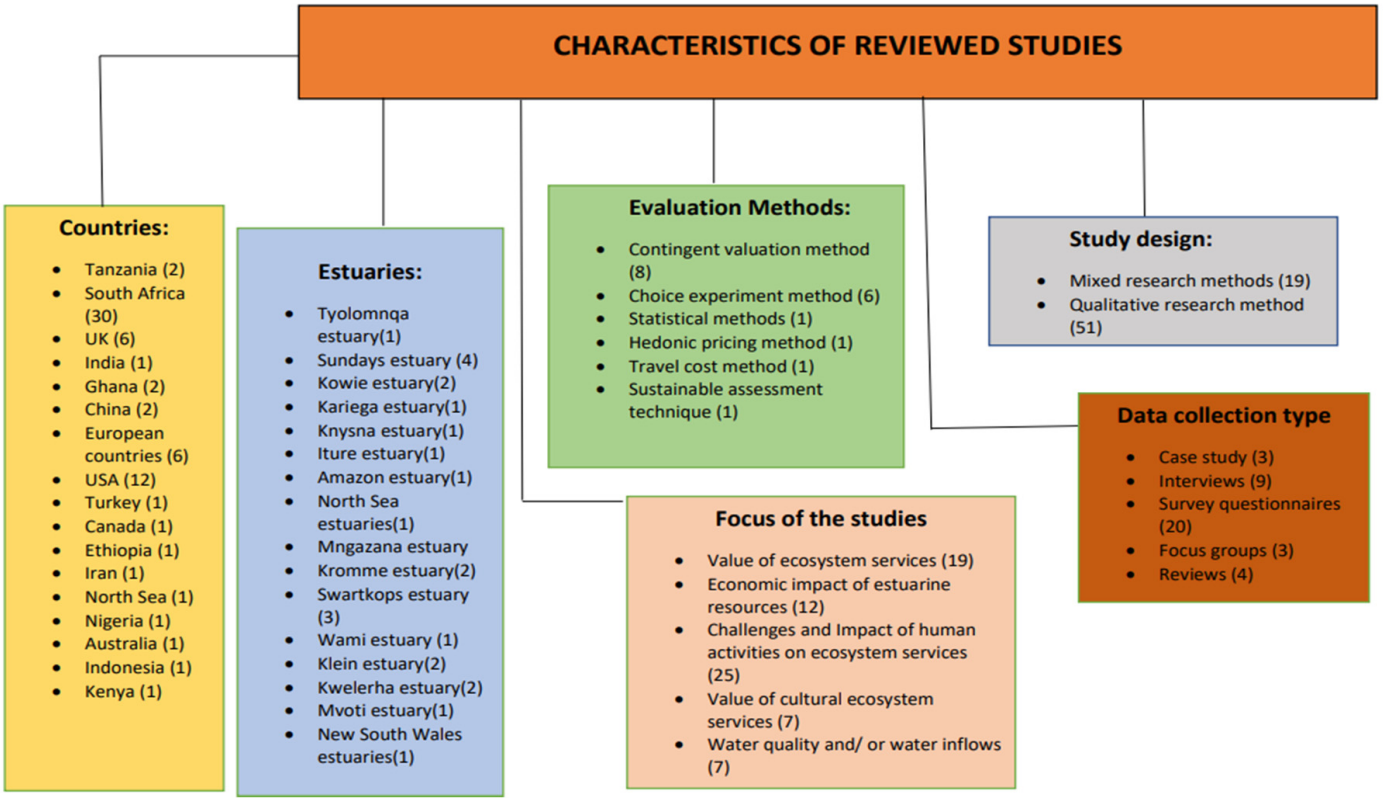

Figure 2. Characteristics of reviewed studies.

On the other hand, the contingent valuation method is mostly applied when evaluating goods and services that are unpriced and these goods and services have value because they contribute to an individual's utility [73]. It is simple because it has direct questions on willingness to pay (WTP) and willingness to accept (WTA), even though the technique has some flaws. In a study by Samdeliri and Shahbazi [74], the contingent valuation method was used to investigate the economic value of recreational activities in ShirinSou Wetland. The study evaluated the ShirinSou Wetland visitor's willingness to pay for recreational usage and the results revealed that visitors were willing to pay $1.48 per visit per household. However, Du Preez et al. [75] argue that respondents may not express their true intentions on willingness to pay questions and that some may overestimate their true feelings; additionally, the author also points out that this method can be tested for reliability and validation to clarify how the values were generated.

The revealed preference method, which includes the travel cost method and hedonic price method, uses actual observations of people's preferences and habits to measure their choices [76]. When determining the market value of a home, the hedonic pricing method is typically used, and prices are determined by the views and exposure to non-market factors such as noise, burglary, or proximity to amenities [69]. The hedonic price method assesses the aesthetic value of estuarine ecosystems, whereas the travel cost method assesses the value of recreational sites by calculating how much people spend on travel costs when visiting them. Preez and Hosking [77] combined this method with the contingent valuation method to assess the economic worth of freshwater inflows into the Klein and Kwelerha estuaries. The study discovered that the variation in estimates is less than 0.7 cents, or that the willingness to pay value to travel cost-value ratio is somewhere between 40 and 95 percent, respectively.

3.4. Localized Evidence: A Collection of Case Studies in the Eastern Cape, South Africa

The value of an estuary can be measured in terms of the benefits it provides, and it can be measured not only in monetary terms, but also in non-monetary terms. Sale et al. [78] assessed the value of recreational services at the Kowie and Kromme estuaries (Table 2), and because the estuaries are freshwater depleted, respondents from both estuaries were asked if they would be willing to pay a specific amount to improve the water quality of the estuaries. Many respondents thought the estuary had worsened and were willing to pay a fee to have the water quality restored.

Table 2. Eastern Cape estuaries.

Name of the Estuary	Length of the Estuary	Water Flows	Industrialization
Swartkops estuary, Port Elizabeth, Eastern Cape	The estuary is 16 km long	Higher flow in summer	The estuary is surrounded by industrial developments
Sundays estuary	Approximately 24 km long	Higher flow in summer	No industrial developments next to the moth of the estuary
Kowie estuary	Approximately 21 km long	Inadequate freshwater inflows	No industrialization along the estuary
Kariega estuary	About 18 km long	Small annual inflow of freshwater	No industrialization along the estuary
Kromme estuary	About 13.7 long	Freshwater inflow into the Kromme Estuary is irregular and relatively low	Few to no industrial developments next to the banks of the estuary.

The Swartkops estuary has recently experienced a problem with water quality degradation, and this poor water quality is affecting activities performed at the estuary such as recreation and cultural ceremonies. The poor water quality at the estuary is mostly caused by land-use activities. A study by Adams et al. [79] discovered that water is not flushed as productively from the upper estuary as was already the case and that the natural hydrology of the estuary has been adjusted. Furthermore, Magobiane [64] conducted a study on the willingness to pay for water quality changes in the Swartkops estuary using the contingent valuation method. Respondents were given questionnaires to elicit their willingness to pay to improve water quality in the Swartkops estuary so that it can be safe for swimming, fishing, and boating. The findings indicated that increasing water quality has a positive economic value, as Swartkops estuary participants were ready to pay a total of R68 848 ($ 4358.49) (median bid) and R203 632 ($12,891.13) (mean bid) per annum for the improvement in the Swartkops estuary's water quality.

Humans value the estuary because they benefit from the ecosystem services provided by the Swartkops estuary; however, Hartmann [80] claims that humans are overusing the estuary's resources. The study goes on to say that some of the bait collectors do not have a permit and they are collecting bait that is more than the bag limit. In addition to being overexploited, the estuary lacks communal management and control. The Swartkops estuary is not effectively maintained, and any problems that develop are not thoroughly investigated and resolved promptly [80].

A study about boat congestion at the Sundays estuary was conducted by Lee and Du Preez [81] using a choice experiment design. The authors highlighted that the estuary is always congested with recreational boats due to demand, so the authors conducted this study to investigate whether estuary users would be willing to pay an additional levy during peak periods to lessen the congestion. The results uncovered that estuary users, especially recreational users, were able to pay an additional amount of R35 ($2.21) per annum on top of the permit fee that is paid by boat users at the Sundays estuary.

Another issue that the Sundays estuary faces is how the estuary is managed, and there is a pressing need to strengthen management rules. A study by Kramer [82] used Marxan conservation planning software to research the suitability of a spatial-based management approach for estuarine fisheries at Sundays estuary in the Eastern Cape. The study was prompted by the shortcomings that conventional management has failed to address and the issue of overexploitation. The study revealed that the unreasonable exploitation of the estuary is caused by rebelliousness and an absence of law implementation. On the other hand, according to Lee and Du Preez [83], the Sundays estuary is overcrowded, with jammed boats as a result of the high demand for the estuary. The estuary is always bustling with people interested in the recreational activities that the estuary provides, such as water skiing, speed boating, recreational boat fishing, padding, etc. The estuary's entry points, which are limited and/or restricted, are also contributing to the congestion [83].

Lee et al. [72] also looked at the economic value of estuarine ecosystem services in Sundays estuary and discovered that recreational estuary users were willing to pay an extra R174 ($11.02) per year to help bring down fishing effort levels in the estuary, resulting in a boat license cost of R268 ($16.97) per year for recreational users after the R174 ($11.02) increase. The Estuarine ecosystem services are important not only to people, but also to the economy because they contribute and are valuable. The economic value of mangroves in the Mngazana estuary in the Eastern Cape was assessed by De Wet [84] using secondary data and a household survey, and it was discovered that the economic value of mangroves in the Mngazana estuary ranged between R1.1 million ($69,636.60) and R13.6 million ($860,961.60).

3.4.1. Threats to the Eastern Cape's Estuaries

There are approximately 143 estuaries in the Eastern Cape, and the majority, if not all, are facing various challenges, which are affecting ecosystem services in some way. Many factors contribute to these threats; for example, the exploitation of fishery resources in the Sundays estuary is a problem [85]. The Sundays estuary is popular for recreational fishing, especially on weekends and during holidays; however, the influx of anglers has resulted in an increase in fishing efforts, resulting in overexploitation of estuary resources. Due to the high number of fishing efforts, the viability of the fishery resources at Sundays estuary is in doubt [85].

Tyolomnqa estuary is another estuary in the Eastern Cape where fishery resources are being overexploited. Participants from the Tyolomnqa estuary raised concerns about the over-exploitation of resources by bait collectors, subsistence fishers, and commercial fishers after being interviewed in a study by [86]. The estuary lacks adequate infrastructure, making proper estuarine management difficult, as well as sufficient access points, resulting in limited public access to the estuary.

Pollution is a problem in some estuaries in the Eastern Cape, and it is primarily caused by urbanization, agriculture, and coastal development. Orr et al. [87] investigated the Kariega, Riet, and East Kleinemonde estuaries and discovered that freshwater inflows flush metals from the water column of the Kariega Estuary during the wet season, and that metal concentrations and enrichment within the Riet and East Kleinemonde Estuaries had seasonal fluctuations. The Swartkops estuary is also polluted, and this is due to a poor and ineffective stormwater management system, which has resulted in changes in water quality due to sewage flowing into the estuary. Stormwater infiltrating the sewer system leads to pump station overflows, resulting in sewage flowing into the estuary [79].

The lack of freshwater inflows at the Kowie estuary is causing sediment deposition and accumulation, which is affecting recreational activities such as fishing, boating, bait collection, and water skiing, all of which have a negative impact on the tourism industry [78]. Nsubuga [34] also discovered that this estuary is experiencing a loss of habitat on the estuary's living resources, as well as overexploitation, as a result of increased fishing efforts. The Kromme estuary is also impacted by the irregularities and low freshwater inflow; as a result, the estuary is freshwater starved, posing a threat to fishing and birding activities, as well as tourism.

3.4.2. Illegal Activities in Estuaries

Since some fishermen harvest to have something to eat with their families or to make money, they end up engaging in illegal activities because they are desperate and rely on fishing for survival. In most cases, bait collectors at the Knysna estuary are only permitted to collect 50 prawns per person per day using only tins or prawn pumps, but they always exceed their limit, or they collect bait with the incorrect equipment, such as pitchforks and spades [82]. Some anglers fish illegally because they cannot afford fishing licenses [88].

Whitfield et al. [11] also discovered that 60 percent of fish caught in South African estuaries each year is caught using an illegal gillnet. Illegal gillnetting is also common in west coast estuaries, with 268 illegal gillnets on the West Coast, whereas on the South Coast, few people are aware of the illegal gillnets, despite the fact that there are 60 illegal gillnets [13]. Even though the nets entrap the crabs, and they can only be released once they reach the shore, most crabs are mangled and eaten by the netters, and most people use illegal gillnets because they are more financially beneficial than shorter nets [89].

4. Discussion

The findings of this review revealed vital information regarding the influence of estuary ecosystem services on humans, the importance of estuaries, and numerous areas of contention about the effects of human activity and climate change on ecosystem services. The review looked at the importance of the ecosystem services and highlighted the important role that estuarine ecosystem services play in uplifting the livelihoods of humans because of the benefits they offer. Two studies [42,84] are in agreement that estuaries bring goods and services to humans and help with their well-being. Furthermore, Summers and Creepo [15] added that the goods and services that are provided by estuaries make life possible for humans. However, a few studies [51–53] contend that humans contribute to the difficulties that estuaries face by raising the demand for land, causing biodiversity loss, and freshwater separation from estuaries since people are increasingly settling next to estuaries or rivers.

The review also revealed that most poor people rely on ecosystem services for their well-being, and some meet their basic needs through provisioning services provided by estuaries, which also help people with income because some of them sell their harvest to locals so that they can feed their families and send their children to school.

McNally et al. [54] further noted that people place a high value on ecosystem services for organic raw materials used in construction and handicraft. Ecosystems supply people with timber that they may use for constructing or manufacturing furniture, and they utilize their talents to convert the raw materials into completed goods, which they sell in their communities to earn money.

Aside from food and raw materials, another reason why people visit the estuary is for leisure activities, the beauty of the estuary, and how the estuary makes them feel, which sometimes helps them escape reality. Both studies, refs. [55,56], concur that estuaries provide cultural ecosystem services that provide individuals with comfort and a nice environment to rest. Martin et al. [36] also discovered that humans like leisure activities such as wandering along the estuary, resting, and boating, and they value the estuary's manmade and natural characteristics. Whereas Refs. [57,58] see cultural ecosystem services as neglected and ignored because they do not have a market value and cannot be sold, they argue that it is easy for people to overexploit and deteriorate them because they know they do not have a market value and do not pay for them.

Some authors have stressed the importance of estuaries to people, and as a result, they are prepared to pay a specific sum as a solution to some of the estuaries' issues. Three studies [70,76,80] applied different valuation methods to evaluate the amount estuary users were willing to pay for estuary resources.

Several methods for valuing the ecosystem services were discovered throughout the review study. Choice experiment and contingent valuation methods were used in the majority of the studies, and both are stated preference methods. The majority of studies that used the contingent valuation method to assess the value of ecosystem services did so by asking people how much they would pay for better water quality and freshwater [37–43]. The choice experiment strategy, on the other hand, involves providing participants with two options from which to choose, each of which is described by a set of qualities that help determine the value of each attribute [67,69].

Findings on the threats to estuaries revealed that pollution is one of the most significant challenges impacting estuaries, harming water quality and recreational activities like fishing, boating, bait gathering, and water skiing, all of which have a negative impact on the tourism industry [37,74]. Estuaries are threatened by overexploitation of resources caused by increased fishing activity and overfishing is among the threats observed on estuaries [60]. The study also found that some people harvest illegally by going over the fishing limit or using improper nets [13,87].

The evidence has implications for countries like South Africa, with an extensive coastline, and ought to be benefiting from this resource. For example, with a 34.4 percent unemployment rate in South Africa, many anglers and bait collectors are unemployed and rely on the provisioning ecosystem services supplied by estuaries to survive [37,38]. According to a study by Lee et al. [72], recreational estuary users from the Sundays estuary were prepared to pay an extra R174 ($11.02) per year to assist in lower fishing effort levels at the estuary, implying that the boat license cost for recreational users would now be R268 ($16.97) per year following the R174 ($11.02) increase. Lee and Du Preez [81] performed another study on the Sundays estuary to assess the direct user charge that estuary users were prepared to pay to minimize boat congestion during the peak season, which is typically between November and February. From the findings, it is clear that recreational users at the Sundays estuary were willing to pay an additional R35 ($2.22) per year to alleviate boat congestion during peak hours.

Sale et al. [78] on the other hand, documented the value of recreational services at the Eastern Cape's Kowie and Kromme estuaries. The findings show that recreational users in the Kowie and Kromme estuaries are willing to pay R938 296.59 ($59,399.80) and R974 019.20 ($61,661.26)p/a, respectively, in exchange for a positive increase in freshwater inputs. Magobiane [64] also assessed the value individuals have for the estuary in light of the estuary's vulnerability to water pollution to further demonstrate that Swartkops estuary users appreciate their estuary. The findings indicated that enhanced freshwater quality flowing into the estuary has an economic benefit, with Swartkops estuary users ready to pay a total of R3 481 987 ($216,442.39) p/a (median bid) and R10 298 688 ($6,519,688.74) per year (Mean bid).

5. Conclusions

In summary, estuarine ecosystem services face significant threats and challenges, the majority of which are caused by human activities, while others are caused by climate change (Table 3). The review also shows that estuaries provide benefits to humans and help them maintain their livelihoods. These benefits can be monetary (for example, provision of ecosystem services) or non-monetary (for example, cultural ecosystem services), but people still value them because they provide different types of satisfaction to them. The majority of research on the value of ecosystem services was conducted globally, with only a few studies conducted in South Africa (Table 4), which highlights a significant research gap in the literature review. This situation emphasizes the importance of increased research effort into the value and conservation of the estuarine ecosystem services in understudied geographic areas.

Table 3. Estuarine threats or challenges originating from human activities and climate changes.

Threats/Challenges from Human Activities	Threats/Challenges by Climate Changes
Pollution	Sedimentation
Dredging	Drought
Overpopulation and Urbanization	Changes to rainfall
Industrialization	Ocean acidification
Oil spills	Changes in temperature
	Freshwater runoff

Table 4. Reviewed studies.

Study	Focus of the Paper	Methodology	Sample	Key Findings
McNally et al. (2016) [32]	The study focuses on various stakeholders, including residents, tourism officials, and conservation organizations, to pinpoint and understand their uses and perceptions of the value of 30 ecosystem services provided by the Wami River and estuaries.	A mixed method approach was used in this study, which included participatory rapid appraisal (PRA) and face-to-face survey questionnaires with residents.	A small group of Tanzanian residents in a community near the Wami River and estuary.	According to the study, almost everyone surveyed valued water because it allows them to drink and bathe, which is a good reason for them to value domestic water, while downstream residents valued fish and commercial fisheries, and upstream residents were interested in flood-recovery agriculture.
Cooper et al. (2016) [40]	The study is all about investigating ecosystem services and the values associated with them, such as spiritual and aesthetic cultural value.	Qualitative research method.	N/A	The findings show that aesthetics and spiritual values are always socially shared and do not have to be solely individual preferences, and it is also stated that people value nature and enjoy the pleasure that comes with aesthetics values.
Magobiane (2011) [64]	Identifying whether the estuary's value would be enhanced if the water quality was improved to allow or make it safe for people to fish, swim, or boat.	Contingent valuation method.	162 Swartkops estuary users were chosen using Stratifies intercept sampling method.	The findings revealed that enhanced freshwater quality water that flows into the estuary has an economic value because people were willing to pay for better water quality.
Sale et al. (2009) [78]	Low water inflows in both the Kromme and Kowie estuaries have had a substantial influence on recreational activities and fishing recruitment; now, the primary purpose of this research is to determine how much recreational users are willing to pay to improve freshwater inflows into estuaries.	Through the use of surveys and questionnaires, the study applies the Contingent Valuation Method (CVM) to assess the estuary users' willingness to pay.	Personal interviews and survey questionnaires were done with recreational estuary users in Kromme and Kowie estuary.	Estuary users in the Kowie and Kromme estuaries are willing to pay R938 296.59 and R974 019.20 per annum for an increase in freshwater inflows, respectively.

Table 4. *Cont.*

Study	Focus of the Paper	Methodology	Sample	Key Findings
Adams et al. (2019) [79]	Investigates the state of the Swartkops estuary's water quality, which has worsened due to water pollution.	Qualitative and quantitative research method.	Water quality data was analyzed from 19 sites, such as estuaries, rivers and point source sites near Swartkops estuary.	The results indicate that water from the estuary's upper reaches is not being flushed efficiently, and that the estuary's natural hydrology has been modified.
Lee & du Preez (2015) [81]	A study was performed to determine the amount to be paid for levy during peak periods in order to alleviate the challenge of boat congestion at Sundays estuary.	Choice experiment method.	Using an on-site sampling method, 175 recreational users from Sundays estuary were asked to participate in a face-to-face questionnaire.	Sundays estuary recreational users were prepared to pay an additional R35 per year to minimize boat congestion during peak periods.
Lee et al. (2013) [83]	The important aim of this study is to figure out how to lessen competitive demand and boat congestion, both of which have resulted in detrimental overcrowding impacts.	The study employs the Choice Experiment (CE) method to determine how much estuary users are willing to pay to alleviate the unfavourable crowding impacts caused by recreational demand at Kromme river estuary.	Meetings and focus groups were held with Kromme river estuary residents to select the attributes and attribute levels. After attributes and levels were selected and survey instruments were designed, personal interviews and questionnaires were conducted on-site with recreational estuary users.	The study found that there has been an increase in the number of people participating in recreational activities at the estuary, and that estuary users are willing to pay an extra R483 per year at peak hours to reduce negative crowding impacts and help improve welfare.
Wet (2004) [84]	The economic value of Mangrooves, which are used to make building materials and are also consumed for subsistence by Mangaza estuary users.	Contingent valuation method.	Mangaza estuary users and cottage owners from local communities.	The mangroves' minimum economic value was calculated to be between R1.1 and R13.6 million, with an even more value of R7.4 million at a real 5 percent discount rate.
Lee et al. (2014) [72]	Evaluating the economic value of estuarine resources at Sundays estuary and propose measures to help reduce the congestion at the estuary.	Choice experiment method.	A survey questionnaire was completed by 175 recreational users from Sunday's estuaries.	Sundays estuary recreational users were prepared to pay R174 per year to drastically alleviate fishing effort levels, causing recreational users pay R268 per year.
Jacobs et al. (2013) [30]	This study provides an overview of the estuarine ecosystems and the demand for services in each estuary.	Qualitative method: survey questionnaire.	27 estuary users and 12 professional experts were surveyed to provide information on the supply of ES.	Estuaries continue to be highly valued because they provide food that is strongly influenced by ecological habitat quality and biodiversity, and they play a significant role in the hydrological cycle, together with regulating water provisioning.

Table 4. *Cont.*

Study	Focus of the Paper	Methodology	Sample	Key Findings
Ayodele & Dyelowo (2020) [38]	The study evaluates ecosystem services in the Omo Biosphere Reserve and investigates the provisioning services provided by forest resources.	Qualitative and quantitative method.	N/A	According to the findings of the study, the Omo Biosphere Reserve provided people with a source of food, freshwater, plants, and other ecosystem services.
Spalding et al. (2014) [21]	Examines the role of ecosystems in safeguarding coastal communities from climate change and hazards because the impacts of climate change are often felt by a large number of people.	Qualitative method.	N/A	Findings showed that through their different roles in wave attenuation, sediment capture, vertical accretion, erosion reduction, and the mitigation of storm surge and debris movement, coastal ecosystems, can play a critical role in assessing the risk of coastal communities to storm surges and coastal hazards.
Martin et al. (2020) [36]	Determines the cultural ecosystem services that are important to residents, as well as the characteristics that residents value for their continued satisfaction and recreational use of the estuaries.	Data was collected through structured self-administered anonymous questionnaire.	Local people and estuary users from New South Wales were recruited using non-probability sampling.	Findings showed that residents believe that estuaries make a significant contribution to their well-being and that they actually appreciate recreational activities such as walking, relaxing, and non-motorized boating, and they value the estuaries' natural and human-made qualities.
Small et al. (2017) [51]	Provides a link between ecosystems and people while also emphasizing the difficulties associated with valuing ecosystem services, particularly those with non-material benefits.	Qualitative and quantitative research method.	N/A	The results indicate that, despite the clear diversity of values, there appears to be agreement across societies on which values are important, and that there is a natural hierarchy of values that favors ecosystem services with nonmaterial benefits.
Barbier (2015) [41]	The study compares the Expect damage function (EDF) and replacement cost methods determining the economic value of expected property damages lowered by marsh wetlands and their vegetation along a storm surge path.	Expect damage function (EDF) method and replacement cost method.	N/A	The results show that, when compared to the EDF approach, the replacement cost method produces incredibly high estimates, and the expected damage function has its own limitations, particularly when households are averse to risk.

Table 4. *Cont.*

Study	Focus of the Paper	Methodology	Sample	Key Findings
Hochard, Hamilton and Barbier (2019) [62]	explores the economic impact of cyclones on nearly 2000 tropical and subtropical communities living along the coasts of 23 major mangrove-holding countries.	Mixed research methods.	2000 tropical and subtropical communities.	The findings imply that mangrove conservation efforts for protective benefits may be more cost-effective, and that mangrove habitat loss may be more harmful than originally understood.
Preez et al. (2010) [17]	The study focuses on determining how much estuary users in various South African estuaries were willing to pay to resolve changes in estuary services caused by reduced freshwater inflows.	Contingent valuation method.	7768 participants.	According to the findings, recreational users' willingness to pay varies depending on the estuary, with a mean willingness to pay of R58 to R582 per annum and a median willingness to pay of R0 to R350 per annum.
Turpie et al. (2002) [55]	The study's goal is to create a way to determine the importance of estuarine conservation and to propose a network of estuarine protected areas that is both efficient and effective.	A combination of quantitative and qualitative research method.	N/A	According to the findings, the importance of an estuary can affect the decision of management class and thus freshwater allocation under the country's Water Act and can be used to enable the development of management techniques for estuaries.
Nsubuga (2004) [34]	Evaluating the sustainability of the Kowie estuary and identifying relevant sustainability indicators for this estuary	Boat-based and shore-based roving creel surveys.	1368 interviews with both line fishers and bait collectors.	From the three sectors that were investigated at Kowie estuary, the sustainability is poor, with 9 of the 13 indicators in the shore-based recreational fishery performing poorly, as well as 11 of 13 in the subsistence line fishery and 10 of 13 in the subsistence bait fishery.
Hartmann (2021) [80]	The study wanted to investigate whether social-ecological systems approaches are being used in the Swartkops Estuary.	Mixed research methods: questionnaires, semi-structured interviews and focus groups.	minimum number of 100 participants and a maximum of 250 participants were recruited using random stratified sampling and purposive sampling.	Finding s revealed that Swartkops is not governed as a common pool resource, and poor management is one of the causes of threats in the estuary, resulting in the estuary being overexploited.

Table 4. *Cont.*

Study	Focus of the Paper	Methodology	Sample	Key Findings
Kramer (2016) [82]	Since Sundays estuary is threatened and its species are overexploited, the study evaluated the feasibility for an ecosystem-based approach using a rapid sustainability assessment technique, as well as a spatial-based management approach for a valuable fishery species using conservation planning software.	A mixed method research approach, using a case study and drivers pressures state impact response model (DPSIR).	N/A	The findings revealed that current levels of exploitation are unsustainable due to lack of compliance and a lack of enforcement. The Sundays Estuary's overall sustainability score was only 23.8 percent. Due to the lack of enforcement of estuarine fisheries regulations in South Africa, alternative management measures such as spatial regulations could be a feasible alternative going forward.
Afentina et al. (2017) [50]	Focuses on cultural ecosystem services and how local people appreciate their rattan' gardens,' as well as the role of rattan agriculture in the protection of local knowledge, wisdom, and values.	Qualitative research method: in-depth interviews with key informants, focus group discussions with farmers, and observations of daily activities of local people.	15 participants were interviewed.	The local community of Tumbang Runen perceives rattan gardens to be an essential part of their culture and social system because they not only provide them with products for basic survival, but they also symbolize the local people's identity.
Boafo et al. (2016) [49]	The study investigates rural households' perceptions of the value of traditional ecological knowledge (TEK) in the management of ecosystem services in Northern Ghana.	A combination of qualitative and quantitative research methods: Interviews, surveys, group discussions, meetings and field observations.	225 participants.	The findings revealed that men were more aware of the rules and regulations than women, and that there is an inverse relationship between awareness and compliance with TEK systems, despite the fact that communities continued to use various forms of TEK.
Golivets (2011) [46]	The study focuses on the aesthetic values of forests and determining which qualities of forests are most liked by the general public.	Survey questionnaire and indoor survey using photographs.	47 participants.	The public appears to be interested in forest aesthetics, and the beautiful landscape of forest sites appears to influence people's judgements of its ecological value, according to the findings.
Figueroa. (2015) [45]	The study's goal is to map out the potential benefits of Nebraska ecosystems' aesthetic values as they relate to environmental planning using social media data.	Mixed method approach.	N/A	According to the findings, parks are the most appealing places to visit based on social media data, and they are more appealing than others due to their establishment as touristic areas, and these cultural ecosystem services always leave people amazed by the beauty of nature.

Table 4. *Cont.*

Study	Focus of the Paper	Methodology	Sample	Key Findings
Helka (2016) [44]	The study investigates the significance of cultural ecosystem services and the various ecosystem services used in Leipzig.	Face to face interviews.	66 participants.	Respondents place a high value on cultural ecosystem services for recreation and leisure, while regulating ecosystem services are placed as the second best because purified water and clean air are necessary for life.
Bostrom et al. (2012) [52]	focuses on cultural ecosystem services and provides a framework for the involvement of ecosystem services research in decision making, with a specific emphasis on research that discusses cultural ecosystem services and values.	Qualitative research method.	N/A	As cultural ecosystem services are intangible and nonmaterial, they are undervalued in many decision-making contexts because the focus is always on economic valuation. This necessitates the development of a framework that discusses the sensitive nature of intangible values as well as the actual fact that ecosystem service change is a complex product of ecological changes.
Milcu et al. (2013) [48]	Focuses on publications about cultural ecosystem services while highlighting some major challenges for cultural ecosystem services research in the future.	Qualitative research method.	107 publications	Findings show that cultural ecosystem services are difficult to market, making it difficult for researchers to assess their worth and develop logical strategies to cultural ecosystem services research while remaining connected to the larger ecosystem services research community.
Mowat (2020) [29]	This research focuses on problems surrounding cultural ecosystem services and traditional communities in South Africa.	Qualitative research method.	N/A	This study discovered that people in South Africa value cultural ecosystem services and use them to create tourism opportunities through recreational activities; however, intangible aspects of CES are underappreciated and there are few studies on them.
Hartel et al. (2014) [43]	The study examines the role of various ecosystem services for local communities as viewed by local residents in a traditional cultural landscape in Transylvania.	Semi-structured interviews and survey questionnaires.	148 participants.	Most people prefer freshwater, healthy soil, sense of place, relaxation and recreation as well as cattle and medical plants, even though the local communities are suffering from social and economic challenges including unemployment and poverty.

Table 4. *Cont.*

Study	Focus of the Paper	Methodology	Sample	Key Findings
Olisah, Adams, Rubudge, (2021) [62]	The paper reviews studies on pollution in South African estuaries from 1960 to 2020.	Qualitative research method.	N/A	The findings suggest that water pollution in South African estuaries, which is caused by human activities, needs to be managed and mitigated in order to preserve critical ecological features and ecosystem services.
Barbier et al. (2011) [31]	The study examines the main ecological services provided by a variety of estuarine and coastal ecosystems, as well as estimates of the major economic values derived from these services.	Qualitative research method.	N/A	Despite the fact that some significant benefits of seagrass beds and beaches have not been properly assessed, there has been a lot of development in terms of the benefits for some systems and services, and reliable valuation estimates for the key services of some estuarine and coastal ecosystems are beginning to emerge.
Duncker et al. (2012) [42]	The research focuses on how forest management directly impacts forest ecosystem services such as timber.	Qualitative research method.	N/A	Several forest management operations have been shown to have an impact on water quality and soil fertility, either favorably or unfavorably. Forest management, on the other hand, had only a minor impact on water quantity.
Munang et al. (2011) [37]	The study makes a strong case that ecosystems are critical to improving food security.	Qualitative research method.	N/A	The findings revealed that ecosystem services are under severe stress and are at risk of more degradation, particularly as a result of climate change. The findings also highlighted that there is a need to ensure that ecosystems do not continue to degrade and must remain healthy and fully functional in order to provide the critical ecosystem services that we rely on.

Table 4. *Cont.*

Study	Focus of the Paper	Methodology	Sample	Key Findings
Mandal et al. (2021) [35]	Evaluate the ecosystem services offered by Purbasthali Oxbow Lake to neighboring villages, as well as the spatial pattern of use, its aspects, and the degree of dependence of rural communities on services offered.	RAWES approach: questionnaire.	N/A	The study identified the category of ecosystem services (provisioning, regulating, cultural, and supporting services) that have aided or benefited the local environment and socio-economic lifestyle of the native villagers, whether directly or indirectly, and the degree of reliance of rural communities on services offered is dependent on the complementary services provided by the lake.
Tidwell et al. (2019 [76]	The study looks into the role of consumer demand in improving peri-urban sanitation quality, as well as the implications, by determining the proportion of plots where improved sanitation would generate a higher return on investment for landlords than building a space for an additional renter to dwell.	Hedonic pricing method and choice experiment method.	1085 participants.	The study revealed that tenants were willing to pay $2.20 more per month for flushing toilets on plots with running water and $3.39 more per month for solid toilet doors, but being unwilling to pay much for basic hole covers and having a negative WTP for adding locks to doors (−$1.04). It also suggested that landlords on any plot with at least three homes should invest in a robust structure as well as a flushing toilet to maximize their revenues.
Carvalho et al. (2013) [39]	The study investigates the effects of bait harvesting on ecosystems and on bait collectors.	Qualitative research method: interviews.	33 participants.	Bait collectors use bait for their own angling or sell it to other anglers for a financial gain, which has an economic impact on the RNLED's neighboring population. Increased bait collector density, on the other hand, had a far greater negative impact on the habitat.
Baus (2017) [61]	Urbanization is wreaking havoc on the environment, and this study focuses on the issue of overpopulation and its impact on ecosystems.	Qualitative research method.	N/A	Overpopulation is causing pollution because humans have used the ocean as a dump for sewage and toxic materials for many years, causing environmental damage and degrading ecosystems.

Table 4. *Cont.*

Study	Focus of the Paper	Methodology	Sample	Key Findings
Davies et al. (2019) [60]	Human-caused environmental degradation harms both the environment and the economy; thus, this study displays the connection between the economy and the environment.	Qualitative research method: document analysis.	N/A	The findings demonstrated how equality and justice are jeopardized, along with human and environmental well-being, and how corporate actors damage both the (local) economy and the (local and global) environment.
Guo et al. (2010) [59]	This study investigates whether economic development causes humans to become less reliant on ecosystem services and biodiversity.	Quantitative research method.	N/A	The results show that humans' reliance on cultural services has grown faster than their reliance on regulating services, while their reliance on provisioning services has decreased, implying that economic growth has made people more reliant on ecosystem services and ecosystems.
Zhou et al. (2015) [58]	The aim of the study is to examine the impact of human activities on the eco-environment and changes in the ecosystems that are as a result of human activities.	Combination of quantitative and qualitative research method.	N/A	Findings reveal that the over-exploitation of water resources and the expansion of constructed oases have resulted in significant eco-environmental degradation and a decline in ecosystem stability.
Robb (2014) [56]	This study looks into the spatial distribution of human activities that have an impact on BC estuaries, as well as threats that have not been considered before.	Mixed research methods: reviewing literature, statistical analysis, etc.	376 estuaries.	The findings show that each estuary-watershed system faced an average of 7.9 threats, with most threat variables having a moderate impact on most estuaries and forestry and recreational fishing having the highest impact.
Fianko at al (2007) [57]	The study looks into water pollution at the Iture Estuary in Ghana's central region, which is said to be caused by high levels of heavy metals in the environment due to anthropogenic activities.	Quantitative research method.	Water samples were collected in 1-L plastic bottles from the middle of the stream at a depth of 20–30 cm.	The results showed that the Iture Estuary is severely polluted, particularly in terms of heavy metals, and that this is having a negative impact on the health of those who depend on the Estuary for domestic purposes without treatment.

Table 4. *Cont.*

Study	Focus of the Paper	Methodology	Sample	Key Findings
Berakhi (2004) [54]	The study focuses on investigating land use land cover (LULC) changes in the Kagera basin, as well as the impact of human activities.	Quantitative and qualitative research method.	N/A	The findings revealed that agricultural activities were by far the most dominant land use change, followed by woodland savanna cover type, and it is evident from the observations that agriculture was by far the most evolving LULC change, followed by woodland savanna, and this is due to population growth and density.
Rao et al. (2011) [53]	The study sought to investigate the water resources dynamics as well as the impact of human activities on ecosystems.	Mixed research methods.	N/A	Increase in population is one of the causes of environmental change because it increases the demand for land and overconsumption of water for watering, and climate change can also have a negative impact on water resources.
Boyd and Banzhaf (2006) [28]	Focuses on the definition of ecosystem services and takes an economic approach to accounting for ecosystem services.	Qualitative research data.	N/A	The study defines ecosystem services as the benefits provided by estuaries to humans. It also outlines a rough strategy for collecting and verifying nonmarket ecosystem services, such as the willingness to pay (WTP) approach.
Mangham, Hanson and McPake (2009) [71]	The study defines the choice experiment method and also outlines the stages and steps that are involved when designing the choice experiment approach.	Qualitative research data.	N/A	The study revealed the advantages and the challenges that many people face when using this method.
Koemle (2020) [70]	The study examines the literature on theoretical and methodological issues in order to identify potential challenges and biases when using the choice experiment approach.	Systematic literature review.	N/A	The method has progressed, but it still faces difficulties in practical applications, and the study also suggested that future research should focus on ways to deal with these issues.
Gürlük (2006) [73]	Focuses on using a willingness to pay approach to conserve the ecosystem of the Misi Settlement in Turkey.	Contingent valuation method.	129 participants.	The estimated worth of the MRDP per head was 67.94 USD per year, and when this value is applied to the households living around the Misi, it yields 2,306,474 USD per year.

Table 4. *Cont.*

Study	Focus of the Paper	Methodology	Sample	Key Findings
Preez & Hoskings (2010) [77]	The study focuses on evaluating the economic worth of freshwater inflows into Klein and Kwelerha estuaries.	Contingent valuation method and travel cost method.	471 households.	The marginal recreational worth of freshwater inflow into the Klein Estuary was 5.7 cents/m^3 (ZAR0.057/m^3), while it was 1.1 cents/m^3 (ZAR0.011/m^3) in the Kwelera Estuary.
Napier et al. (2009) [88]	The study's major goal is to determine the nature of the fishery as well as the number of participants and effort involved in it.	Qualitative research method: Interviews and focus groups.	100 estuary users.	The study revealed that, subsistence fishing is worth approximately R0.7–R1.1 million per year. The fishery, however, is poorly supervised and does not attain its full potential because it is now operating under recreational restrictions. Damaged bait species, such as Marphysa spp., pose the greatest damage to the estuary.
Cowley et al. (2013) [85]	This study presents empirical data on fishing resource exploitation in the Sundays Estuary on South Africa's south-east coast.	Qualitative research method: on site interviews.	89 participants.	The entire annual effort was assessed to be 63,785 angler-hours, with an annual yield of 16,214 fish, (8.0 t). Effort and mean catch per unit effort followed seasonal patterns, peaking in the summer.
Maponya (2013) [86]	This study summarizes the results of a knowledge audit that examined at the state of estuarine sources of knowledge, gaps, and needs from the viewpoint of estuary users in the Tyolomnqa Estuary in the Eastern Cape.	Qualitative research method: Case study, focus groups and un-structured interviews.	16 participants.	The study discovered that people living near the Tyolomnqa Estuary lacked sufficient understanding of how to manage estuarine-related issues, and that a lack of practical know-how, skills, and experience would harm and damage valuable natural resources such as estuaries.
Orr et al. (2008) [87]	The goal of this study was to see how seasonally linked changes in rainfall, and hence river flow, affected metal concentrations and enrichment in the sediment and water column of three Eastern Cape estuaries.	Mixed research method.	16 sites.	According to the results, increased freshwater inflow resulted in a decrease in Co, Ni, and Pb enrichment in the Kariega Estuary sediments. During the dry season, the average concentrations of Cd and Pb in the Kariega Estuary's water were greater than the South African water quality requirements for coastal marine waters, but reduced dramatically during the wet season.

Table 4. *Cont.*

Study	Focus of the Paper	Methodology	Sample	Key Findings
Whitfield et al. (2020) [13]	The study focuses on marine protected areas (MPAs) that provide protection for extensively exploited marine fish species, with a particular emphasis on the protection needs of fish species in estuaries.	Mixed research method.	N/A	Most anglers were uninformed of the fishing laws relevant to their target species, and several claimed to not have a valid fishing permit.
Hoppe-Speer, Adams, and Bailey (2011) [68]	Looks into the effects of natural changes as well as anthropogenic fac-tors on the distribution and state of mangroves along the Eastern Cape coast.	Mixed research method	17 estuaries in the Eastern Cape	Mangroves in the Eastern Cape are under threat from both human activity and natural disasters, and as a result, they are degraded.
Lamberth & Turpie (2003) [15]	The study aims to describe the many forms of estuarine and marine fisheries that exploit estuarine fish, as well as their overall participation and effort, as well as estimate total catches of estuary-associated species in estuaries and the marine environment.	Qualitative research method.	129 estuaries.	Commercial seine and gillnet fisheries accounted for 50% of the estuarine catch in all of the estuaries studied, recreational angling for 46%, and traditional trap and spear fisheries for 4%. The total catch value was R433 million every year, with recreational angling accounting for 99 percent of it.
Coetzee (2015) [66]	Focuses on imple-menting passive and active biomonitoring methods in Durban Harbour and Richards Bay Harbour using semi-permeable mem-brane devices (SPMDs) and indicator organ-isms (mussels) for chemical and bio-chemical analysis.	Mixed research method	N/A	The findings revealed during the dry season, both harbours had higher levels of these pollutants than Shef-field Beach, while Richards Bay Harbour had higher levels of PAHs due to an oil spill a few weeks prior.
Crook & Mann (2002) [89]	This study explores existing organizational systems and reviews the legal fisheries in these three locations from 1995 to 1997, providing reasons why the three fisheries work differently.	Qualitative research method.	N/A	The findings demonstrated that the so-called "tragedy of the commons" is avoided when communities employ CPR in an organized, self-regulating manner.
Du Preez et al. (2009) [75]	The study focuses on assessing the willingness-to-pay (WTP) for a project in Underberg, KwaZulu-Natal, South Africa, that involves removing alien vegetation and restoring native flora.	Contingent valuation method.	260 households.	The project's average WTP was R21.12 in 2005 (R26.40 in 2008), the total WTP was R25 344.00 (R31 680.00 in 2008), and the WTP per hectare was R21.87 (R27.34 in 2008).

Table 4. *Cont.*

Study	Focus of the Paper	Methodology	Sample	Key Findings
Samdeliri & Shahbazi (2017) [74]	The study aims to determine the recreational value of ShirinSou Wetland in Hamadan Province's Kabodarahang County.	Contingent valuation method.	175 participants.	The findings suggest that 81 percent of those polled are willing to pay for recreational use of the wetland, with an estimated WTP of 44,671 IRR (US$ 1.68) per person. The wetland's overall annual recreational value is estimated to be around 809 (million IRR) (or US$ 30,348).
Ntshangase (2017) [69]	Assesses beach users' preferences for beach management at different beaches in Nelson Mandela Bay in a study.	Choice experiment method.	200 respondents.	The study's findings found that consumers are prepared to pay for a variety of upgrades, including an extra water bill to use the beaches.
Blaber (2000) [33]	The study takes a global approach to synthesizing the impacts of fishing on estuaries and coastal waters, with case studies for each of the eight process-oriented categories impacted by fishing.	Qualitative research method.	N/A	According to the findings, the effects of fishing in estuaries and coastal seas are complex and potentially far-reaching. The majority of fisheries, on the other hand, will always be in a state of uncertainty about what to do about their consequences for a variety of reasons.
Potts et al. (2021) [47]	The study looks at the economic activity created by recreational fishing in South Africa, as well as the economic prospects offered by this industry for societal benefit.	Mixed research method.	1320 participants.	The study revealed that, recreational fishing supported 94,070 full-time jobs and created ZAR 32.6 billion in economic activity per year. Despite the fact that low-income households benefited from less than 10% of economic activity.
Izegaegbe, Vivier, and Mzimela, (2021) [65]	The study's aim is to look into the Paratylodiplax blephariskios in contaminated mudflats in South Africa's subtropical Richards Bay Harbour (RBH).	Mixed research method.	131 Crabs	The findings emphasize the im-portance of utilizing pollution indi-ces in bioaccumulation studies in conjunction with bioindicator taxa and argue that these indices should be included in all future RBH bioac-cumulation research.

Table 4. *Cont.*

Study	Focus of the Paper	Methodology	Sample	Key Findings
Summer & Crespo (2017) [16]	The study looks on the role of ecosystem services in community well-being.	Qualitative research method.	N/A	The transdisciplinary science of ecosystem management, which brings together ecologists, biologists, resource economics, social scientists, and holistic systems experts, is urgently needed because of the complexities of the relationship between ecosystem services and community well-being.
Shackleton, Kirby, and Gambiza (2011) [67]	The research looks into the positive aspects of alien species, such as their effects on livelihoods and the good they may do in communities.	Qualitative researchmethod (Interviews).	36 traders	Traders in Makana Municipality benefit from prickly pear, and for some, selling prickly pear is their primary source of income.

Supplementary Materials: The following supporting information can be downloaded at: https://www.mdpi.com/article/10.3390/su14127252/s1, PRISMA checklist.

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