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RESEARCH ARTICLE

Drivers of the Total Economic Value (TEV) of Wetland Loss in the Lower Niger-Orashi River Basin (LNORB) of Southern Nigeria

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ABSTRACT

Wetlands provide essential ecological, economic, and socio-cultural services, yet they continue to experience rapid degradation due to increasing anthropogenic pressures. This study examined the factors influencing the Total Economic Value (TEV) of wetland loss in the Lower Niger–Orashi Basin (LNORB), Nigeria, with emphasis on the economic, environmental, social, and institutional dimensions of wetland degradation. A quantitative survey research design was adopted, and data were collected from 331 respondents across communities within the LNORB. Descriptive statistics, Kendall's Tau-b correlation, and Principal Component Analysis (PCA) were employed to analyse the data. The results revealed a high dependence on wetland resources, with 86.1% of respondents utilizing wetlands every week. Potable water use, tree logging, farm practices, aquaculture, land reclamation, heavy metal accumulation, cultural values, and government corruption emerged as the most influential factors affecting the TEV of wetland loss. Kendall's Tau-b analysis showed significant positive relationships between economic and social factors and between economic and institutional factors ($p < 0.05$). PCA further identified two principal environmental components explaining 87.09% of the total variance, confirming significant variation among environmental factors. The study concludes that wetland loss in the LNORB is driven by interconnected economic, environmental, social, and institutional factors. It recommends strengthening institutional governance, promoting sustainable livelihood practices, and integrating wetland conservation into regional development planning.

Keywords: *TEV; Wetland loss; Lower Niger; Orashi; PCA; Kendall's Tau-b*

1. INTRODUCTION

Wetland ecosystems provide services to humans such as flood mitigation, nutrient removal, water storage, recreation, and others. However, the degradation and loss of wetlands have influenced the economic returns of wetland-related activities and ultimately the livelihood options of people (Ayanlade & Proske, 2016). The Total Economic Value (TEV) distinguishes between use values and non-use (or passive use) values, where value refers to the value of actual, planned, or possible uses of a wetland and its resources, and non-use values are the values that people ascribe to keeping the wetland in existence, even when there is no actual, planned, or possible use (Akujuru, 2014; Ogbonna et al., 2019). While this understanding is valid, there appears to be a loss of wetland values caused mostly by human activities and natural stressors, such as erosion, land subsidence, droughts, annual flooding, and storms (Ayanlade & Proske, 2016; Nse et al., 2020; Sarkar et al., 2020).

In the Lower Niger-Orashi River Basin (LNORB), human activities have also played a dominant role in wetland loss, ranging from alteration of water flow, pollution, habitat changes, and ponded pasture systems with their resultant effects on the local economy (Ogbonna et al., 2019). Investigations indicate that key primary indirect drivers of degradation and loss of wetlands in LNORB have been population growth and increasing economic development, while the primary direct drivers of wetland loss include infrastructure development, land conversion, water withdrawal, eutrophication and pollution, over-harvesting and over-exploitation (Nwaogu et al., 2017; Ogbonna et al., 2019). Furthermore, Wetlands in the LNORB have experienced substantial degradation and economic loss, particularly with respect to the areas of forest and agricultural land use (Ayanlade & Proske, 2016). Nwaogu et al. (2017) show that wetlands in LNORB typified by Oguta had an 87.3% increase between 1987 and 2002, but decreased to 53% in 2015. Today, the decreasing rate has grown deeper. For example, at present, wetland loss due to oil exploration, exploitation, and transportation is put at 20% while loss to light forest is about 30%, whereas more than 15% are currently under risk of being drained and reclaimed for industrial and residential uses (Jibiri & Eke, 2021). Also, people in the LNORB are often tempted and coaxed to eliminate wetlands in most cases through oil exploration, exploitation, and transportation by ditching and draining to maximize arable lands as they face pressure of rising costs and reduced profit (Ogbonna et al., 2019). Many residents of the LNORB are still unsure of the expected economic returns and values associated with wetlands, as they seem skeptical and unpersuaded to be involved in wetland conservation; otherwise, there would have been more preserved wetlands.

Thus, a lack of awareness about the economic services and values of wetlands has been the main problem in the communities of the study area. The concept of TEV, which provides such a framework that categorises these values, appears not to have been completely explored. As such, economic, environmental, social, and institutional factors that affect wetland loss are not well understood (Nwaogu et al., 2017). On that note, this research aimed at assessing the influence of socioeconomic and environmental factors on the TEV of wetland loss in the LNORB of Southern Nigeria. In doing this, the study determined if there is a significant relationship between economic and social factors that affect the TEV of wetland loss in the study area. Also, the study ascertained if there is significant variation in environmental factors that affect Total Economic Values (TEVs) of wetland loss in the study area.

2. LITERATURE REVIEW

In recent times, wetlands have come under serious threat of reclamation for other land uses. A realistic estimate is that 50 % of the world's wetlands have been lost to other land uses (Verhoeven & Setter, 2010). The recession of coastal mangroves in tropical regions (Richards & Friessa, 2016) and the disappearance of mid-latitude plateau lakes (Tao et al., 2015) is all part of the emblematic picture of global wetland loss. Food demand and urban sprawl have always come at the expense of the natural landscape in the past 100 years. Consequently, the natural ecological process has been drastically changed, and the loss of biodiversity is shocking (McCauley et al., 2013).

Human activities have been attributed as one of the main reasons for wetland recession (Schnaiberg et al., 2002; Zhang et al., 2021). More intensive human activities often result in more pronounced manifestations and more complex forming mechanisms of land use conflict (Ma et al., 2020). Also, excessive nutrient loading has become a growing threat to rivers, lakes, marshes, and canals, while the growing pressures from multiple direct drivers seem to have increased the likelihood of potentially abrupt changes in wetland ecosystems (Ayanlade & Proske, 2016). The resultant effect of this is a reduction in the capacity of wetlands to mitigate impacts and results in further reduction in human well-being (including an increase in the prevalence of diseases), especially for poorer people in lower-income communities, where technological solutions are not readily available (Finlayson et al., 2005). At the same time, demand for many of these services (such as denitrification, flood and storm protection) has increased, as observed in the Oguta oil-producing locality of Imo State (Jibiri & Eke, 2021). Also, stakeholders who are knowledgeable about the economic values associated with wetland conservation and preservation are more likely to realize greater financial benefits and market returns (Verhoeven & Setter, 2010). Thus, knowledge could motivate more attention and commitment to wetland preservation and be a good step towards ensuring food sufficiency and security while improving the social and economic welfare of the society. Therefore, wetland operators are likely to conserve wetlands due to their belief that economic growth is achievable through wetland preservation and conservation (Ogbonna et al., 2019). Some studies on wetlands seem to focus on ecosystem services (Mazzotti et al., 2009), farmers' willingness to participate in wetland restoration (Odudu, 2015), and drivers of change in tropical wetlands (Sarkar et al., 2020). Although wetlands are gradually becoming areas of research interest, related studies focusing on the TEV of wetlands appear to focus mainly on the valuation and management of wetlands (Adeleke, 2019; Asmare et al., 2022; Okonkwo et al., 2015) without specific attention to the interdependent factors that underlie the TEV of wetland loss in rural settings.

Based on existing literature, the following hypotheses were developed for the study:

Hypothesis 1 (H01): There is no significant relationship between economic factors and social factors that affect wetland loss.

Hypothesis 2 (H02): There is no significant relationship between economic factors and institutional factors that affect wetland loss.

Hypothesis 3 (H03): There is no significant variation in environmental factors that affect wetland loss.

3. MATERIALS AND METHODS

Considering the objectives of this study, the research design adopted is a survey design, using a quantitative approach. This study measured the fundamental variables and constructs identified. By adopting the quantitative method of data collection and analysis, this study blended and maximized the relevant strengths inherent in quantitative methods to analyse the results.

The Study Area

The Lower Niger-Orashi River Basin (LNORB) is made up of communities occupying the wetlands of Ogbaru Local Government Area of Anambra, Oguta and Ohaji/Egbema communities in Imo State, including Egbema, Asse and Ndoni communities in Rivers State in South-East/ South-South geopolitical zone of Nigeria (See Figure 1). The entire LNORB lies in the sub-equatorial humid dense rain forest zone of South-Eastern Nigeria. LNORB is situated between the East of the Lower Niger and the West of the Orashi River. It also extends between three (3) and five (5) kilometres east of Orashi River to join the South-Eastern mainland at Ihiala and Uli in Anambra State, including Oguta and Egbema in Imo State. The LNORB lies approximately between Latitudes 4 30' N and 6°15' N of the Equator and Longitudes 6°30' E and 7°00' E of the Meridian. Major communities in the LNORB include Atani, Ossamali, Ochuche, Akiri, Ogwu-Ikpele, and Ogwu-Aniocha, all of Ogbaru Local Government of Anambra State. Communities found in Imo State include Oguta, Orsu-Obodo, Ezi-Orsu, Opuoma, and Mmahu, while the communities located in Rivers State are Omoku, Obrikom, Ndoni, Asse, and Odougiri.

The 2006 population census put the population of the LNORB at 831,842 people. Various annual population growth rates of 2.2% for Ogbaru (Anambra State), Oguta and Ohaji/Egbema (Imo State), 2.1%, and Ogba/Egbem/Ndoni, 2.3%, are recorded respectively according to the 2006 census. The population of the LNORB is estimated to be about 1,161,922 people in 2024. The LNORB is mainly an agrarian and fishing wetland environment. The area is blessed with high-yielding oil and gas fields, making it a host to major International Oil Corporations, including AGIP, Shell, Chevron, Addax, and most recently Sahara Upstream Nigeria Ltd (SUNL).

The LNORB has untapped tourism potential and a rich cultural heritage that can yield far bigger economic value. For instance, the Oguta Blue Lake is a marvelous tourist attraction, especially at the confluence where the waters of the Lake and the Orashi River meet, but their respective colors of blue and brown refuse to mix. Oguta Lake is the largest natural freshwater lake in South-Eastern Nigeria, located in a natural depression within the floodplain of the River Niger. Its water surface area varies from 180 to 300 ha depending on the season, and its average depth is 5.5m. It receives perennial drainage from Rivers Njaba, Utu, and Awbana, which have their source in the Awka-Orlu Cuesta in North-Central Imo State.

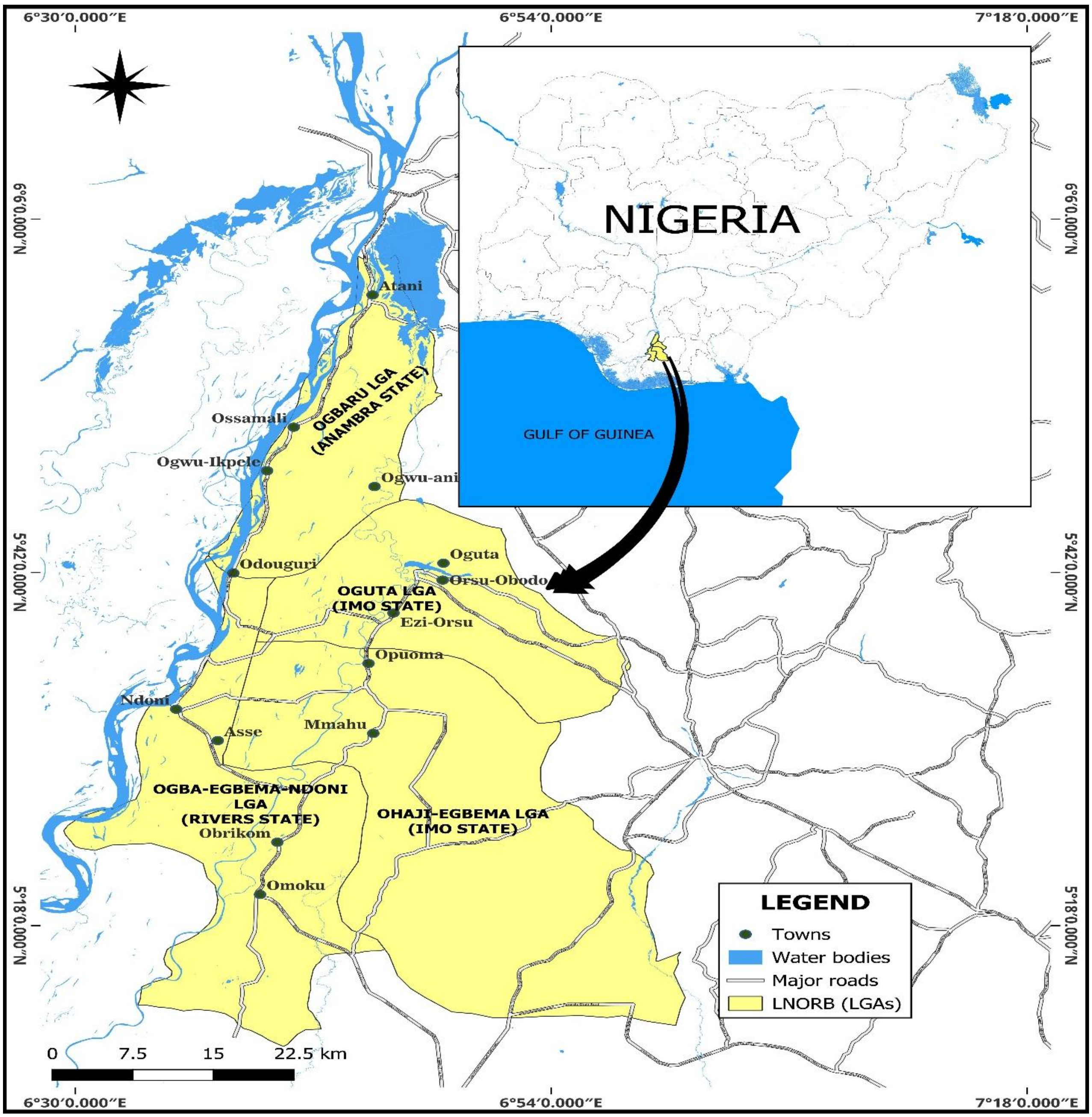

Figure 1. Lower Niger-Orashi River Basin (LNORB)

Sampling Techniques

In adopting an appropriate sampling procedure and strategy, this study ensured that the respondents were aware of the issues being examined, in view of their professional and academic backgrounds. Thus, this study adopted a stratified random sampling technique. Stratification was based on respondents' location within the study area. The basis for this was to ensure adequate and better representation with respect to certain characteristics of the units sampled. The questionnaires were administered face-to-face with respondents aged 18 years and above, and who have lived in the LNORB for not less than 5 years.

Since the scope of this work is restricted to the LNORB, the sample size (n) for the study was drawn specifically from the population (N), mathematically as follows:

Sample size (n) = $\frac{N}{1+N(e^2)}$ …………………………………………………Eqn. 1

Where:

N= Population of LNORB = 1,161,922; e = error margin = 5% or 0.05 in decimal; 1 = Constant

Hence, n = 400

Add attrition, 5% of 400 = 20

Therefore, Sample size (n) = 420.

Based on this sample population size (420), the questionnaire for this research was distributed.

Method of Data Analysis

Data analysis for this study involved both descriptive and inferential statistics.

Hypothesis 1 ($H_0 1$): There is no significant relationship between economic factors and social factors that affect wetland loss in the LNORB.

Hypothesis 2 ($H_0 2$): There is no significant relationship between economic factors and institutional factors that affect wetland loss in the LNORB.

In this study, the first and second hypotheses will be tested using Kendall's tau-b statistic. Kendall's tau-b is appropriate for both hypotheses given that it analyses the relationship between ordinal-ranked variables. The primary objective of this test is to determine the level of significance for the direction and strength of the correlation between the two variables in each case. Furthermore, keep in mind that each hypothesis's two ordinal-scaled variables are connected in a monotonic way. To find Kendall's tau-b (τB) coefficient, the formula below was applied:

$$\tau B = \frac{\mathrm{A} - \mathrm{B}}{\sqrt{(\mathrm{A} + \mathrm{B} + \mathrm{T_P}) * (\mathrm{A} + \mathrm{B} + \mathrm{T_Q})}} \text{ ………………………………………………… Eqn. 2}$$

Where:

A = concordant pairs; B = discordant pairs; T_P = tied cases of variable P;

T_Q = tied cases of variable Q

Hypothesis 3 ($H_0 3$): There is no significant variation in environmental factors that affect wetland loss in the LNORB.

In identifying environmental factors that affect wetland loss in the LNORB, Principal Component Analysis (PCA) was applied to the 23 environmental factor variables. Given that the sample size is sizable and the two sets of variables have a sufficient amount of correlation, PCA was appropriate. The linearity of the variables will be interpreted, and the components preserved using PCA's scatter plots of the data sets, Kaiser-Meyer-Olkin (KMO) Measure of Sampling Adequacy, and Bartlett's test of Sphericity were also employed.

Validity and Reliability of Research Instrument

To validate the study's research questionnaire, it was reviewed by the project supervisors and a statistician. Statistical analysis of the pilot study results from 40 respondents, using Cronbach's test of validity, had a Cronbach's Alpha value of 0.994 for the questionnaire items.

4. RESULTS

Following the data obtained from the field, the researcher hereby presents the study results and analyses arising therefrom.

Table 1. Regularity of wetland use for economic, environmental, and social needs in the Lower Niger-Orashi basin (LNORB)

Regularity	Frequency	Percent	Cumulative Percent
Weekly	285	86.1	86.1
Fortnightly	29	8.8	94.9
Once a month	14	4.2	99.1
Once in 7 – 12 months	3	0.9	100
Total	331	100	

Table 1 shows the regularity with which respondents use the wetland in the lower Niger-Orashi basin (LNORB) regarding their economic, environmental, and social needs. Respondents on weekly need are 285 or 86.1%, while those who need it fortnightly are 29 or 8.8%. Respondents needing it once a month and once in 7-12 months are represented by 14 or 4.2% and 3 or 0.9%, respectively. The analysis above indicates that the LNORB regularly provides for the economic, environmental, and social needs of the people within its area of influence.

Table 2. Rankings of economic factors affecting wetland loss in LNORB

Variables	Very Low [*n* (%)] 1	Low [*n* (%)] 2	High [*n* (%)] 3	Very High [*n* (%)] 4	Min.	Max.	Mean	Std. Dev.	Ranks
Food cost	16 (4.8%)	31 (9.4%)	166 (50.2%)	118 (35.6%)	1	4	3.17	.786	4
Building materials cost	17 (5.1%)	29 (8.8%)	202 (61%)	83 (25.1%)	1	4	3.06	.736	5
Potable water use	20 (6%)	24 (7.3%)	131 (39.6%)	156 (47.1%)	1	4	3.28	.843	1
Domestic water use	18 (5.4%)	26 (7.9%)	164 (49.5%)	123 (37.2%)	1	4	3.18	.797	3
Commercial water use	167 (50.5%)	126 (38.1%)	27 (8.2%)	11 (3.3%)	1	4	1.64	.771	13
Tree logging activities	11 (3.3%)	21 (6.3%)	191 (57.7%)	108 (32.6%)	1	4	3.20	.697	2
Transportation	166 (50.2%)	107 (32.3%)	39 (11.8%)	19 (5.7%)	1	4	1.73	.883	11
Sand mining	76 (23%)	49 (14.8%)	132 (39.9%)	74 (22.4%)	1	4	2.62	1.071	8
Other raw materials	74 (22.4%)	91 (27.5%)	99 (29.9%)	67 (20.2%)	1	4	2.48	1.051	9
Fishing	130 (39.3%)	107 (32.3%)	59 (17.8%)	35 (10.6%)	1	4	2.00	.998	10
Lodging facilities	176 (53.2%)	112 (33.8%)	36 (10.9%)	7 (2.1%)	1	4	1.62	.763	14
Boat expeditions	194 (58.6%)	96 (29%)	35 (10.6%)	6 (1.8%)	1	4	1.56	.754	15
Aquatic research	201 (60.7%)	96 (29%)	29 (8.8%)	5(1.5%)	1	4	1.51	.719	16
Water access fees	304 (91.8%)	27 (8.2%)	-	-	1	4	1.08	.274	17
Security cost	173 (52.3%)	110 (33.2%)	39 (11.8%)	9 (2.7%)	1	4	1.65	.793	12
Employment creation	22 (6.6%)	35 (10.6%)	222 (67.1%)	52 (15.7%)	1	4	2.92	.724	7
Population increase	32 (9.7%)	49 (14.8%)	158 (47.7%)	92 (27.8%)	1	4	2.94	.901	6

From Table 2, showing the ranking of economic variable factors affecting wetland loss in LNORB, it can be seen that potable water use ranked highest with a mean score of 3.28. This is followed by tree logging activities with a mean score of 3.20. Other rankings are as shown in the table, with the water access fee ranking lowest with a mean score of 1.08.

Table 3. Rankings of environmental factors affecting wetland loss in LNORB

Variable	Very Low [*n* (%)]	Low [*n* (%)]	High [*n* (%)]	Very High [*n* (%)]	Min.	Max.	Mean	Std. Dev.	Ranks
Farm practices	16 (4.8%)	32 (9.7%)	155 (46.8%)	128 (38.7%)	1	4	3.19	.801	1
Climate regulation	74 (22.4%)	93 (28.1%)	102 (30.8%)	62 (18.7%)	1	4	2.46	1.036	7
Weather control	151 (45.6%)	106 (32%)	45 (13.6%)	29 (8.8%)	1	4	1.85	.961	14
Carbon sequestration	159 (48%)	113 (34.1%)	38 (11.5%)	21 (6.3%)	1	4	1.76	.891	13
Extreme events	128 (38.7%)	94 (28.4%)	60 (18.1%)	49 (14.8%)	1	4	2.09	1.075	11
Water flow regulation	194 (58.6%)	98 (29.6%)	31 (9.4%)	8 (2.4%)	1	4	1.56	.762	16
Sewage waste discharge	200 (60.4%)	70 (21.1%)	38 (11.5%)	23 (6.9%)	1	4	1.65	.936	15
Solid waste disposal	216 (65.3%)	74 (22.4%)	29 (8.8%)	12 (3.6%)	1	4	1.51	.803	17
Spawning grounds	113 (34.1%)	90 (27.2%)	74 (22.4%)	54 (16.3%)	1	4	2.21	1.085	9
Migratory species	134 (40.5%)	124 (37.5%)	45 (13.6%)	28 (8.5%)	1	4	1.90	.934	12
Accelerated Eutrophication	98 (29.6%)	89 (26.9%)	78 (23.6%)	66 (19.9%)	1	4	2.34	1.104	8
Industrial effluent discharge	95 (28.7%)	109 (32.9%)	93 (28.1%)	34 (10.3%)	1	4	2.20	.971	10
Sedimentation/Silting	35 (10.6%)	48 (14.5%)	148 (44.7%)	100 (30.2%)	1	4	2.95	.933	5
Fish depletion	160 (48.3%)	128 (38.7%)	28 (8.5%)	15 (4.5%)	1	4	1.69	.810	14
Hospital waste disposal	200 (60.4%)	113 (34.1%)	17 (5.1%)	1 (0.3%)	1	4	1.45	.608	19
Excessive Water Diversion	142 (42.9%)	117 (35.3%)	53 (16%)	19 (5.7%)	1	4	1.85	.893	12
Biodiversity protection	183 (55.3%)	145 (43.8%)	3 (0.9%)	-	1	4	1.46	.517	18
Wetland conservation	312 (94.3%)	19 (5.7%)	-	-	1	4	1.06	.233	20
Species invasion	86 (26%)	95 (28.7%)	93 (28.1%)	57 (17.2%)	1	4	2.37	1.048	6
Aquaculture practices	19 (5.7%)	35 (10.6%)	146 (44.1%)	131 (39.6%)	1	4	3.18	.838	2
Land reclamation	33 (10%)	50 (15.1%)	129 (39%)	119 (36%)	1	4	3.01	.955	3
Heavy metal accumulation	31 (9.4%)	64 (19.3%)	109 (32.9%)	127 (38.4%)	1	4	3.00	.977	4

Table 3 shows the ranking of environmental variables that affect wetland loss in LNORB. The table shows that farm practices ranked highest with a mean score of 3.19 and were closely followed by agricultural practices with a mean score of 3.18. Hospital waste disposal came last with a mean score of 1.06. Other rankings are as shown in the table.

Table 4. Rankings of social factors affecting wetland loss in the LNORB

Variable	Very Low [*n* (%)]	Low [*n* (%)]	High [*n* (%)]	Very High [*n* (%)]	Min.	Max.	Mean	Std. Dev.	Ranks
Aesthetics	153 (46.2%)	111 (33.5%)	43 (13%)	24 (7.3%)	1	4	1.81	.922	11
Sacredness	65 (19.6%)	82 (24.8%)	88 (26.6%)	96 (29%)	1	4	2.65	1.097	5
Spiritual needs	57 (17.2%)	81 (24.5%)	92 (27.8%)	101 (30.5%)	1	4	2.72	1.078	3
Recreation	147 (44.4%)	107 (32.3%)	51 (15.4%)	26 (7.9%)	1	4	1.87	.947	10
Tourism	106 (32%)	101 (30.5%)	73 (22.1%)	51 (15.4%)	1	4	2.21	1.057	7
Existential values	43 (13%)	77 (23.3%)	123 (37.2%)	88 (26.6%)	1	4	2.77	.985	2
Legacy values	53 (16%)	74 (22.4%)	122 (36.9%)	82 (24.8%)	1	4	2.70	1.014	4
Water sports	119 (36%)	93 (28.1%)	71 (21.5%)	48 (14.5%)	1	4	2.15	1.066	8
Health and safety	126 (38.1%)	124 (37.5%)	50 (15.1%)	31 (9.4%)	1	4	1.96	.953	9
Cultural values	37 (11.2%)	55 (16.6%)	130 (39.3%)	109 (32.9%)	1	4	2.94	.970	1
Waterborne diseases	99 (29.9%)	93 (28.1%)	94 (28.4%)	45 (13.6%)	1	4	2.26	1.032	6

Table 4 shows the ranking of variables of social factors influencing wetland loss in LNORB. It shows that cultural values with a mean score of 2.94 ranked highest among the tested variables, while aesthetics ranked least with a mean score of 1.81.

Table 5. Rankings of institutional factors affecting wetland loss in the LNORB

Variable	Very Low [*n* (%)]	Low [*n* (%)]	High [*n* (%)]	Very High [*n* (%)]	Min.	Max.	Mean	Std. Dev.
Taxation issues	157 (47.4%)	122 (36.9%)	47 (14.2%)	5 (1.5%)	1	4	1.70	.766
Task force activities	134 (40.5%)	116 (35%)	58 (17.5%)	23 (6.9%)	1	4	1.91	.923
Government bureaucracy	18 (5.4%)	47 (14.2%)	175 (52.9%)	91 (27.5%)	1	4	3.02	.797
Access control	142 (42.9%)	116 (35%)	50 (15.1%)	23 (6.9%)	1	4	1.86	.917
Government corruption	10 (3%)	26 (7.9%)	100 (30.2%)	195 (58.9%)	1	4	3.45	.767
Incentivization	39 (11.8%)	54 (16.3%)	113 (34.1%)	125 (37.8%)	1	4	2.98	1.007
Information awareness	62 (18.7%)	51 (15.4%)	94 (28.4%)	124 (37.5%)	1	4	2.85	1.122
Wetland regulations	241 (72.8%)	90 (27.2%)	-	-	1	4	1.27	.446
Environmental policies	146 (44.1%)	107 (32.3%)	56 (16.9%)	22 (6.6%)	1	4	1.86	.927
Political stability	97 (29.3%)	140 (42.3%)	65 (19.6%)	29 (8.8%)	1	4	2.08	.914
Security provision	150 (45.3%)	102 (30.8%)	47 (14.2%)	32 (9.7%)	1	4	1.88	.985
Technical capacity	50 (15.1%)	67 (20.2%)	88 (26.6%)	126 (38.1%)	1	4	2.88	1.084
Financial capacity	35 (10.6%)	49 (14.8%)	114 (34.4%)	133 (40.2%)	1	4	3.04	.987

Table 5 shows the ranking of variables of institutional factors affecting wetland loss in LNORB. The analysis shows that government corruption ranked highest with a mean score of 3.45, followed by financial capacity with a mean score of 3.04. Taxation issues, having a mean score of 1.70, ranked lowest.

Hypotheses Test Results

$H_0$1: There is no significant relationship between economic factors and social factors that affect the TEV of wetland loss in the LNORB

Table 6 shows the results of the 22 variables applied in testing the first hypothesis: 11 variables from Economic factors namely: [Food cost (ECON-1), Building materials cost (ECON-2), Potable water use (ECON-3), Domestic water use (ECON-4), Commercial water use (ECON-5), Tree logging activities (ECON-6), Transportation (ECON-7), Sand mining (ECON-8), Other raw materials (ECON-9), Fishing (ECON-10), Lodging facilities (ECON-11)] as well as 11 variables from social factors [Aesthetics (SOC-1), Sacredness (SOC-2), Spiritual needs (SOC-3), Recreation (SOC-4), Tourism (SOC-5), Existential values (SOC-6), Legacy values (SOC-7), Water sports (SOC-8), Health and safety (SOC-9), Cultural values (SOC-10), Water borne diseases (SOC-11)]. The results indicated that there was a total of one hundred and twenty-one (121) correlations among designated variables from economic and social factors affecting TEV of wetland loss in the study area. Overall, all the inter-correlated variables were statistically significant at the .05 level. Also, all inter-correlations were positive, indicating that an increase in one led to an increase in the other.

Table 6. Coefficients for the inter-correlation between Economic and Social factors affecting wetland loss in the LNORB

Variable	SOC-1	SOC-2	SOC-3	SOC-4	SOC-5	SOC-6	SOC-7	SOC-8	SOC-9	SOC-10	SOC-11
ECON-1	.721*	.829*	.847*	.730*	.689*	.815*	.773*	.755*	.735*	.881*	.765*
ECON-2	.688*	.793*	.791*	.696*	.680*	.822*	.780*	.721*	.708*	.806*	.717*
ECON-3	.760*	.823*	.826*	.751*	.701*	.794*	.763*	.750*	.728*	.805*	.754*
ECON-4	.723*	.820*	.836*	.730*	.683*	.816*	.765*	.747*	.730*	.869*	.751*
ECON-5	.893*	.753*	.751*	.863*	.751*	.746*	.741*	.816*	.809*	.720*	.780*
ECON-6	.712*	.801*	.820*	.724*	.676*	.799*	.763*	.756*	.723*	.876*	.742*
ECON-7	.923*	.803*	.786*	.900*	.749*	.769*	.783*	.822*	.840*	.732*	.798*
ECON-8	.592*	.578*	.594*	.584*	.659*	.595*	.658*	.637*	.590*	.601*	.622*

ECON-9	.880*	.871*	.862*	.863*	.791*	.858*	.850*	.823*	.847*	.839*	.850*
ECON-10	.862*	.875*	.879*z	.885*z	.788*	.886*z	.844*	.814*	.892*z	.818*	.855*
ECON-11	.851*	.773*	.761*	.841*	.671*	.739*	.742*	.752*	.786*	.722*	.733*

* = significant, p ≤ 0.05; **; ECON = Economic; SOC = Social.

All the correlation coefficients in Table 6 are above .500. Results show that ECON-7 (Transportation) had the highest coefficients of .923 and .900 with SOC-1 (Aesthetics) and SOC-4 (Recreation), respectively. Other inter-correlations with high coefficient values in Table 4.3.1 are: ECON-5/SOC-1 (.893), ECON-1/SOC-9 (.880), ECON-9/SOC-2 (.871), ECON-10/SOC-2 (.875), ECON-10/SOC-3 (.879), ECON-10/SOC-4 (.885), ECON-10/SOC-6 (.886), ECON-10/SOC-9 (.892), ECON-1/SOC-10 (.881). On that note, H_01 is rejected since the calculated significance levels of most of the correlations in Table 6 are less than the .05 alpha level. This implies that there is a significant relationship between economic factors and social factors that affect the TEV of wetland loss in the LNORB.

H_02: There is no significant relationship between economic factors and institutional factors that affect the TEV of wetland loss in the LNORB

Table 7 shows the results of the 22 variables applied in testing the second hypothesis: 11 variables from Economic factors [Food cost (ECON-1), Building materials cost (ECON-2), Potable water use (ECON-3), Domestic water use (ECON-4), Commercial water use (ECON-5), Tree logging activities (ECON-6), Transportation (ECON-7), Sand mining (ECON-8), Other raw materials (ECON-9), Fishing (ECON-10), Lodging facilities (ECON-11)] as well as 11 variables from institutional factors: [Taxation issues (INS-1), Task force activities (INS-2), Government bureaucracy (INS-3), Access control (INS-4), Government corruptionINS-5), Incentivization (INS-6), Information awareness (INS-7), Wetland regulations (INS-8), Environmental policies (INS-9), Political stability (INS-10), Security provision (INS-11)]. The results indicate that there was a total of one hundred and twenty-one (121) correlations among designated variables from economic and social factors affecting TEV of wetland loss in the LNORB. Overall, all the inter-correlated variables were statistically significant at the .05 level. Also, all inter-correlations were positive, indicating that an increase in one bivariate variable led to an increase in the other.

Table 7. Coefficients for the inter-correlation between Economic and Institutional factors affecting wetland loss in the LNORB

Variable	INS-1	INS-2	INS-3	INS-4	INS-5	INS-6	INS-7	INS-8	INS-9	INS-10	INS-11
ECON-1	.715*	.721*	.854*	.724*	.729*	.855*	.408*z	.712*	.732*	.760*	.668*
ECON-2	.684*	.679*	.895*	.713*	.660*	.724*	.325*z	.703*	.733*	.759*	.599*
ECON-3	.778*	.738*	.761*	.744*	.828*	.794*	.459*z	.584*	.751*	.728*	.727*
ECON-4	.721*	.722*	.834*	.723*	.736*	.849*	.389*z	.697*	.732*	.752*	.672*
ECON-5	.880*	.826*	.683*	.804*	.702*	.719*	.498*	.596*	.781*	.765*	.874*
ECON-6	.701*	.704*	.845*	.716*	.687*	.786*	.407*	.746*	.726*	.741*	.651*
ECON-7	.936*	.842*	.708*	.885*	.695*	.723*	.427*	.678*	.879*	.780*	.778*
ECON-8	.587*	.588*	.626*	.562*	.509*	.553*	.764*	.450*	.544*	.609*	.616*
ECON-9	.867*	.835*	.816*	.842*	.766*	.813*	.461*	.604*	.820*	.845*	.805*
ECON-10	.851*	.842*	.798*	.913*	.755*	.784*	.415*	.679*	.914*	.848*	.707*
ECON-11	.865*	.787*	.691*	.825*	.672*	.724*	.338*z	.696*	.849*	.722*	.695*

* = significant, p ≤ 0.05; **; ECON = Economic; INS = Institutional.

Most intercorrelation coefficients in Table 7 are above .500. Only ten intercorrelations were below .500. These were between ten out of the eleven economic factors in the analysis and INS-7 (Information awareness). Results show that ECON-7 (Transportation) had the highest coefficient in Table 4.3.2, with its correlation with INS-1 (Taxation issues) with a coefficient of .936. Also, ECON-10 (Fishing) had correlation coefficients of .913 and .914 with INS-4 (Access control) and INS-9 (Environmental policies), respectively. Other inter-correlations with high coefficient values in Table 4.3.2 are: ECON-

2/INS-3 (.895), ECON-7/INS-4 (.885), ECON-5/INS-1 (.880), ECON-7/INS-9 (.879), ECON-5/INS-11 (.874), ECON-9/INS-1 (.867), ECON-11/SOC-1 (.865), ECON-1/INS-6 (.855), ECON-1/INS-3 (.854), ECON-10/INS-1 (.851). On that note, H_02 is rejected since the calculated significant levels of most of the correlations are less than the .05 Alpha level. This implies that there is a significant relationship between economic factors and institutional factors that affect the TEV of wetland loss in the LNORB.

H_03: There is no significant variation in environmental factors that affect the Total Economic Value of wetland loss in the lower Niger – Orashi basin.

The 22 environmental factors [Farm practices (ENV_01), Climate regulation (ENV_02), Weather control (ENV_03), Carbon sequestration (ENV_04), Extreme events (ENV_05), Water flow regulation (ENV_06), Sewage waste discharge (ENV_07), Solid waste disposal (ENV_08), Spawning grounds (ENV_09), Migratory species (ENV_10), accelerated enrichment/Eutrophication (ENV_11), Industrial effluent discharge (ENV_12), Sedimentation/Silting (ENV_13), Fish depletion (ENV_14), Hospital waste disposal (ENV_15), Excessive Water Diversion (ENV_16), Biodiversity protection (ENV_17), Wetland conservation (ENV_18), Species invasion (ENV_19), Aquaculture practices (ENV_20), Land reclamation (ENV_21), Heavy metal accumulation (ENV_22)]that affect TEV of wetland loss were analysed using PCA to discover if there is significant variation in its structure. In order to determine whether the dataset satisfied the presumptions regarding the number of variables, sampling suitability, and data linearity, it was first determined that environmental factors in the analysis are multivariate, making them appropriate for PCA. Table 8 shows that each variable has a Kaiser-Mayer-Olkin (KMO) measure of sampling adequacy score of.961, which is fitting for PCA.

Table 8. KMO and Bartlett's Test in the PCA

Kaiser-Meyer-Olkin Measure of Sampling Adequacy		.961
Bartlett's Test of Sphericity	**Approximate Chi-Square**	14498.242
	Difference	231
	Significance	.000

Furthermore, Table 8 shows that Bartlett's test of sphericity was statistically significant: $\chi 2$ (231) = 14498.242, p =.000. As a result, the PCA could use the KMO and Bartlett test results. The number of components to be preserved was selected using the scree plot test, the eigenvalue-one (Kaiser) criterion, the extracted loadings proportion of total variance accounted for, and the interpretability criterion. Each component's PCA eigenvalue indicates the proportion of variation that can be accounted for by that component. The Kaiser criterion, sometimes referred to as the eigenvalue-one criterion, states that components are not allowed to be kept unless their eigenvalue score is at least 1. PCA's initial extraction using the Equamax technique yielded two components with an eigenvalue of at least one. Furthermore, since the scree plot (see Figure 2) supported extracting two components, a two-component extraction looked more acceptable. The variation explained by components with at least one eigenvalue score is shown in Table 9 following PCA extraction.

Table 9. Extracted loading with eigenvalues of at least one in the PCA

Component	**Extraction Sums of Squared Loadings**		
	Total	**% of Variance**	**Cumulative %**
1	17.345	78.841	78.841
2	1.816	8.253	87.094

After extraction using PCA, Table 9 shows that two out of the 22 components had eigenvalues of at least 1. The PCA scree plot showing a graph of eigenvalues of Environmental factors affecting TEV of wetland loss against their respective components is displayed in Figure 2, with the deflection zone noticeably demonstrated.

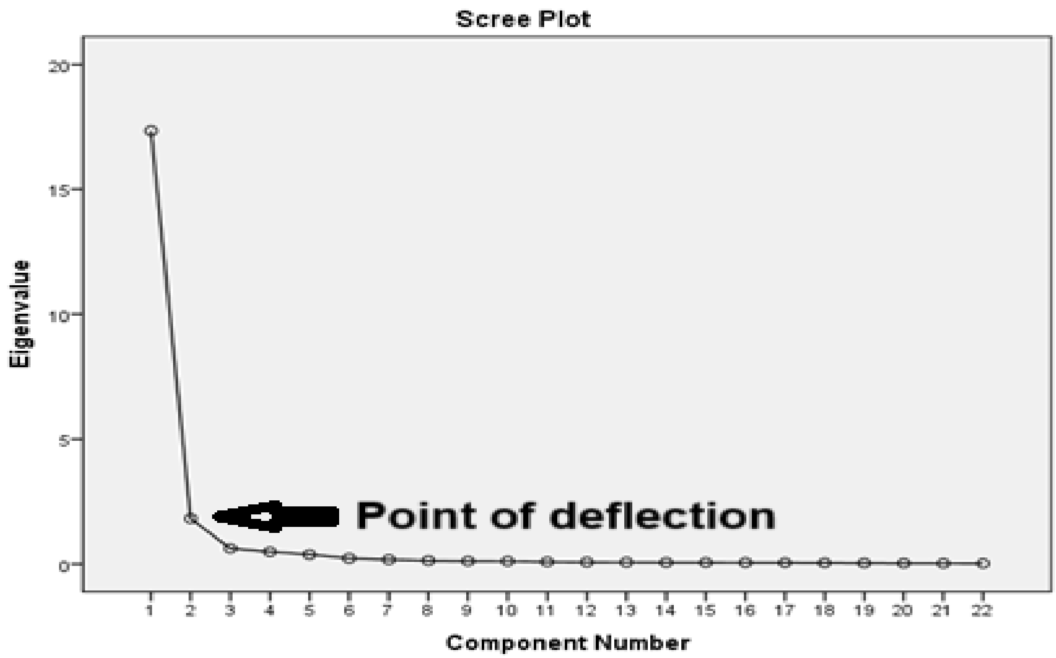

Figure 2. Scree plot showing eigenvalues

Eigenvalues following the second component (the point of deflection) did not differ much, as shown by the scree plot in Figure 2. The scree plot test, therefore, presumes that the first two elements ought to be retained. To determine the interpretability requirement, the "simple structure" idea is employed. PCA became easier to comprehend as a result of its two-component structure. In light of this, the rotated component matrix table (refer to Table 10) illustrates how these two elements were able to provide the simple framework required for the interpretation of PCA.

Table 10. Rotated Component Matrix with communalities for the two components of the PCA

Variable	**Details**	**Components**		**Communalities**
		1	**2**	
ENV__01	Farm practices	**.882**	.288	.862
ENV_02	Climate regulation	**.809**	.514	.918
ENV_05	Extreme events	**.681**	.620	.848
ENV_09	Spawning grounds	**.745**	.606	.922
ENV_11	Accelerated enrichment/Eutrophication	**.786**	.559	.931
ENV_12	Industrial effluent discharge	**.641**	.623	.799
ENV_13	Sedimentation/Silting	**.886**	.285	.866
ENV_17	Biodiversity protection	**.682**	.553	.772
ENV_19	Species invasion	**.799**	.523	.912
ENV_20	Aquaculture practices	**.900**	.256	.876
ENV_21	Land reclamation	**.892**	.306	.889
ENV_22	Heavy metal accumulation	**.914**	.298	.924
ENV_03	Weather control	.581	**.759**	.915
ENV_04	Carbon sequestration	.564	**.747**	.876
ENV_06	Water flow regulation	.481	**.811**	.888
ENV_07	Sewage waste discharge	.414	**.812**	.831
ENV_08	Solid waste disposal	.398	**.859**	.896
ENV_10	Migratory species	.591	**.746**	.905
ENV_14	Fish depletion	.506	**.812**	.914
ENV_15	Hospital waste disposal	.496	**.781**	.855
ENV_16	Excessive Water Diversion	.554	**.749**	.869
ENV_18	Wetland conservation	-.062	**.829**	.690

The PCA's rotated component matrix and respective communalities for the 22 environmental factors affecting TEV of wetland loss in the LNORB are shown in Table 10. Emboldened factor loadings are those that are heavily loaded on either of the two components for relevant environmental factors in the analysis. The findings reveal that PCA of environmental factors affecting TEV of wetland loss is divided into two parts, with component 1 strongly loading on twelve variables (ENV_01:Farm practices, ENV_02: Climate regulation, ENV_05: Extreme events, ENV_09: Spawning grounds, ENV_11: Accelerated enrichment/Eutrophication, ENV_12: Industrial effluent discharge, ENV_13: Sedimentation/Silting, ENV_17: Biodiversity protection, ENV_19: Species invasion, ENV_20: Aquaculture practices, ENV_21: Land reclamation, ENV_22: Heavy metal accumulation). The variable on Heavy metal accumulation (ENV_22) had the highest factor loading score, .914. Out of these twelve variables were highly loaded on component 1; this was also the highest factor loading in the entire rotated component matrix in Table 4.3.5. However, the variable on .641 (ENV_12) had the lowest factor loading under component 1, with a score of .641; this was also the lowest factor loading in the entire rotated component matrix. Furthermore, component 2 strongly loaded with ten environmental factors affecting TEV of wetland loss in the study area (ENV_03: Weather control, ENV_04: Carbon sequestration, ENV_06: Water flow regulation, ENV_07: Sewage waste discharge, ENV_08: Solid waste disposal, ENV_10: Migratory species, ENV_14: Fish depletion, ENV_15: Hospital waste disposal, ENV_16: Excessive Water Diversion, ENV_18: Wetland conservation). The variable on Solid waste disposal (ENV_08) had the highest factor loading score among the heavily loaded variables to component 2 at .859. Also, the environmental factor on Migratory species (ENV_10) had the lowest factor loading under component 2, with a score of .746. In terms of communalities for the 22 environmental factors considered in the PCA, ENV_11 (Accelerated enrichment/Eutrophication) and ENV_22 (Heavy metal accumulation) had the largest variance explained, with communality scores of.914 and.924 respectively (see Table 4.3.5). On that note, $H0_3$ is rejected since the PCA shows a two-component structure in its rotated component matrix. Therefore, there is significant variation in environmental factors that affect the TEV of wetland loss in LNORB.

Discussion of findings

The findings of this study provide empirical evidence that the Total Economic Value (TEV) of wetland loss in the Lower Niger–Orashi Basin (LNORB) is influenced by interconnected economic, environmental, social, and institutional factors. The study extends previous research by quantitatively demonstrating that wetland loss cannot be explained by a single category of drivers but rather by the interaction among multiple dimensions. This supports the view that wetlands are multifunctional ecosystems whose ecological integrity, economic benefits, and social values are inseparable.

The finding that 86.1% of respondents utilize wetlands on a weekly basis demonstrates the high level of dependence of rural communities on wetland resources for their livelihoods and well-being. This confirms the assertion of Finlayson et al. (2005) that wetlands provide indispensable ecosystem services, including water supply, food production, flood regulation, and livelihood support, particularly in low-income communities where technological alternatives are limited.

Regarding the economic factors affecting wetland loss, potable water use emerged as the most important factor, followed by tree logging activities, domestic water use, food cost, and building material demand. These findings indicate that communities rely heavily on wetlands as primary sources of freshwater and natural resources. This supports the observations of Ayanlade and Proske (2016), who reported that increasing human dependence on wetland resources intensifies ecosystem degradation through excessive resource extraction and nutrient loading. Similarly, the high ranking of tree logging confirms the findings of Zhang et al. (2021) and Schnaiberg et al. (2002), who identified anthropogenic activities as major drivers of wetland degradation globally.

The environmental findings further demonstrate that farm practices, aquaculture activities, land reclamation, heavy metal accumulation, and sedimentation are the most significant environmental drivers of wetland loss. The prominence of agricultural activities confirms earlier reports by Sarkar et al. (2020), who identified agricultural expansion as one of the major drivers of tropical wetland degradation. The high ranking of heavy metal accumulation suggests increasing environmental pollution within the basin, particularly in an oil-producing region where industrial activities may contribute contaminants to wetland ecosystems. This finding is consistent with Jibiri and Eke (2021), who reported increasing environmental stress associated with oil exploration activities in the Niger Delta.

The study also reveals that cultural values, spiritual needs, existential values, and legacy values constitute the most important social factors influencing the TEV of wetland loss. This finding demonstrates that wetlands possess significant non-market values beyond their direct economic functions. It supports the TEV framework, which emphasizes both use and non-use values of environmental resources. The result agrees with Verhoeven and Setter (2010), who argued that greater awareness of the economic and social values of wetlands promotes stronger conservation behaviour. Similarly, the importance attached to cultural and spiritual values reflects the traditional relationship between rural communities and wetlands in the Niger Delta, where wetlands often serve as sacred sites, cultural heritage locations, and symbols of community identity. However, aesthetics and recreation ranked relatively low, suggesting that respondents prioritize livelihood and cultural functions over leisure-related uses.

Institutional factors also emerged as important determinants of wetland loss. Government corruption recorded the highest mean score, followed by financial capacity, government bureaucracy, incentivization, technical capacity, and information awareness. These findings suggest that institutional weaknesses significantly undermine wetland conservation in the LNORB. The high ranking of financial and technical capacity further suggests that effective wetland management requires adequate institutional resources and skilled personnel. Interestingly, wetland regulations received one of the lowest rankings, implying that existing regulations may either be poorly enforced or inadequately implemented.

The first hypothesis examined the relationship between economic and social factors affecting the TEV of wetland loss. The findings revealed strong, positive, and statistically significant correlations among all economic and social variables, leading to the rejection of the null hypothesis. These results demonstrate that economic dependence on wetlands is closely associated with their social and cultural significance. Activities such as food production, water use, transportation, and fishing are directly linked to cultural values, recreation, spiritual needs, and community identity.

The second hypothesis investigated the relationship between economic and institutional factors. The study found statistically significant positive correlations across almost all variables, resulting in the rejection of the null hypothesis. This finding indicates that institutional conditions strongly influence the extent to which economic activities contribute to wetland loss. Weak governance structures, bureaucratic inefficiencies, corruption, and inadequate policy implementation appear to facilitate unsustainable exploitation of wetland resources.

The third hypothesis examined whether significant variation exists among environmental factors affecting the TEV of wetland loss. Principal Component Analysis revealed a two-component structure explaining approximately 87.1% of the total variance, indicating substantial variation among environmental drivers. These findings demonstrate that environmental factors influencing wetland loss can be broadly categorized into direct anthropogenic disturbance and ecological regulatory processes. Also, high communalities recorded for eutrophication and heavy metal accumulation further indicate that pollution-related factors account for a substantial proportion of environmental degradation within the basin.

5. CONCLUSION

This study examined the factors influencing the Total Economic Value (TEV) of wetland loss in the Lower Niger–Orashi Basin (LNORB) by investigating the economic, environmental, social, and institutional dimensions of wetland degradation. The findings demonstrate that wetlands are critical natural resources that sustain livelihoods, provide essential ecosystem services, and support the socio-cultural well-being of communities within the basin. The study further established that wetland loss is driven primarily by anthropogenic activities, particularly intensive resource use, agricultural expansion, land reclamation, pollution, and weak institutional governance.

The hypotheses tests confirmed significant relationships between economic and social factors as well as between economic and institutional factors affecting the TEV of wetland loss. In addition, the Principal Component Analysis revealed significant variation in the environmental factors influencing wetland degradation, highlighting the complex and multidimensional nature of wetland ecosystems. Overall, the study concludes that safeguarding the total economic value of wetlands in the LNORB requires an integrated management approach that balances economic development with environmental protection, effective institutional governance, and community participation.

The findings suggest the need for stronger institutional frameworks for wetland management within the Lower Niger–Orashi Basin. Government agencies should strengthen the enforcement of existing environmental regulations, improve transparency and accountability in wetland governance, and ensure that development activities such as land reclamation, logging, and resource extraction are subjected to effective environmental monitoring and compliance mechanisms.

There is also a need to promote sustainable livelihood practices that reduce dependence on unsustainable wetland resource exploitation. Governments, development partners, and local communities should encourage sustainable agriculture, responsible forestry practices, and alternative income-generating opportunities while implementing continuous environmental education programmes to increase public awareness of the ecological, economic, and socio-cultural importance of wetlands.

Finally, wetland conservation should be fully integrated into regional development and environmental planning. Policymakers should prioritize wetland protection in land-use planning, climate change adaptation, and infrastructure development while providing adequate financial and technical support for wetland restoration, ecological monitoring, and collaborative research to ensure the long-term sustainability of the Lower Niger–Orashi Basin's wetland ecosystems.

6. COMPETING INTEREST

None to declare

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