Assessing Wetland Services in the Niger Delta, Nigeria

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Abstract

Man's perception about wetland has drastically changed from viewing the ecosystem as wasteland that can only be drained or sandfilled for economic uses. Apart from performing functional values, wetlands offer services that are both beneficial to man and the environment. In the light of this, the study examined wetland services in the Niger Delta, Nigeria. Out of the one hundred and twenty (120) questionnaire administered on the respondent Estate Surveyors and Valuers in the study area, seventy-two (72) were retrieved out which fifty-five (55) respondents reported that they had participated in wetland valuation assignment in time past. It was these 55 that were used for analysis in the study. The study revealed that the components of wetland environment that are capable of assessment, using the market support approaches are mostly valued in the Niger Delta. It further revealed that flood control (RII = 3.81), cultural heritage (RII = 3.80), spiritual and inspiration (RII = 3.60) and erosion regulation (RII = 3.42) are very important services in the Niger Delta. Based on these findings, the study therefore recommends that Estate Surveyors and Valuers should give consideration to the services performed by wetlands when conducting valuation within such ecosystems.

Keywords: Compensation, Niger Delta, Valuation, Wetland Ecosystems, Wetland Services

Introduction

Wetland ecosystems, which are an important environmental/natural resource, form part of the total wealth of a nation. However, because many of its services are not traded in the open market and their values are not captured using the conventional approaches to valuation, they are usually ignored in the systems of national accounts. As a result, conventional measures of wealth give incorrect indications of the state of its well-being, leading to misinformed policy actions, poorly informed decision-making, or ill-advised strategic social choices, especially for compensation purposes. Until recently, wetlands were often viewed as wastelands, useful only when drained or sandfilled and converted to uses supported by economic principles. However, it is now well known that wetlands benefit people and the natural world in remarkable ways.

Wetlands which were historically viewed as waste of valuable land that could be improved through drainage and destruction (Mitsch and Gosselink, 1986), are widely recognised today for providing valuable ecological services (Woodward and Wui, 2001). It is on this background that this study examined wetland services in the Niger Delta, Nigeria.

The capacity of an ecosystem to provide services in a sustainable manner depends on the biotic and abiotic characteristics which should be quantified with ecological, biophysical or other indicators.

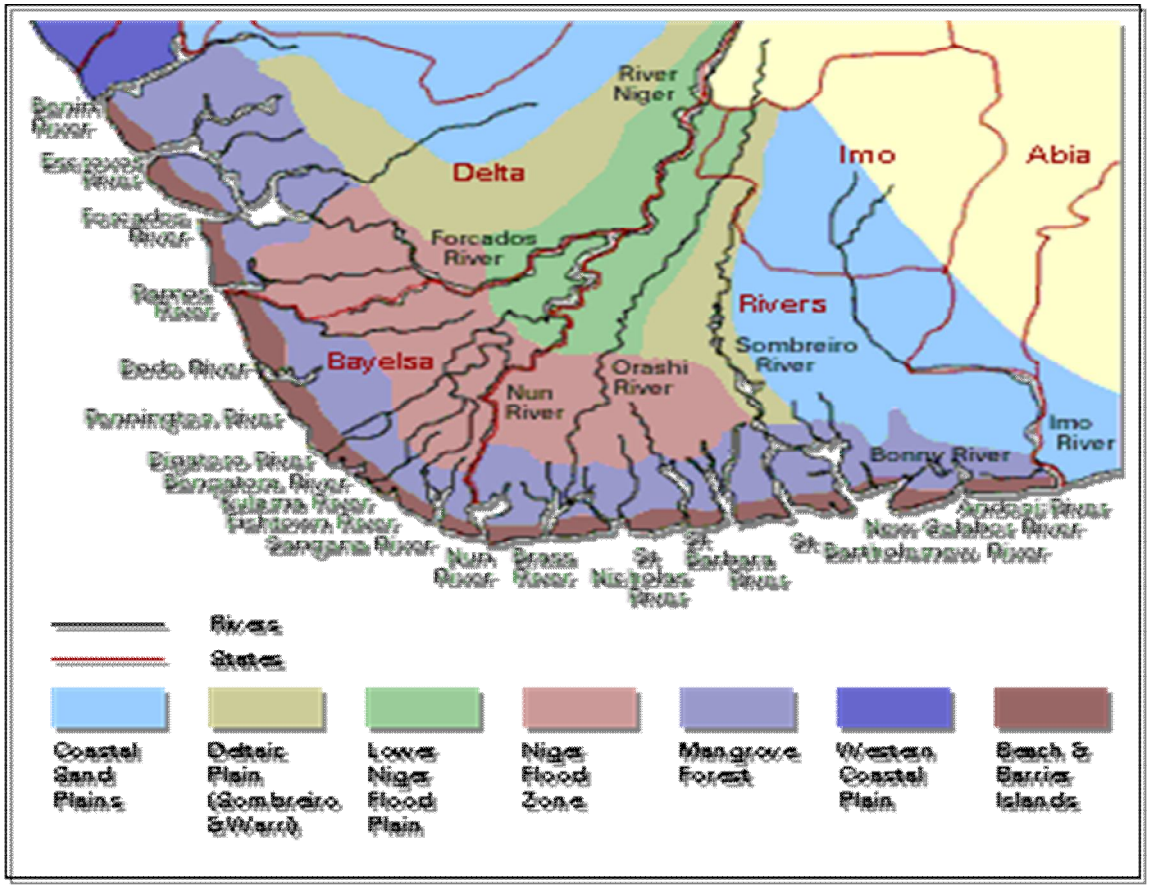
The ecosystem services are the benefits people obtain from ecosystem processes and non-material uses (Millennium Ecosystem Assessment, 2003). These beneficial outcomes result from wetland functions (e.g., better fishing and hunting, cleaner water, better views, and reduced human health risks and ecological risks). These require some interaction with, or at least some appreciation by humans. The types of potential services depend to some degree on the level of functions but predominantly on other factors (e.g., access, proximity to people).

The Niger Delta

The Niger-Delta area of Nigeria coincides approximately to the South-South geopolitical zone of the country (Fig I). The region is the most blessed deltas in the world, in both human and material resources but the unfavorable manner in which these resources are harnessed overtime, is the bane of the region's predicament. Before the discovery of crude oil, agriculture was the dominant occupation of the people. Crude oil was discovered in commercial quantity in the region specifically in the present Bayelsa State in 1956 (Omofonmwa and Odia, 2009). The Niger Delta covers 20,000 km² within wetlands of 70,000 km² formed primarily by sediment deposition. The Niger Delta is one of the world's 10 most important wetland and coastal marine ecosystems and is home to some 31 million people. This floodplain makes up 7.5% of Nigeria's total land mass. It is the largest wetland and maintains the third-largest drainage basin in Africa.

The Delta's environment can be broken down into four ecological zones: costal barrier islands, mangrove swamp forests, freshwater swamps, and lowland rainforests. This incredibly well-endowed ecosystem, which contains one of the highest concentrations of biodiversity on the planet, in addition to supporting abundant flora and fauna, arable terrain that can sustain a wide variety of crops, lumber or agricultural trees, and more species of fresh fish than any ecosystem in West Africa (Omofonmwa and Odia, 2009 and Wikipedia 2014) are still being undervalued. The spate of pollutions and environmental damage in the Niger Delta, (oil spills, disposal of waste, gas flaring, seismic surveys and the construction of roads and pipelines, dredging, inadequate clean up prolongs, and cumulative impact) calls for a paradigm shift in assessing (valuation) this important natural resource.

Fig. I: Map of Niger Delta, Nigeria



Source: http://www.waado.org/nigerdelta/Maps/NigerDelta_Rivers.html

Wetland Services

The overall economic value of a wetland is derived from the values associated with the services it is expected to provide overtime. Wetland services include any outcome that contributes to a generally accepted measure of human welfare, including recreational and educational opportunities, aesthetic, spiritual enrichment, and market-based goods and services. The services provided by wetlands include beneficial outcomes associated with biodiversity support, carbon sequestration, and water filtration (King and Mazzotta, 2000). While some services associated with functions, (biodiversity support or carbon sequestration) are not site dependent (i.e. does not depend on the location of the wetland) others such as those related to aesthetics and educational/recreational opportunities are highly site dependent.

For the purposes of valuing wetlands, it is useful to consider wetlands as "factories" of beneficial services. The capacity of wetland to provide these services is partially derived from its level of function and partially derived from location-specific. King and Mazzotta (2000) identify the various wetland services emanating from wetland functions and grouped them into active or passive services.

Millennium Ecosystem Assessment (2005) identifies the services provided by or derived from wetlands, putting them under four main categories as contained in Table 1

Table 1: Ecosystem Services Provided by or Derived from Wetlands

	Wetlands Services	**Benefits to Human well-being**
Provisioning	Food	Production of fish, wild game, fruits and grains
	Fresh Water	Storage and retention of water for domestic, industrial and agricultural use
	Fiber and fuel	Production of logs, fuelwood, peat, fodder
	Biochemical	Extraction of medicines and other materials from biota
	Genetic Materials	Genes for resistance to plant pathogens; ornamental species, etc.
Regulating	Climate regulation	Source of and sink for greenhouse gases; influence local and regional temperature, precipitation and other climatic processes
	Water regulation (Hydrological flows)	Ground water recharge/discharge
	Water purification and waste treatment	Retention, recovery, and removal of excess nutrients and other pollutants
	Erosion regulation	Retention of soils and sediments
	Natural hazard regulation	Flood control, storm protection
	Pollination	Habitat for pollinators
Cultural	Spiritual and inspirational	Source of inspiration; many religions attach spiritual and religious values to aspects of wetland ecosystems
	Recreational	Opportunities for recreational activities
	Aesthetic	Many people find beauty or aesthetic value in aspects of wetland ecosystem
	Educational	Opportunities for formal and informal education and training
Supporting	Soil formation	Sediment retention and accumulation of organic matter
	Nutrient cycling	Storage, recycling, and acquisition of nutrients

Source: Adapted from Millennium Ecosystem Assessment (2005)

In assessing the value of wetland services, three categories of values were established thus; ecological values (Farber, Constanza and Wilson, 2002 and Millennium Ecosystem Assessment, 2003), socio-cultural values (Millennium Ecosystem Assessment, 2003) and economic values (Turner, et al. 2003, Seidl, and Moraes, 2000 and Straton, 2006).

Factors Affecting Wetland Services

According to a report prepared by Natural Resources Agency of California (2010) wetlands are celebrated world-wide for the many services they provide. They help regulate climate, store surface water, control pollution and flooding, replenish aquifers, promote nutrient cycling, protect shorelines, maintain natural communities of plants and animals, serve as critical nursery areas, and provide opportunities for education and recreation. No wetland provides all these services, and the level of any service varies among wetlands. The location of a wetland, its size, shape, source of water, ecological characteristics, and how it is managed determine the kinds and levels of service it can provide. Wetland services have not always been appreciated. Throughout most of recorded world history, wetlands were regarded as wastelands and problem areas to be drained or filled. Wetlands tend to form on flat lands that are easily developed if adequately drained.

Materials and Methods

In collecting data for this study both primary and secondary data were employed. While secondary data was used for literature aspect of the study, questionnaire was administered for the collection of primary data. Both descriptive and exploratory approaches were used for literature review, while explanatory approach was used in analysing the data collected.

Questionnaire was administered on the 120 Estate Surveying and Valuation firms in Bayelsa, Delta and Rivers States (as contained in the lists made available by the NIESV's Branch Secretaries in the three States). Out the questionnaire administered, seventy-two (72) were retrieved and of this, fifty-five (55) had taken part in wetland valuation at one time or the other and these were used for analyses carried out in the study. The data collected were collated, analysed and presented using tools such as frequency distributions and percentages, relative importance index (RII) and principal component analysis (PCA) with its diverse variants.

Results and Discussion

A total of 120 questionnaires were administered on respondent Estate Surveyors and Valuers out of which 72 were retrieved. However, only 55 of them had been involved in wetland valuation and these were used for the purpose of analysis as contained in Tables 2 – 8.

Table 2: Involvement in Wetland Valuation Exercises

Wetland Valuation Exercise	Frequency	Percentage
No	17	23.6
Yes	55	76.4
Total	72	100.0

Results as contained in Table 2 reveal that majority of the respondent Estate Surveyors and Valuers (76.4%) have at one time or the other participated in wetland valuation. This situation is not unexpected since a chunk of the Niger Delta land consists of wetlands and a high proportion of these have either been acquired by multinational oil companies or their activities have resulted in the pollution of wetland ecosystems and valuation is usually required to determine the compensation payable to the affected people or community as the case may be. The high rate (76.4%) of participation in wetland valuation by Estate Surveyors and Valuers in the study area could be due to incessant oil spillages and physical development resulting from continuous expansion of companies involved in oil exploration.

Table 3: What Estate Surveying and Valuation Firms Valued

What was Valued	Responses	
	No	Yes
Attributes	41 (74.5%)	14 (25.5%)
Functions	39 (70.9%)	16 (29.1%)
Land	21 (38.2%)	34 (61.8%)
Buildings	47 (85.5%)	8 (14.5%)
Services	35 (63.6%)	20 (36.4%)
Crops	11 (20.0%)	44 (80.0%)

Table 3 shows that 80.0% of the respondents valued crops and 61.8% valued land, the components of wetland environment that are capable of assessment, using the market support approaches. Other components that are not traded in the open market (attributes, functions and services) were rarely valued by respondent Estate Surveyors and Valuers. This could be attributable to the non-recognition of such components by NIESV guidance notes on property valuation. The preponderance of valuation of crops and land within wetland sites in the study area can be attributable to the incessant conversion of wetland sites to other uses, supported by economic justifications and pollution of wetland resources due to oil spills and gas flaring, regular occurrences in the Niger Delta region. This could also result from the compensation provisions in the Land Use Act 1978, Oil Pipelines Act 1990 and 1999 Constitution which all provided for compensation on land, buildings and crops or profitable trees at the expense of wetland components.

Table 4: Wetlands Services

	Responses	
Services	**No**	**Yes**
Food Supply	22 (40.0%)	33 (60.0%)
Freshwater Supply	37 (67.3%)	18 (32.7%)
Raw materials for production	29 (52.7%)	26 (47.3%)
Climate regulation	15 (27.3%)	40 (72.7%)
Groundwater recharge	32 (58.2%)	23 (41.8%)
Erosion control	11 (20.0%)	44 (80.0%)
Flood control	11 (20.0%)	44 (80.0%)
Cultural heritage and amenity	11 (20.0%)	44 (80.0%)
Spiritual and Inspiration	18 (32.7%)	37 (67.3%)
Recreational	37 (67.3%)	18 (32.7%)
Educational	47 (85.5%)	8 (14.5%)
Aesthetic	44 (80.0%)	11 (20.0%)

A look at Table 4 reveals that erosion control (80.0%), flood control (80.0%), cultural heritage (80.0%), climate regulation (73.6%) and spiritual and inspiration (67.3%) are the prominent services provided by wetlands in the Niger Delta region. The choice of erosion and flood control services might not be unconnected with the fact that the study area is always prone to annual flooding and the adverse effects that would have been suffered are usually curtailed, to some extent, through temporary retention of flood water in the wetlands region. The presence of shrubs and other trees within wetland environment reduces the damaging effects of erosion on both top soil and properties near and within wetland environments. Wetland sites are always centres for traditional religious and spiritual activities, hence the choice of cultural heritage and spiritual and inspiration were to take care of the religious and spiritual attachment that people have with the wetland sites. Climate regulation was also chosen, taking into consideration that Nigeria, as a whole, is a tropical region with high temperature all the year round, and wetland sites in the study area serve the purpose of dousing the adverse effects of heat on the region. The choice of food supply (58.3%) is not unexpected as the people of the region depend on the wetlands for their livelihood.

Table 5: Ranking of Wetlands Services

Wetland Services	5	4	3	2	1	Total	RII	Ranking
Food Supply	12 a_in_i = 60	8 a_in_i = 32	16 a_in_i = 48	11 a_in_i = 22	8 a_in_i = 8	55 170	3.09	7th
Freshwater Supply	4 a_in_i = 20	16 a_in_i = 64	11 a_in_i = 33	16 a_in_i = 32	8 a_in_i = 8	55 157	2.85	9th
Raw materials for production	4 a_in_i = 20	18 a_in_i = 72	14 a_in_i = 42	11 a_in_i = 22	8 a_in_i = 8	55 164	2.98	8th
Climate regulation	9 a_in_i = 45	23 a_in_i = 92	11 a_in_i = 33	3 a_in_i = 6	9 a_in_i = 9	55 185	3.36	5th
Groundwater recharge	8 a_in_i = 40	18 a_in_i = 72	14 a_in_i = 42	8 a_in_i = 16	7 a_in_i = 7	55 177	3.22	6th
Erosion regulation	16 a_in_i = 80	21 a_in_i = 84	3 a_in_i = 9	0 a_in_i = 0	15 a_in_i = 15	55 188	3.42	4th
Flood control	24 a_in_i = 120	18 a_in_i = 72	2 a_in_i = 6	1 a_in_i = 2	10 a_in_i = 10	55 210	3.81	1st
Cultural heritage and amenity	23 a_in_i = 115	15 a_in_i = 60	8 a_in_i = 24	1 a_in_i = 2	8 a_in_i = 8	55 209	3.80	2nd
Spiritual and inspiration	23 a_in_i = 115	10 a_in_i = 40	7 a_in_i = 21	7 a_in_i = 14	8 a_in_i = 8	55 198	3.60	3rd
Recreational	1 a_in_i = 5	9 a_in_i = 36	30 a_in_i = 90	11 a_in_i = 22	4 a_in_i = 4	55 157	2.85	9th
Educational	0 a_in_i = 0	6 a_in_i = 24	8 a_in_i = 24	24 a_in_i = 48	17 a_in_i = 17	55 113	2.05	10th
Aesthetic	0 a_in_i = 0	3 a_in_i = 12	9 a_in_i = 27	15 a_in_i = 30	28 a_in_i = 28	55 97	1.76	11th

Table 5 illustrates the ranking of wetland services by the respondents. Flood control, with RII of 3.81was ranked as the most important service provided by wetlands in the study area. This was followed by cultural heritage and amenity (RII = 3.80), spiritual and inspiration (RII = 3.60) and erosion regulation (RII = 3.42), which were ranked 2nd, 3rd and 4th respectively. The result in Table 5 could be due to the incessant flooding experienced and cultural and/or spiritual attachment to the creeks and water bodies in the study area.

Table 6: Communalities

	Initial	Extraction
Food Supply	1.000	.581
Freshwater Supply	1.000	.668
Raw Materials for Production	1.000	.578
Climate Regulation	1.000	.707
Groundwater Recharge	1.000	.669
Erosion Regulation	1.000	.832
Flood Control	1.000	.912
Cultural Heritage and Amenity	1.000	.572
Spiritual Inspiration	1.000	.639
Redreational	1.000	.797
Educational	1.000	.749
Aesthetic	1.000	.675
Extraction Method: Principal Component Analysis.		

Table 6 indicates the amount of variance in each variable that is accounted for i.e. it extracts only that proportion that is due to the common factors and shared by several items. Initial communalities are estimates of the variance in each variable accounted for by all component or factors. Extraction communalities are estimates of the variance in each variable accounted for by the components. The communalities in Table 6 are all high indicating that the extracted components represent the variables well.

Table 7: Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	2.793	23.277	23.277	2.793	23.277	23.277
2	2.091	17.423	40.700	2.091	17.423	40.700
3	1.413	11.776	52.476	1.413	11.776	52.476
4	1.073	8.945	61.421	1.073	8.945	61.421
5	1.010	8.416	69.837	1.010	8.416	69.837
6	.772	6.437	76.274			
7	.752	6.267	82.542			
8	.666	5.554	88.095			
9	.502	4.181	92.277			
10	.479	3.991	96.268			
11	.352	2.930	99.198			
12	.096	.802	100.000			

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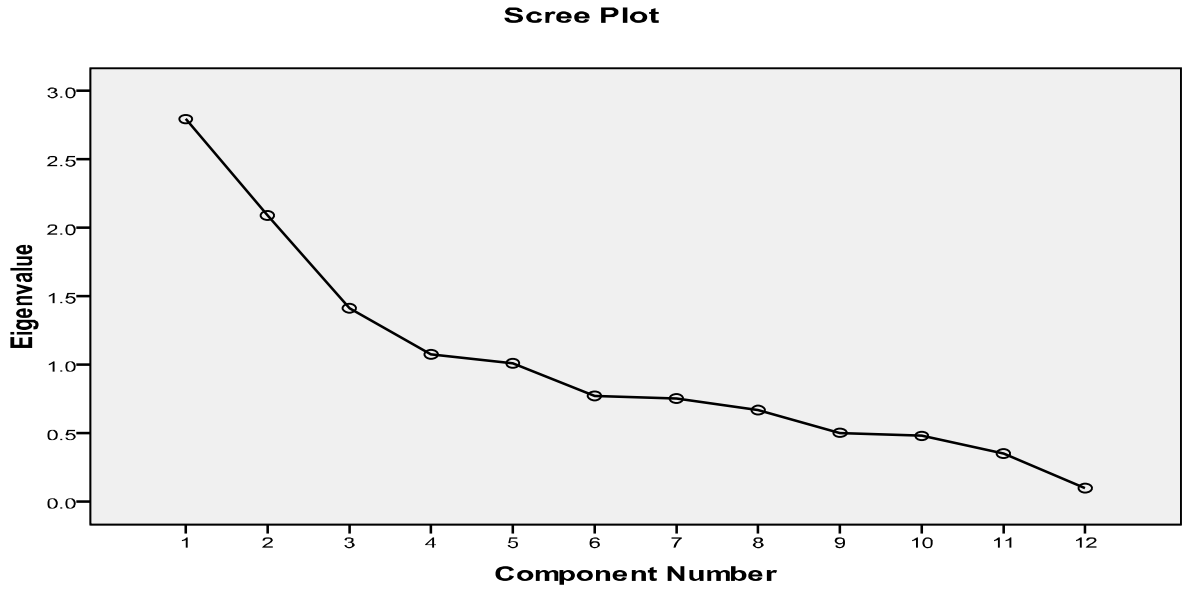
Extraction Method: Principal Component Analysis.

Table 7 shows the variance explained by the initial solution (initial eigenvalues), extracted components and rotated components. Under the initial eigenvalues, the total column gives the amount of variance in the original variables accounted for by each component; the percent of variance column gives the proportion of the variance accounted for by each component of the total variance in all of the variables. In the table, eigenvalues greater than 1 was extracted and this show that the first five principal components (food supply, freshwater supply, raw materials for production, climate regulation and groundwater recharge) having eigenvalues greater than 1, form the extracted solution accounting for 69.8% of the total variability in the original twelve components (variables) so that the complexity of the data set can considerably be reduced using the extracted components. This situation could be due to the peculiarity of the Niger Delta environment.

Fig II: Scree Plot for Wetland Services in the Niger Delta



The scree plot in fig. II was used to display the relative magnitude of the eigenvalues of the correlation matrix. By graphing the eigenvalue against the component number, it established the number of components that should be retained. The figure shows that only the first five components (food supply, freshwater supply, raw materials for production, climate regulation and groundwater recharge) are the major wetland services in the Niger Delta and should therefore be retained. Though five components accounted for what happened in the other seven components, the curve begins to tail off after the fifth component. It could therefore be deduced from the graph that each successive component after the first five accounted for smaller and smaller amounts of the total variance hence, may be less important.

Table 8: Component Correlation Matrix

	Component				
	1	**2**	**3**	**4**	**5**
Food Supply	-.215	.465	.304	-.476	-.017
Freshwater Supply	-.321	.666	-.112	.246	.221
Raw Materials for Production	.587	.052	.234	-.396	.135
Climate Regulation	.244	-.309	.130	.456	.572
Groundwater Recharge	-.550	.286	.046	.415	-.333
Erosion Regulation	.724	.440	-.313	.116	-.059
Flood Control	.805	.434	-.232	.148	-.012
Cultural Heritage and Amenity	.432	-.563	.157	.163	.131
Spiritual Inspiration	.645	.388	.078	.086	-.245
Recreational	-.272	.465	-.196	-.220	.649
Educational	.262	.111	.817	-.037	.013
Aesthetic	-.147	.417	.589	.360	.055

Extraction Method: Principal Component Analysis.

a. 5 components extracted.

Table 8 shows the rotated component matrix of the five components that accounted for 69.8% of the total variability in the original twelve variables. The first component (food supply) is most highly correlated with erosion regulation (0.724) and spiritual inspiration (0.645) however it is less correlated with aesthetic. The second component (freshwater supply) is weakly correlated with food supply and recreational (0.465 respectively), the third component (raw materials for production) is most highly correlated with educational (0.817), the fourth component (climate regulation) is weakly correlated with climate regulation (0.456) and the fifth component (groundwater recharge) is most highly correlated with recreational (0.649). Table 11 reveals that the correlations between the five components are not very strong however, they are the most important factors/services that accounted for what happens in the remaining seven.

Conclusion and Recommendations

In the study, the services offered wetland ecosystems in the Niger Delta were examined, using both descriptive and inferential statistics. The study identified twelve (12) wetland services in the Niger Delta. In ranking the services, it was evident that flood control (RII = 3.81), cultural heritage (RII = 3.80), spiritual and inspiration (RII = 3.60) and erosion regulation (RII = 3.42) are the most important wetland services in the Niger Delta. The principal component analysis conducted corroborates the findings from the frequencies and ranking tables. In the light of the various findings, the study therefore recommends that Estate Surveyors and Valuers should give consideration to wetland services in their conduct of wetland valuation as this would help in proper assessment of the worth of this important ecosystem.

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