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ACCOUNTING FOR SUB-SOIL ASSETS IN NIGERIA: ITS IMPLICATIONS, BENEFITS AND CHALLENGES

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AUTHORS' CONTRIBUTIONS

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ABSTRACT

The current study focused on accounting for sub-soil assets: Its implications, benefits, and challenges in Nigeria from the theory of comparative advantage point of view. The study employed a survey research design. Two hypotheses were formulated for the study and the one sample t-test was employed in validating the hypotheses. The study found that there is significant adoption and utilization of measurements of sub-soil assets in Shiroro Dam. The study also found that there is significant use of Analytical techniques to improve accountants' performance in accounting for sub-soil assets. Other qualitative findings emanating from the study included the absence of green and clean sub-soil exploration activities in Nigeria which is a strong factor responsible for the agitations in the Niger-Delta regions of Nigeria. The study also discovered a strong link between accounting for subsoil assets and long-term development. Consequently, the study recommends amongst others that (IAS41-Agriculture) be adopted and maintained as a principle for measuring all costs related to biological assets to ensure proper valuation of sub-soil assets and proper disclosure of green sub-soil exploration thereby mitigating the adverse effect of oil and other sub-soil explorations in Nigeria.

Keywords: Sub-soil assets; sub-soil resources; challenges.

1. INTRODUCTION

"The wealth embodied in sub-soil resources makes up a significant proportion of the wealth of most nations, often more than the wealth embodied in produced capital, therefore making natural resources management a key aspect of economic development" [1]. "Many countries have seen significant rises in revenues from subsoil resources due to the rise in commodity prices. Sub-soil resources such as oil, gas, minerals, and timber are expected to continue to play a significant role in resource-abundant economies, as demand from rapidly growing economies increases, and as supplies of non-renewable resources decline and renewable resource harvests approach maximum sustained yield levels. Not surprisingly, countries richly endowed with natural capital have the potential to derive significant current income from resources" [2].

Nigeria is a nation with various sub-soil and natural resources some of which have been and are being explored; some others have not yet been explored. It is well known that the country is a major producer of crude, a commodity that is of great importance to the world economy. Apart from crude, Nigeria is also the host of several other mineral and natural resources such as Limestone, Iron ore, Tin, Columbite, Coal,

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Bitumen, Natural gas, to mention but a few. These minerals have the capacity and potentials to increase the Gross Domestic Product (GDP) of the nation, industrialize the economy, lift the huge numbers among the citizenry out of poverty, and be of other immense benefits to the nation and citizenry. However, the potential benefits of those resources to the nation and citizenry are scarcely realized for the larger part of the population. Larger parts of the population languish in poverty and this continues from ages to ages. Some have described the experience of the nation as 'Suffering in the midst of plenty'. Hence, a robust GDP but an impoverished per capita income. This is a problem to Nigeria as a nation.

Natural resources are generally classified into two categories, namely: Mineral and Environmental resources. While Environmental resources concerns nature's elements which support biological life such as Rivers, forests, fertile (arable) land, Sunlight, mountains, to mention but a few; Mineral resources on the other hand are usually buried in the earth's crust and are usually mined through industrial processes which are often referred to as the extractive industry. These mineral resources (otherwise referred to as sub-soil resources) include Limestone, Iron ore, Tin, Columbite, Coal, Bitumen, Natural gas, etc. Nigeria as a nation is hugely blessed in sub-soil assets. The need to make the best use of Nigeria's sub-soil asset, therefore, rests on the need for proper valuation and accounting for sub-soil resources which are required for holistic growth planning. This valuation and accounting are also as important as a transparent institution with a sound governance structure; owing to the fact that inclusive decision-making helps provide not only legitimacy for sub-soil resource management policies, but ensures that the range of knowledge and social interests and values are considered in policy-making. Against this backdrop, the current study, therefore, examines sub-soil accounting methods, policy challenges, and benefits.

2. REVIEW OF RELATED LITERATURE

2.1 Conceptual Review

2.1.1 Sub-soil resources

According to OECD [2], "sub-soil resources, both renewable and non-renewable, and ecosystem services are a part of the real wealth of nations". They are the natural capital out of which other forms of capital are made. Mortimer [3], on the other hand, has observed that "Sub-soils are the essential ingredients that enable us to make more of life. However, as it can be seen above, the extraction, processing, delivery and use of these Sub-soils have an adverse impact on the environment. As advanced society is placing increasing emphasis on the environmental sustainability of all human activity, the need for ameliorating mining hazards becomes increasingly pertinent as well in this regard".

2.1.2 Sub-soil resources accounting

"Sub-soil resource accounting is the collection, summary, interpretation and reporting of accounting data relating to mineral resources which are organised in terms of stocks and flows. Sub-soil resources accounts involve both physical units and monetary values" [4]. "Sub-soil resource accounting may be applied not only at a macro-economic level, but also at a micro-economic level. Generally, sub-soil resource accounts are regarded as a means of creating linkages between the mineral resources and the economy. One of the main problems relating to sub-soil resource accounting is the valuation of resources in pecuniary terms despite the widespread international support for the concept and practice of sub-soil resource accounting" [4,5]. The objective of sub-soil resource accounting is to garner information on the state of sub-soil resources and the changes affecting them. Hence, it is therefore an important link in the chain of sustainable development.

Nwadialor [4], also pointed out that "some developed economies such as Norway have made some remarkable progress in Sub-soil resources accounting. There is also need to improve the management of sub-soil resources within Nigeria. In addition, there is the use as planning tools, highlighting the linkages between economic development, natural resource use and environmental concerns". "The integration secures consistency between economic analysis and analysis of important environmental and resource issues such as air pollution and energy use. It is important to organize the natural resource accounts in a manner that facilitates its usefulness for analytical purposes. This will enhance the probability that the linkages between economic, natural resource, and environmental issues are brought to the attention of the decision makers suggested proposal of correcting GDP or other aggregates of the national accounts" [6].

Bassey, Bessong, Oben, and Effiong [6], in their study explains "the Norwegian model where sub-soil resource accounting in Norway is not considered as a goal in itself, but rather as a way of providing systematised data for analytical purposes. Thus,

information based on the energy accounts and the associated emission inventories have been integrated into more comprehensive analytical tools by expanding the macroeconomic planning models. By integrating the resource and environmental data with economic models, several aims are achieved. First, consistency between economic planning, expected growth in energy use and the resulting emission to air is secured in the model-based forecasts. Secondly, by providing output tables covering economic, energy and environmental variables, the linkage between these policy areas is brought to the attention of the policy makers. Finally, by making a single modelling tool available to both the Ministry of Finance and the Ministry of the Environment among others, communication and collaboration toward an integrated development model among the different branches of the government is enhanced and ensured. Given the several similarities between Nigeria and Norway in terms of mineral and environmental resources, and by virtue of the developmental progress Norway as a nation has made by taking advantages of these resources, it may be right for Nigeria to adopt some of the strategies Norway has used successfully".

2.1.3 Implication of sub-soil activities

Achieving sustainable development in Nigeria requires that certain changes need to take place mostly in the way exploitation is perceived and, in the exploitation, process itself [7]. Limiting environmental impacts from aggregate quarrying in developed countries commonly requires the best management practices. This includes both institutional changes by the competent authorities, as well as application of novel exploitation techniques by the operators, which should be consistent with the future [8]. "This is available in handbooks and guidelines published by various organizations including government offices and industry associations. Industry practices are advanced in many industrialized countries that aggregate extraction adhere to best management practices as a temporary activity, rather than a permanent one" [9].

Any form of growth or developmentin particular implies the creation of order from disorder (local reduction in entropy), which requires expenditure of energy. Generating that energy is achieved at the expense of creating more disorder elsewhere (e.g., by burning low entropy fuel minerals to release energy and leave a higher entropy mixture of gases or atomic particles; or by eating complex foodstuffs for growth and excreting degraded materials). We cannot defeat the laws of thermodynamics, but we can maximise our efficiency in this transformation process and choose which types of entropy and waste we increase and where we increase them. Using solar energy, for example, entails tapping into a source of power generated by the distant sun.

"This massive energy + entropy generator far exceed sour energy needs, and is operating anyway whether we use it or not, so it represents one of the best options for an external energy supply that minimally impacts our local (global) environment. All other energy sources involve power generation on Earth, with resultant wastes and entropy dissipated within our environment.

With regards to the extractive minerals industry, energy consumption is actually one of its largest environmental impacts, with some estimates attributing up to 7 % of world energy consumption to mining, mineral processing, and smelting (especially aluminium smelting). These impacts, in the form of pollution from power generating plants and vehicle emissions, are less obvious and more easily externalized than the more visible impacts of mine construction, emissions from mineral processing, and waste disposal, but may turn out to have much longer lasting and wider-spread consequences if fears of resultant climate change prove correct. Although technological innovation has enabled extraction of minerals from lower and lower grade resources, this is achieved mostly at the cost of increased energy consumption (e.g., in mining larger volumes of rock per unit of mineral extracted), and this trend can only be expected to increase as reserves of the most easily mined and accessible ores are drawn down" [10].

An awareness of the importance of social issues related to mining has come later than the global awakening to environmental issues, and has recently, in the last decade, reached a parallel level of importance. The history of social abuse associated with the mining industry (but by no means exclusively so) stretches back to pre-Roman times, but a global awareness of human rights perhaps only dates to the 18th century, the Age of Enlightenment, when the iniquities of slavery became matters of widespread concern. Nevertheless, indirect abuses, particularly of indigenous and other underpowered people, have continued well into the 20th century, and continue today in some countries including, Nigeria.This has most commonly taken the form of dispossession of land and property, or degradation of environments required for subsistence as observed in Niger-Delta, Nigeria.

2.1.4 Challenges of mining for sub-soil resources

"Before Sub-soils resources can become useful commodities, they have to undergo the following sequential stages of development: exploration with or without prior processing, mine development, mining and processing. The different stages of Sub-soilresource development produce adverse effects on the environment. The first step towards the establishment of a mine is the provision of basic infrastructure like access roads, power and water supply. Thereafter, mining starts by making an opening(s) in the ground. This will affect the physical landscape as it may disturb the water table, alter stream flow, and generate huge amount of dust and noise. If in the open-cast mining, the material of interest is hard rock, it is extracted by blasting, followed by crushing to obtain the required sizes. Vibrations caused by the blasting can damage structures like buildings, roads, bridges, etc in the vicinity of the quarry. The associated noise can cause ear and heart problems, especially if combined with pulsation as is the case with drilling equipment.

On the other hand, underground mining has minimal effect on the physical landscape. The main effect on the landscape results from subsidence caused by the sub-surface voids created by the mining and removal of materials. Subsidence is usually accompanied by differential horizontal strains, which may adversely affect structures like high rise buildings, dams, roads and bridges.

Mining, in spite of its numerous advantages, unfortunately, has been one of the major causes of environmental degradation in Nigeria. Mining, in addition to the negative effects cited above, produces severa1 adverse impacts on the environment and these include; a desolate landscape of earth mounds as is the situation in some parts of Plateau State, destroying the scenic beauty in places like Rayfield; agricultural land is rendered barren by mining, with the possibility of causing rural/urban drift; water from mine ponds is used for domestic and industrial purposes. The water in some mine ponds especially in lead-zinc mines is contaminated with toxic trace elements" [11]; pollution from oil spillage is the primary environmental hazard in oil producing states in Nigeria; etc. The mining effects from their nature also give rise to air, land and water pollution, thereby constituting health hazards to both terrestrial and aquatic habitats with serious consequences. This will be highlighted because it is critical to the sustainability of live on earth.

2.1.5 Health hazards associated with mining sub-soil resources

The mining, smelting and treatment of ores, for example, such as sulphide ores and the combustion of fossil fuels, emit such gases as carbon dioxide and sulphur dioxide. Quarrying pollutes the air with dust and noise. The processing of uranium zirconium, tantalite, wolframite and tin ores can pollute the air with ionizing radiation. Silica particles pollute the air in proximity to rock drilling sites, in mines and quarries. Asbestos particles pollute asbestos mine and processing areas.

Liquid waste from mining/Sub-soil processing requires specialized storage. Most Sub-soil processors dodge this responsibility by running the waste into the nearest stream. This causes serious pollution and destroys aquatic life. Human beings have often got the effect through the food chain or directly through contaminated water. Slime and quartz that were released by kaolin processing plants account for the white coloration of extensive areas near those plants. The slime has affected aquatic life; and the slime and quartz have rendered the farmlands in these areas infertile. This has occasionally generated serious friction between farmers and Sub-soil industrialists.

2.2 Theoretical Framework

2.2.1 Theory of comparative advantage (1817)

The theory of comparative advantage was developed by a classical economist – David Ricardo in 1817 in his book on *"The Principle of Political Economy and Taxation"* in an example involving England and Portugal. However, England was relatively better at producing cloth, therefore, it made sense for England to export cloth and import wine from Portugal. The relevance of this theory to Nigeria is obvious; by definition, these natural resources give a country that has them an advantage in their extraction and use over others (countries that do not have them); the country must make concrete, bold, and rapid efforts in addressing their needs and exploring areas of comparative advantage. The viability of any state, as well as its ability to reduce poverty, create jobs, and contribute meaningfully to the centre, is heavily reliant on the comparative advantage factor.

In the case of Nigeria, the country is rich in mineral resources, including limestone, natural gas, and petroleum, to name a few. The energy sector might use petroleum and natural gas as basic materials. As a

result, Nigeria should be able to produce/generate electricity at a lesser cost than other countries that do not possess similar mineral resources. As a result of these mineral resources, Nigeria might be said to enjoy a competitive cost advantage in the energy sector. Limestone, for instance, serves as a raw material for the building, construction, and cement industries. Nigeria contains a lot of limestone. Nigeria should therefore be able to produce these goods at a lower cost than other countries that must import these resources.

3. EMPIRICAL ANALYSIS

Bassey, Bessong, Oben, and Effiong [6], in Nigeria explored "the potential benefits of sub-soil resources to the nation and citizenry. In their study, they pointed optimal sub-soil resource extraction are far from realized for the larger part of the population. Hence, the study examined how natural resources accounting can be used to benefit Nigeria as a nation, and its citizenry. Two (2) research questions were raised and two hypotheses formulated to guide the study. Relevant literatures to buttress and illuminate the work were reviewed. The survey method was adopted as a research design while the Pearson Correlation Coefficient analysis was considered as method for measuring, testing and analyzing the key hypothetical variables in the study. The findings revealed that sub-soil resources accounting could significantly impact upon nation's development".

Akanwa, and Ikegbunam [12] carried out "a review on Natural resource exploitation in Nigeria with focus on the consequences of human actions and best practices for environmental sustainability. The study pointed that the mining environment has been characterized by a number of risks and vulnerabilities with the implications for the attainment of the SDGs. One of these risks is the unwholesome, unregulated and unsustainable process of extracting natural resources in Nigeria". Akanwa, and Ikegbunam [12] also opined that the abundance of solid minerals in the country has led to massive exploitation in various ways that has brought about dire consequences on environmental resources. This includes the ever-increasing issues of climate change, landscape destruction, land cover changes, change in livelihood, endangered animal/plant species and risks on human life among others are likely to sabotage environmental sustainability. They found that there is need for a greater attention to be given to environmental and sustainable best practices in literature. Therefore, this paper assessed human actions such as mining/quarry industry and its effects on the natural environment and it also identifies the factors undermining environmental sustainability and hence, sustainable development goals. The study also reviewed various related studies, personal research, published and unpublished journals were reviewed and concluded that the concepts of sustainable development and best practice in quarrying/mining were adopted to critically assess the situation. The paper identified three major factors affecting increased unsustainable mineral exploitation practices that are detrimental to achieving sustainable development.

Moshi [13], in "Tanzania also identified areas which need adequate preparation in order to ensure that the extraction of natural gas becomes the main driver for inclusive and sustainable growth and development in Tanzania, including reduction in donor dependence". According to Moshi [13], "the preparedness package includes ensuring that: fiscal regime to capture rent is in place, requisite human resources are made available and developed, savings are invested in the domestic economy, ownership is on joint-venture basis to encourage high retention rates in the domestic economy, up-stream unfolding of industries is encouraged (value-addition), contract negotiation capacities are strengthened, the negotiation processes are transparent and consultative, local community benefit effectively from the resource, the investment in other non-gas sectors (e.g. agriculture and manufacturing) is scaled-up, and politicians rise above their party interests so that they contribute positively towards the development of the natural gas sector and policy making process".

Nwadialor [4], in his study pointed that "Nigeria is endowed with abundant mineral resources. However, their extraction and processing through mining activities especially, of the solid minerals are going on at different scales of intensity. Some of these operations, and their negative impacts to the environment which include: land degradation, ecological disruption giving rise to air, land and water pollution and death of flora and fauna, etc often go on unchecked. These disturbing situations and means to minimize them have surprisingly not been taken seriously because of lack of regulatory implementation impetus or due to the little revenue accruing from these resources which is not even meaningful to be reflected in the nation's Gross Domestic Product (GDP). It is in this regard, that the paper critically reviewed the state of mineral exploitation in Nigeria, its adverse effects on the environment and associated health hazards, including the strategies for hazard reduction, and conservation of mined-out areas. From this review study, it was feared that natural catastrophes such as earthquake

and volcanic eruptions - occasioned by possible geomorphologic and geostatic equilibrium destabilization may be imminent in the country as a result of these mining activities. It was therefore recommended that a holistic approach to evaluating hazards represented by different kinds of mine waste be put in place by adopting remote sensing and Geographical Information System (GIS) in assessing environmental impact of mining and its new developments".

Richards [14] conducted "a study on challenges for sustainable mineral resources development in 21st Century. He asserted that the modern minerals industry is more environmentally responsible and socially aware than at any time in the past, and yet faces increasing challenges to improve its performance in these areas still further. Some of these expectations are reasonable and achievable, but others are unrealistic (e.g., zero impact) if real development is to continue. Moreover, because society is the ultimate beneficiary of the industry's products, it should be prepared to pay for the improvements it demands". According to Richards [14], "externalized costs, such as many environmental and social impacts, should be internalized into prices, and higher royalties should be charged on gross revenue to ensure effective capture of value of non-renewable resources by host countries. Such costs to consumers could be offset by higher recycling value, leasing, or deposit-return schemes. His study concluded that NGOs have an important role to play in working with industry to convince society to accept such changes".

Adekoya [15], "a Nigerian scholar observed that another effect of the damage, which may not be immediately seen, is the disturbance of the ecological system with possible adverse consequences on the floral and faunal community. He went on to inform that recent environmental impact studies of limestone mining and cement industry in Sagamu area reveal a declining Kola nut output from the plantations within a few kilometres radius of the cement factory. This phenomenon is most probably associated with dust pollution as plenty of dust is discharged into the air mainly from the cement factory. The particulate matter eventually gets deposited on the kolanut leaves and flowers as well as the soil supporting the plants. The overall effect of this is that the photosynthetic and fruiting ability of the kola nut trees is impaired with consequent decrease in kolanut production".

Honda [16], "in Tokyo, Japan carried out an investigation on monitoring of re-vegetation area in devastated land, caused by copper mines pollution, using aerial photography and satellite remote sensing and observed that sulphurous acid gas exerted a serious influence on trees within 149km^2 around the Bessemer smelting plant located in the mine area". Honda [16] also asserted that "within another 38km^2, only plants, which were resistant to sulphurous acid gas such as bamboo trees remained. Frequent floods and sediment disasters, which seemed to be caused by destruction of forest, as a result, had a serious unpleasant influence on the crops, and health of villagers in ruins. Over the 33 years, from 1956 to 1988, he revealed, 1168 hectares of hill-side seeding and 339 of check-dams have been undertaken, as restoration attempt at the cost of 119billion Yen. Through these measures, the area had considerably recovered; but even at present a large devastated area is left as it stands, where any work is hard to be done. So, in his conclusion, he stated that for the overall restoration of vegetation, a large amount of cost, long term, and difficult measures are expected" [17,18].

4. METHODOLOGY

4.1 Research Design

"The study employs survey research design. A survey research design is one in which a group of people or items are studied collecting and analyzing data from only a few people or items considered to be representative of the entire group" (Nworgu, 2006).

4.2 Population of the Study

The population of the study comprises Skilled covering Accountants and Book-keepers in Shiroro Dam in Shiroro, Munya, LGA, Niger State, Nigeria. Only this area was considered because of its proximity to the researcher's permanent residence.

4.3 Sample and Sampling Technique

Given the size of the population, large and indefinite due to the high traffic of unskilled workers, the study employed the approach adopted by Nwankwo (2010) which states that in other to have a manageable population size, if the population of a study is in a few hundred, a 40% or more will do, if many hundreds, a 20% sample will do and several thousand, a 5% or less will do. The study also determined its primary data sample size using Cochran's formula for the large population using an estimated proportion of the population of:

$$n_0 = \frac{Z^2 Pq}{e^2}$$

Where,

n_0 = Sample Size
Z^2 = Z-value
p = estimated proportion of the population
e^2 = desired level of precision (margin of error)
q = 1-p

Hence, $n_0 = \frac{1.96^2(0.95)(1-0.95)}{0.05^2}$

$n_0 = 72.9904$ (Approx. = 73)

4.4 Method of Data Collection

Data for the study was collected through primary source and secondary source. Structured questionnaire was used in collecting the primary data. The questionnaire was structured on a 4-point Likert scale of Strongly Agree, Agree, Disagree and Strongly Disagree. The ranges of scores will be weighted as 4, 3, 2, and 1 respectively. With the assistance of one qualified research assistant, the researcher read out the questions from the instruments and immediately recorded the respondents' responses. The research assistant was given a briefing on the procedure for gathering data as well as how to distribute and retrieve the instruments. The instrument was distributed and retrieved over the course of three days.

4.5 Validity of the Instrument

Construct validity was used in validating the instrument. This was carried out by subjecting the instrument to factor analysis with the use of SPSS version 23. The validity test was done by giving out 73 item of questionnaire concerning Sub-soil accounting in Shiroro, Munya, Niger State, and Nigeria to ensure accuracy of the sampling adequacy; the result is as shown in Table 1.

Table 1. KMO and Bartlett's test

KMO and Bartlett's Test		
Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.872
Bartlett's Test of Sphericity	Approx. Chi-Square	479.127
	Df	45
	Sig.	.000

Source: SPSS Ver. 23

The KMO and Bartlett's Test result revealed a Kaiser-Meyer – Olkin Measure of Sampling Adequacy value of 0.872. KMO and Bartlett's Test results were meritorious when measured by Facto Analysis's appropriateness. The instrument is therefore regarded as valid.

4.6 Reliability of the Instrument

For reliability of primary data, a statistical analysis was conducted to determine the internal consistency of the items of the questionnaire. This was done using Cronbach Alpha. Pallant (2007) stressed that "when a psychometric scale is used, the internal consistency could be checked using Cronbach alpha".

Reliability Statistics: The Cronbach's alpha on the test of measurement reliability scale for the extent of sub-soil accounting in Shiroro Dam, Niger State showed an alpha level of .808 which is above the generally accepted threshold of .70. Thus, the measurement is reliable [19,20].

Table 2. Cronbach's alpha values for research question one as in structured questionnaire

Reliability Statistics	
Cronbach's Alpha	**N of Items**
.808	10

Source: SPSS ver. 23

4.7 Method of Data Analysis

The technique employed in analyzing the quantitative data in the study is the descriptive statistics done with the aid of a statistical package for social science (SPSS ver. 23). A mean of 2.5 was used as a decision thresh-hold in answering the research questions while the One-Sample Mean T-test was used in testing the formulated hypotheses. The level of significance is 5%, while 95% confidence interval is adopted for the study.

4.7.1 Decision rule

The research hypothesis will be accepted when the probability value (p-value) is less than 0.05; if greater than 0.05 the research hypothesis will be rejected and null hypothesis accepted.

5. DATA PRESENTATION AND ANALYSIS

5.1 Descriptive Statistics

5.1.1 Analysis of research questions

Research Question One: What is the level of adoption and utilization of measures of sub-soil assets in Shiroro Dam?

Table 3. Descriptive statistics of investigative questions

Descriptive Statistics								
Investigative Question	**SA**	**A**	**D**	**SD**	**N**	**Sum**	**Mean**	**Std. Dev.**
Accounting for sub-soil assets is fully operational in Shiroro Dam.	47	7	4	15	73	232	3.18	1.229
Sub-soil accounting technique adopted by natural resource and mining organizations in Nigeria is effective to ensure proper resource management.	46	12	10	5	73	245	3.36	.963
There are probable indications that the future demand for sub-soil accounting measures for a robust reporting.	42	8	10	13	73	225	3.08	1.199
Sub-soil accounting sends market signals that would have direct impact on resource control policies.	47	0	10	16	73	224	3.07	1.295
Accountants do not sufficiently addresses the difficulties in developing models for sub-soil asset valuation.	61	8	4	0	73	276	3.78	.534
Valid N (listwise)					73			

Source: Field Survey, 2021.

The descriptive statistics of the investigative questions are shown in Table 3, and they reveal that the mean statistics of the ten (5) questions are greater than 2.50, with the lowest question (question 4) scoring a mean of 3.07, which is still higher than 2.50. There is a substantial degree of acceptance and exploitation of sub-soil asset measurements in Shiroro Dam, as shown by the summary statistics, where the grand mean value for the investigation questions is 3.294, which is over the decision threshold.

Research Question Two: To what extent has Analytical techniques improved the accountants' performance in the accounting for sub-soil assets?

Table 4.

Descriptive Statistics								
Investigative Question	**SA**	**A**	**D**	**SD**	**N**	**Sum**	**Mean**	**Std. Dev.**
The heightened state of corruption in Nigeria may undermine the effective accounting for sub-soil assets in Nigeria.	53	5	9	6	73	251	3.44	1.000
The Introduction of Brainstorming session in sub-soil operations was to make accountants proactive in developing models and measures to account for sub-soil assets.	64	9	0	0	73	283	3.88	.331

Descriptive Statistics								
Investigative Question	**SA**	**A**	**D**	**SD**	**N**	**Sum**	**Mean**	**Std. Dev.**
Critical scrutiny of any document made available to the public improves the chances on discovering deliberate misstatement in the sub-soil accounting	45	10	4	14	73	232	3.18	1.194
Analysing financial records is a deliberate attempt to make useful enquiry into measures and sustainable techniques for accounting for sub-soil assets.	46	10	8	9	73	239	3.27	1.083
High level analysis is necessary in ensuring wholesome computation of sub-soil assets.	40	15	11	7	73	234	3.21	1.027
Valid N (listwise)					73			

Source: Field Survey, 2022

The descriptive statistics of the investigative questions are shown in Table 4, and they reveal that the mean statistics of the ten (5) questions are greater than 2.50, with the lowest question (question three) scoring a mean of 3.18, which is still higher than 2.50. According to the summary data, the grand mean value for the investigative questions is 3.396, which is above the threshold for making a judgement. As a result, analytical techniques have significantly enhanced the performance of accountants when it comes to accounting for subsoil assets.

5.2 Test of Hypotheses

5.2.1 Test of hypothesis one

H_{01}: There is no significant adoption and utilization of measurements of sub-soil assets in Shiroro Dam.

Table 5.1a.

One-Sample Statistics				
	N	**Mean**	**Std. Deviation**	**Std. Error Mean**
R1	73	33.4384	6.83331	.79978

Table 5.1b.

One-sample Test						
	Test Value = 0.05					
	t	**Df**	**Sig. (2-tailed)**	**Mean Difference**	**95% Confidence Interval of the Difference**	
					Lower	**Upper**
R1	41.747	72	.000	33.38836	31.7940	34.9827

Source: SPSS ver. 23

Table 5.1a-b shows a t statistic value of 41.747 which is significant at .05 level; the sig (2-tailed) value was .000. Hence, ($p < .05$). Thus, the study finds evidence to refute the null hypothesis and accept the alternate. Thus, there is a significant adoption and utilization of measurements of sub-soil assets in Shiroro Dam.

5.2.2 Test of hypothesis two

H_0: There is no significant use of Analytical techniques to improve accountants' performance in the accounting for sub-soil assets

Table 5.2a.

One-sample statistics				
	N	**Mean**	**Std. Deviation**	**Std. Error Mean**
R1	73	31.6743	6.83331	.7487

Table 5.2b.

One-sample test						
	Test value = 0.05					
	t	Df	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
					Lower	Upper
R1	40.556	72	.000	32.4230	31.7940	33.6827

Source: SPSS ver. 23

Table 5.2a-b shows a t statistic value of 40.556 which is significant at .05 level; the sig (2-tailed) value was .000. Hence, ($p < .05$). Thus, the study finds evidence to refute the null hypothesis and accept the alternate. Thus, there is a significant use of analytical techniques to improve accountants' performance in the accounting for sub-soil assets in Nigeria.

6. DISCUSSION

Nigeria is fortunate in being well endowed with a great variety of Sub-soil resources, the nature and distribution of which are related to the complex geological history of the country and its adjacent continental shelf. These resources are national assets and their extraction and, more importantly their use; make an essential contribution to wealth creation, the nation's infrastructure and the quality of life of its population. However, the extraction, processing, delivery and use of these Sub-soils have some negative impact on the environment. This is more so evident when it has been established that mining had been a very significant part of the Nigerian economy during the colonial era and can still be in this twenty-first century. Adiuku-Brown [17] has observed that natural catastrophes such as earthquake and volcanic eruptions have not been experienced in Nigeria for some decades now. Nigeria by virtue of its location in West Africa is within intraplate area. Therefore, according to the simple concept of plate tectonics it is unlikely to experience such hazardous earth processes as experienced in countries located within the Circum-pacific and the Alphine belts. However, volcanic cones and ashes dated back to the lower Tertiary and Quaternary geologic periods can be seen in Miango, Vom, Barkin Ladi and Panyam areas of Plateau State. These have remained inactive for several years and do not seem to constitute a problem as could be expected in other countries located in active earthquake zones.

In Nigeria, mining operations consist of opencast and underground mining. In opencast mines, the quarry produced for example, is often deeper than the water-table so there is a tendency for it to be flooded, and often the surface and underground water are polluted by effluents and waste materials from the mines. The mine water may be acidic or alkaline. Sometimes a part of the quarry may become unstable and collapse or cause local landslide. The tin mine at Sabon Gida Kanar exhibits this problem of local landslide. Furthermore, most of the underground mines in Nigeria are the illegal "Lotto" mines [12]. Richards [14], also saw that "the shafts are narrow and are sunk manually. Meaning, there was no obvious provision is made for ventilation; however, the person who is lowered down the shaft takes a lighted candle along. When the candle quenches it means that the oxygen in the shaft is no more sufficient. The risk of this device is that the candle uses up part of the limited supply of oxygen, and also the naked light can ignite a combustible gas in the shaft and cause an explosion. The reports of mine accidents in the country, resulting from explosions or collapse are seldom made known to the public, yet these incidents occur with high frequencies to the detriment of miners, the environment, and national economy".

Summarily, the hypothesis testing indicated there is a significant adoption and utilization of measurements of sub-soil assets in Shiroro Dam. The study also found that, there is a significant use of Analytical techniques to improve accountants' performance in the accounting for sub-soil assets. This is consistent with Bassey, Bessong, Oben, and Effiong [6], in Nigeria who explored "the potential benefits of sub-soil resources to the nation and citizenry and found that sub-soil resources accounting could significantly impact upon nation's development".

7. CONCLUSIONS AND RECOMMENDATIONS

Historically, mining activities have produced wastes, which contain pollutants of toxic chemicals. Such wastes often pose a significant risk to the health of living organisms. In Nigeria, Ghana, South Africa, and most developed countries, such as United Kingdom, Canada, France, etc, the hazards represented by these wastes mainly reflect historical mining activities. Furthermore, the wastes can limit

the ways in which surrounding land can be used, and in extreme cases can cause major pollution incidents. Hence, rightly enough, modern society is placing increasing emphasis on the environmental sustainability of all human activity. As well, the extraction of Sub-soils resource can be highly visible and is increasingly the focus of attention for many environmental pressure groups. Consequently, the danger is that the Sub-soils resource industry may come to be regarded as "unacceptable" resulting in significantly reduced activity, declining economic contribution and worsening balance of payments as imports rise. This calls for sustainable mining aimed at reducing the impacts on the environment; as discussed in the current study.

The current study therefore recommends that there is a holistic approach to addressing the effects of mining activities and the wastes generated. In doing this, studies aimed at evaluating the hazards represented by different kinds of mine waste should be embarked upon. Also, it is recommended that IAS41-Agriculture be adopted and maintained as a principle for measuring all costs related to biological assets to ensure proper valuation of sub-soil assets and proper disclosure of green sub-soil exploration thereby mitigating the adverse effect of oil and other sub-soil explorations in Nigeria.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. World B. Where is the Wealth of Nations: Measuring Capital for the 21st Century. Washington, DC: World Bank; 2006.
2. OECD. The economic significance of natural resources: key points for reformers in eastern Europe, Caucasus and central. Asia Publishing. Organization for economic co-operation and development; 2011.
   Available:http://www.oecd.org/env/eap.
3. Mortimer J. Background and purpose of minerals' 98 Earthwise Magazine; Published by the British Geological Survey; Issue. 1998;12:4-5.
4. Nwadialor IJ. Minimizing the impact of mining activities for sustainable. Mined-out area conservation in Nigeria. FUTY J Environ. 2011;6:1597-8826.
5. Stuivelin SJ. Natural Resource Accounting: an inventory of possibilities for SAIs. Netherlands Court of Audit; 1998.
6. Bassey EB, Bessong KP, Oben VO, Effiong GT. Accounting for natural resources: the Nigerian experience.GNOSI: An interdisciplinary journal of human theory and praxis. 2019;2(1).
7. Morgan JP. Partner in the global pursuit of sustainability. Accenture Institute for High Performance; 2008.
8. Sustainable aggregate resource management. (SARM, 2011). Best Practices in Quarrying. Sustainable aggregate resource management conference, september 20-22, 200. Ljubljana. Slovenia; 2011.
9. Wellmer FW, Becker-Platen JD. Sustainable development and exploitation of mineral and energy resources: a review. Int J Earth Sci. 2002;91:723-45.
10. Skinner BJ. A second Iron Age ahead? Am Sci. 1976;64:258-69.
11. Adiuku, Brown ME. The role of the geologist in controlling pollution and man-induced geologic hazards. Proceedings of the environmental education for sustainable development. Focus on Nigeria. Department of Arts & Social Science Education, University of Jos. Nigeria Udoh, S.U, and Akpa, G.O. (Edited). 1997b;499.
12. Akanwa AO, Ikegbunam FI. Natural resource exploitation in Nigeria: consequences of human actions and best practices for environmental sustainability – a review. Sparkling Int J Multidiscip Res Stud; 2019.
    ISSN 2581-7574.
13. Moshi PBH. Opportunities and challenges for the extraction of natural gas in Tanzania: TheImperative of adequate preparedness. Afr J Econ Rev. 2014;I1.
14. Richards JP. Challenges for Sustainable Mineral Resources Development in the 21st Century Resource Geology. 2005;55(2):137.
15. Adekoya JA. Negative environmental impact of mineral exploitation in Nigeria. Proceedings of the regional training workshop on impact of human activities on the west African savanna, held at the federal university of technology, Akure, Nigeria. United nations educational, scientific and cultural organization - MAB Sponsored; 1995.
16. Honda K. Monitoring of revegetation area in Asio devastated land – How expensive and difficult to restore the destructed forest. Asian J Remote Sens. 1991;l(l):127-8.
17. Adiuku, Brown ME. Geology related environmental issues: the situation as it affects Nigeria. Proceedings of the environmental

education for sustainable development: focus on Nigeria. Nigeria: Department of Arts & Social Science Education, University of Jos. Udoh SU, Akpa GO. (Edited). 1997a;499.

18. Adiuku-Brown ME, Ogazi AE. Heavy metal pollution:from mining practices: A case study of Zurak. J Min Geol. 1991;27(2):205-11.
19. Ricardo D. The works and correspondence of David Ricardo PieroSraffa, Dobbs M, editors. Cambridge: Cambridge University Press; 1951;I-XI.
20. United Nations (UN). Glossary of environment statistics, studies in methods, series F. New York: United Nations. 1997;67.