Abstract - The Kwa fall is an exotic, fascinating, glittery natural waterfall whose water continuously falls freely from the upper course of the Kwa river and flows through the exposures of hard resistive schist. The schist of the Kwa fall is highly jointed with a foliation trend in NE-SW direction. A deep pool of cool water collects at the bottom of the waterfall. This and other smaller pools are protected from direct sunlight by canopies of the tropical rainforest trees and serve as a cool water bath in hot afternoons. A proper development of the Kwa fall, a geotourist attraction with an excellent geotourism potential, will not only preserve the amazing geology, geography and culture of the inhabitants of the Kwa fall and its environs but will also enhance the economic fortunes of Cross River State. Geotourism is currently a growing field around the world but not much has been done in this part of the world to join the global trend. A field-based study approach was adopted for this research which attempts to analyze the characteristics and challenges of the geotourism potential of the Kwa fall with a view to improving the benefits that could be associated with it.

Keywords - Geology, Geotourism, Kwa fall, Oban Massif, Schist.

I. INTRODUCTION

Reference [1] considers geotourism as a geographic based tourism while [2] sees Geotourism as an encompassing tourism that sustains or enhances the geographical character of the place being visited, including its environment, culture, aesthetics, heritage and the well-being of its residents. Geotourism is essentially ‘geological tourism’[3]. The geological element focuses on geology and landscape and includes both ‘form’, such as landforms, rocky outcrops, rock types, sediments, soils and crystals, and ‘process’, such as volcanism, erosion, glaciations etc [3]. The tourism element of geotourism includes tourists visiting, learning from, appreciating and engaging in geosites. Geotourism is a form of natural area tourism that specifically focuses on geology and landscape [4]. It promotes tourism to geosites and the conservation of geo-diversity and an understanding of earth sciences through appreciation and learning. This is achieved through independent visits to geological features, use of geo-trails and viewpoints, guided tours, geoactivities and patronage of geosite visitor centers [4].

Geotourism is growing around the world through the growth of geoparks as well as independently in many natural and urban areas where tourism’s focus is on the geological environment. Some countries e.g. South Africa, Australia, Oman, Hongkong, Portugal have developed geotourism to international standard. This is because Geotourism is environmentally responsible and is committed to conserving resources and maintaining biodiversity of both plants and animals as well as protecting the cultural heritage. Hence, it is culturally responsible and committed to respecting the local status of an environment. Geotourism also leads to excellent geological interpretations and preservation of the environments.

The importance of this study is to contribute to the existing literature on geotourism, and also sensitize the public to the importance of geotourism as well as the geotourism potentials of the Kwa fall in Cross River state. This Geotourism attraction will create an enjoyable and pleasure-filled enriching experience for visitors.

II. LOCATION OF THE KWA FALL
Kwa fall is located within Longitudes 05\(^0\) 08’ - 05\(^0\) 09’ and Latitudes 08\(^0\) 30’ -08\(^0\) 50’ in Aningeje, Akamkpa Local Government Area, Cross River State (fig 1) and covers an area of about 20sq.km. It lies within the highlands/hills, southeast of the Oban Massif basement complex of the Southern Eastern Nigeria. (Fig 2a and 2b). The Kwa fall is about 25 kilometers from Calabar Metropolis and can be accessed through Calabar- Oban road. An interesting but perilous boat ride can however be made from Calabar to Kwa fall through the channel of the Great Kwa river. This boat ride would welcome a tourist to a true tropical rainforest experience.

Figure 1: Location of the Kwa fall.
III. MATERIALS AND METHODOLOGY

The methodology adopted for this research is the basic field geologic mapping. This principle involves the bearing and pacing methods. A Global positioning system (GPS) was also used during the mapping exercise to locate positions precisely on the topographic map. Documentation of geological events by careful visual observation, as well as measurement of structural imprints, making of sketches, taking of photographs of lithologic units and petrographic studies was also carried out.

Oral interviews were also conducted on the visitors and the administrator/tour guide to obtain detailed information about the geotourism attraction of the Kwa fall.

IV. DISCUSSION

4.1 THE GEOLOGY OF THE KWA FALL

The Schist in the Kwa fall are highly fractured, banded and are associated with Pegmatite and quartz intrusion. The schist shows conspicuous segregation of mineral suites into light and dark bands with the light bands being generally thinner than the dark bands of the schist (fig 3).
According to [5], the light band contains porphyroblasts of garnet, kyanite and sillimanite whilst the dark band consists of mafic minerals dominantly mica phyllosilicates. The occurrence of garnet + kyanite + K-feldspar + sillimanite assemblage in the Kwa fall schist is interpreted as evidence that Barrovian metamorphism took place in the Oban Massif [5]. [5] and [6] observed that this metamorphism increased in grade from West to East i.e. from middle greenschist in the Cross River Channel to uppermost amphibolites facies at the Kwa fall area.

Structural study carried out in the Kwa fall reveals the presence of veins, foliations and joints. The analyses of data generated from the field tectonic studies (measurement of attitudes of foliations and joints) was made possibly using a rose diagram. The result shows a dominant trend of NE-SW for foliations and joints while a minor trend of NW-SE was recorded respectively (figure 4a and 4b) which is attributed to the Pan African thermotectonic event [11].
Figure 4: Rose diagram (a) Trend of joints. (b) Trend of foliations

Thin section analysis of the rocks from the site using a petrographic microscope reveals the presence of the following minerals and their percentages by visual counting: garnet (35%), mica (20%), quartz (20%), kyanite (10%) and others (15%).

Geochemical study of the schist by [6] shows that the dark portion of the schist has very low silica (43.70% SiO$_2$) and low alumina (12.40% Al$_2$O$_3$). The high lime content (10.00% CaO) and loss on ignition of 9.92% indicates the presence of secondary calcite [6]. [6] went further to say the leucocratic portion is quite siliceous (77.20% SiO$_2$) pointing to abundance of quartz and feldspar. It however, still retains the condition Al (Na+K+Ca) greater than one which permits the occurrence of Al-excess minerals, kyanite and sillimanite, in the leucocratic portion of the schist as opposed to the melanocratic portion of the schist.

The schists in Kwa fall area have been dated by the Rb-Sr method and the ages obtained are 527± 26 Ma from the dark portion and 627± 24 Ma from the light portion [5]. [7] Interpreted the first age as dating diaphthoresis because of the preponderance of retrograde chlorite in the dark portion. The age of 627± 26 Ma is similar to the age of 676± 26 Ma obtained by these authors from gneisses in Old Netim Quarry and is thought to represent the main tectonothermal event in the Oban Massif.

4.2 GEOTOURISM POTENTIAL OF THE KWA FALL.

The Kwa fall is a thrilling and spectacular waterfall located in a deep steep-walled canyon in the upper course of the Great Kwa River. The upper course of the Great Kwa River is characterized by a strong swift current capable of digging relatively rapidly. The Great Kwa River cascades down on highly resistive schist of the Barrovian metamorphism. Kwa fall resort is characterized by its well arranged staircase of over 200 steps (fig 5) which link an exquisite cottage situated on the plain to the cool pools of water at the foot of the waterfall. This exquisite cottage (fig 6) serves as a reception and a relaxation point for visitors. The Great Kwa river sand beach situated close to the cloudy water is a spot for serene relaxation for fun seekers, excursionist, tourist and geotourist. The cloudy water at the foot of the fall forms a deep pool which serves as a wonderful bath in hot periods. Other pools of water collect at different locations from the foot of the fall (fig 7).

The geotourism potentials of the Kwa fall lies in the presence of geological and environmental significant features such as the waterfall associated with fascinating geomorphic features, excellent pools in close proximity with a small beach, a rich and extremely attractive vegetation as well as hills.
and picturesque environment. The Kwa fall and hills are characterized by typical tropical rain forest of mahogany, obeche, ebony and other tall trees as well as climbers and grasses which blend with the undulating landscape that surrounds the fall. The canopies of evergreen large tropical rainforest trees form a covering that shields direct sunlight from the ground. The evergreen trees surrounding the fall constitute wonderful spot for birds, reptiles and monkeys to relish in their natural habitat. This natural environment is also a popular destination for photographers as it served as the background for the Miss World 2002 swim photo shots [8].

Figure 5: The stair case from the plain to the cloudy water of the Kwa fall.
The Kwa fall is a place where flowing water rapidly drops from the upper course of a river forming a cloud of water at the foot of the rocks. The water falls on resistive schist, which is highly jointed. The genesis of the Kwa fall is similar to that of the Mayes waterfall which is reported to have formed when the river was young and the channel was seldom narrow and deep [9, 10]. When the river courses over resistant bedrock, erosion happens slowly, while downstream the erosion occurs more rapidly [9].
Reference [9] went further to explain that as the water course increases its velocity at the edge of the waterfall, it plucks material from the river bed. Whirlpools created in the turbulence as well as sand and stones carried by the water course increase the erosion capacity. This causes the waterfall to carve deeper into the bed and to recede upstream. Often over time, the waterfall will recede back to form a canyon or gorge downstream as it recedes upstream, and it will carve deeper into the ridge above it.

The Kwa fall derives its source from the upper course of the Great Kwa River which is fed with water from the surrounding hills. The volume of the Great Kwa River is dependent on the intensity of the rainfall. The main relief of Kwa Fall is closely connected with geology and geological features and is characterized by a diversity of landforms. Besides the exquisite geology that characterizes the Kwa fall, a spot for cultural heritage in the cottage also adds glamour to this tourist delight (fig 8).

The Cultural spot of the Kwa fall beckons on visitors to come and learn, understand as well as appreciate the traditional character of the place, its arts and culture, history, people and lifestyle as well as cuisines and drinks.

The Kwa fall attracts visitors from all works of life and these visitors come from within and outside Cross River state. On a few occasions tourists from outside the country have also visited the Kwa fall. Entries made in the daily visitors log book showed that a total of 107 visitors (58 males and 49 females) visited the Kwa fall in 2015. Most of the visitors were there to view the natural environment with only 5% visiting for academic purposes. It is pertinent to note that the influx of visitors to the Kwa fall has tremendously dropped. This is partly due to the dilapidating state of infrastructures within the resort. Visitors to the Kwa fall can be classified into four groups viz.: geologist, geotourist, tourist and excursionist (fig 9) and the major reasons for visiting this tourist delight also vary. An interview conducted in the course of this research revealed the following reasons:

a. To escape from the daily life routine
b. To see an exotic place with exciting activities
c. To travel with friends and family
d. To learn new things (curiosity)
e. To relax and rest
f. To meet people with similar interests and hobbies
g. To have fun.
h. To refresh mental and physical state.
i. To explore new places (adventure)
j. And in rare instances, academic purposes.

4.3 FACTORS AFFECTING GEOTOURISM POTENTIALS OF KWA FALL AND MITIGATION MEASURES.

The enormous geotourism potentials that abound in the Kwa fall makes it an asset to the host communities, government, and even stakeholders. Several factors however militate against the geotourism potentials of this natural wonder. The factors affecting the geotourism potentials of the Kwa fall are not quite different from those recorded elsewhere. Aga et al (2012) listed the factors affecting Mayes waterfall to include: lack of political will, high cost of development, lack of continuity in government’s developmental plans, absence of infrastructural facilities, spiritual bigotry and inclination as regards the fall and hills, demographic considerations, social habits and educational consideration. These and other factors considered below constitute a setback to the development of the Kwa fall

4.3.1 Poor registration / documentation procedure. Visitors to the Kwa fall are not properly registered and no official payment is made at point of registration in this tour facility. This therefore results in poor documentation as the number of visitors on site at any particular time cannot be
ascertained. Lack of proper registration also results in loss of revenue to the state government as payments realized from this exercise would have been used to maintain the facilities in the Kwa fall.

Visitors should be encouraged to register their remarks in the log book before leaving the resort. This will serve as a feedback mechanism on areas that should be improved upon.

4.3.2 Lack of funding / political will. Lack of funds/ insufficient funds has militated against the development of the geotourism potentials of the Kwa fall. This may be mostly due to lack of political will which may not be unconnected with the geographical location of the fall. The fall is located a bit far from Calabar Metropolis and the government of the day must diligently inquire to see the gains before embarking on an investment. The Local Government and host communities / stakeholders therefore have to let the government of the day see the gains that will accrue to it should this tourist delight receive adequate funding.

4.3.3 Lack of guides and tour notes. The absence of guides and tour notes is a set back to the development of the Kwa fall resort. Efforts should be made to recruit trained personnel to administer this tourist delight. Health and safety tips as well as evacuation arrangements in case of accidents during tour of the facility by visitors should also be put in place.

4.3.4 Lack of awareness. Another problem affecting the geotourism potential of the Kwa fall is lack of awareness. The geotourist attraction of the Kwa fall has not been adequately promoted by Cross River state government. Visitors to the sites are therefore mostly either locals or those that had contacts with previous visitors. T-shirt and other branded items should be given as incentives to tourists at the end of their visit to this natural wonder and enough sensitization and awareness campaign should be embarked upon by the state government including erection of billboards, newspaper/magazines publications and radio/ television adverts.

4.3.5 Lack of infrastructural Facilities. Due to inadequate / poor infrastructural facilities, tourists only visit the Kwa fall and leave for Calabar Metropolis immediately after their visitation. This has a psychological impact on the stress level of visitors. The negative impact of the daily visits on the local economy (rural income) also looms large as the income that would have been injected into the local economy is withheld.

For the geotourism potentials of the Kwa fall to fully develop, infrastructural facilities like good access roads, constant electricity supply, bars, restaurants, security, pipe borne water supply and hotels / cottages should be provided by the state government/stakeholders. The income generated from registration and provision of services to visitors can be ploughed back into the maintenance and servicing of the infrastructures. Part of the income generated can also be used in expanding the facilities and improving the quality of service in the Kwa fall resort.

4.3.6 Beliefs and religious practices of the host communities. Beliefs concerning the Kwa fall have a considerable role to play in the development of the geotourism potential of the area as no visitor would feel relaxed in an unsafe environment. The government and host communities should ensure that Kwa fall and its hills is a safe haven for maximum relaxation.

Proper mitigation of these issues would give Kwa fall its pride of place as one of Africa’s geotourist destinations.

V. SUMMARY AND CONCLUSION

Geotourism potentials of the Kwa fall are enormous but currently not fully developed. These potentials include the presence of an exotic and exciting waterfall associated with fascinating geomorphic features, excellent pools connected with a small beach, rich and extremely attractive
vegetation as well as hills and picturesque environment. If the geotourism potentials of this natural wonder is well developed it will be a tourist’s number one destination site. The reasons for this under development are numerous and include: poor infrastructure (lack of hotels/accommodation, lack of restaurant and bars, lack of sit out points, unsafe walk way to the fall, poor road network), lack of political will, poor transportation system, lack of maintenance of existing infrastructures, lack of partnership among the community, government and stakeholders. To increase the public interest in the geotourism potential of the Kwa fall, all parties (community, government and stakeholders) must contribute significantly by creating public awareness and preserving the geotourism attraction for the purpose of training, teaching, environmental conservation, research, sustainable development, job creation and revenue generation.

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