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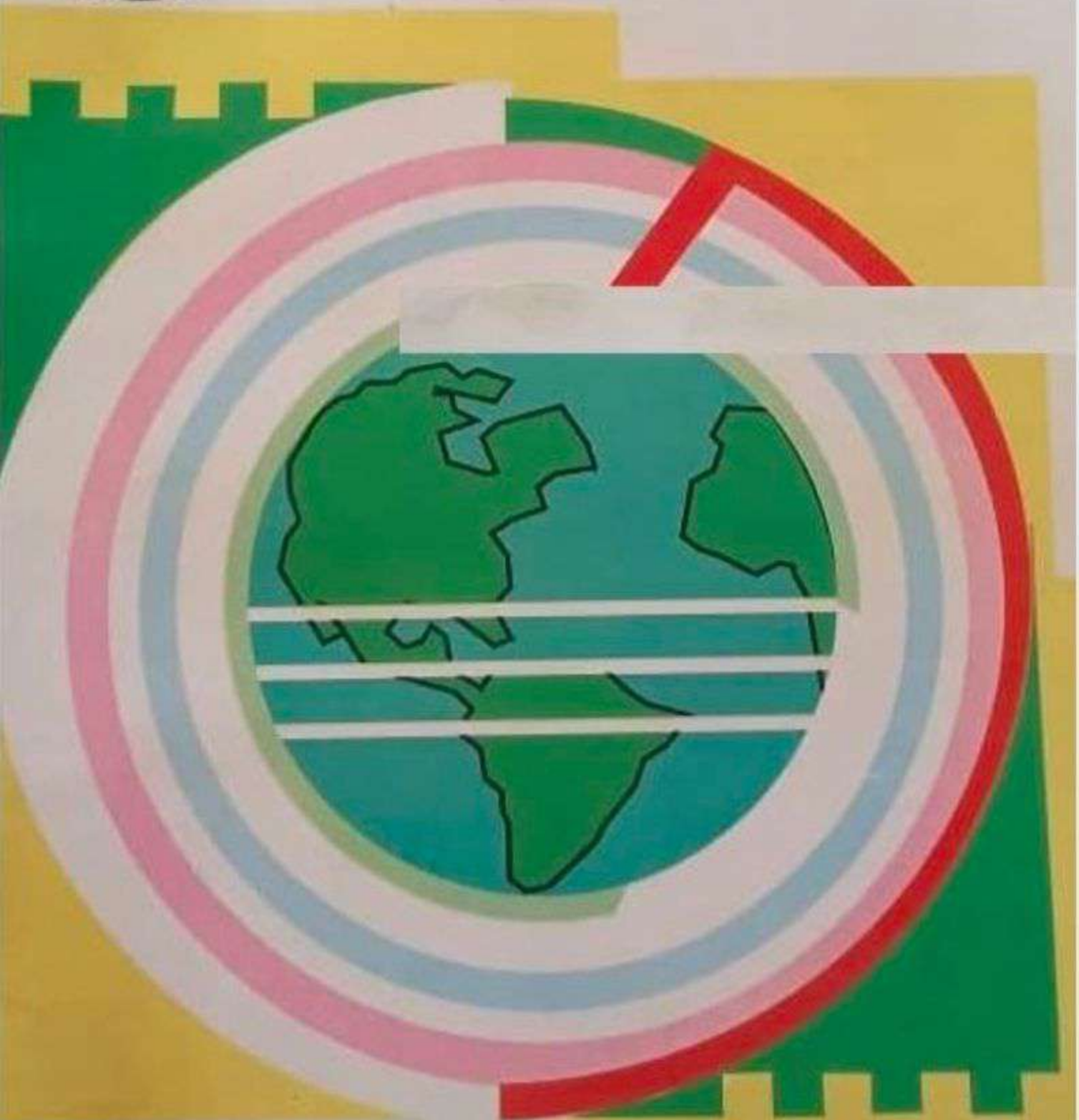

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# THE SCOPE OF DESERT ECOTOURISM ACTIVITIES IN THE BULATURA OASES SECTOR (BOS) OF CHAD BASIN NATIONAL PARK (CBNP) IN YOBE STATE-NIGERIA

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***Abstract:*** *Globally, sand dune is a blessing not a curse as perceived by Nigerians. Effective ecotourism planning and management requires the determination of attractions in destinations however, this information is grossly inadequate in Nigeria's aeolian sand dunes destination hence the need for this study. The study aimed at assessing the scope of desert ecotourism activities in the Bulatura Oases Sector of Chad Basin National Park in Nigeria. The objective of this study is to assess the physical characteristics of sand dunes in the study area as well as determining ecotourism activities that can be supported by the dunes and patronized by tourist using Remote Sensing, Geographic Information System (GIS), Laboratory analysis, field observation and interview. The result shows 440 dunes with 18 different shapes, variable sizes and heights with 7 different colours in the study area. The result also shows that all the 33 sand-based ecotourism activities compiled from literature can be supported by sand dune's shapes, sizes, heights and colours which constitute their physical characteristics in the study area. Although all these 33 activities were observed to be supported by dune's physical characteristics in the study area based on cultural compatibility however, only 27 were accepted for patronage based on economic consideration and uniqueness of each activity. The study concluded that the 6 rejected activities should be practiced. It further recommended the practice of all supportable desert ecotourism activities in the study area to enhance revenue generation and variability in ecotourism menu.*

**Key words:** Activities, Bulatura Oases Sector, Chad Basin National Park, Desert Ecotourism, Sand Dune

## INTRODUCTION

A dune is a single or coalescing heap(s) of sand formed by agent of erosion on the earth surface and in other planets due to friction on the surfaces of these planets. Dunes in dune-fields, sand-seas or erg are known to have different

shapes ranging from simple, compound and complex. Simple shapes are non-contiguous while compound and complex are a combination of two or more simple shape of the same (compound) or different (complex) dunes. The interaction between wind, sand and obstacles leads to the formation of different shapes while the intensity and duration of wind in addition to availability of little or plenty sand contributes significantly to the diversity of dune shapes (McKee, 1979; Bagnold, 1971). Simple dune's shapes include but not limited to barchans, dome, streak, reversing, linear, star and parabolic (Tsoar, 2001; Habes, 2010; Goudie et al. 2021; The National Aeronautics and Space Administration (NASA), 2023).

Different dune's sizes have been recorded in different spatial locations. Amin and Abu-Seif (2019) recorded an average dune area of 1,833.687$m^2$ in South Jeddah area of Saudi Arabia while Solazzo et al. (2018) recorded a range of 3,411$m^2$ - 74,319$m^2$ in the Paria Plateau of USA. Liu et al. (2018) recorded an average dune area of 650$m^2$ in the Tirari Desert of South Australia. Dune's height in these locations can range from few centimetres to more than 2000m tall. In South Jeddah area of Saudi Arabia, Amin and Abu-Seif, (2019) observed a height range of 1.9m - 21.5m while Stone (2013) recorded a height of 100m, 145m and 2–10m high for Linear, Star and Barchan shape dunes respectively. Pinkish, reddish, white, light grey and brown, yellowish-red, reddish-yellow, reddish-browns, brown and light yellowish-red are some of the coloured dunes seen in the southwest desert region of the United State, in central Saudi Arabia and in the Abardej area of Iran (White and Bullard, 2009; Roudgarmi and Farahani, 2016; Bradley et al., 2018). These ever-changing physical characteristics of sand dunes makes them one of nature's most admired desert attraction hence its utilization for tourism.

In most sand bearing destinations, tourists do not only come for sightseeing (Singh, 2018). Dune's characteristics also support and encourage the practice of different sand-base sports ranging from sledging, jogging, parasailing, paragliding, sand dune Camel/Horse riding, sand dune cycling, biking tour and so on (Eshraghi et al., 2010; Gagnol and Landel, 2016; BharatGoGreen, 2023; Ofre, 2024). Although some activities like sand bathing, sand dune's camping, dancing, Jeep safari using 4wheel drive and sandboarding are size-dependent and can be supported by only a single dune's characteristics however, others depended on a combination of two or more characteristics to offer tourist the desired satisfaction required to ensure continuity. These activities include but not limited to dune hiking/climbing, watching/sightseeing, stargazing/Astronomic tour, guided nature tour, watching dawn and dusk and botanical tour (Tourist information for tottori, 2015; Dell, 2016; Yabai, 2019; Woyo and Amadhila, 2018). These activities help to increase the revenue generation from dunes as well as the recreational and tourism worth of the destination hence the global recognition and consideration of sand dune as a natural resource for national development. A collection of sand-base ecotourism activities have been practiced in desert ecotourism destinations like Colorado in the USA, Rajasthan in India, Tottori in Japan, South Australia, Iran, Morocco, Algeria, Egypt, Namibia, Niger republic and Nigeria (Rais, 2013; Tourist information for tottori, 2015; Yabai, 2019; Eshraghi et al., 2010; Woyo and Amadhila, 2018). These and many more activities help to enhance and sustain tourist patronage and revenue generation hence their recommendation for practice in sand bearing destination where necessary.

Additionally, dunes have been wildly acknowledged and celebrated as an important

natural resource necessary for national development. In countries like Ireland, Peru, Japan, Carolina, New Zealand, Netherlands, South Africa, Namibia, Nigeria, Spain and India, dunes have been used for coastal environmental protection and restoration, cereal crop cultivation, construction, mineral resource mining, cultural preservation and recreation (Ramesh et al., 2022, Ofre, 2024). In eastern Japan, Misawa village was spared from the 2011 devastating impacts of the great tsunamic earthquake due to the embankment formed by the coastal dunes (Nandasena et al., 2012). In Saudi Arabia and in Michigan -USA, dunes are used for construction (Abu-Seif et al., 2016; Clark, 2022). In South Africa, it is mined for minerals and heavy metals (Barnett, 2012). Socially, the tales of Maori cultural heritage in New Zealand (Hesp, 2000), the ancient Dutch painters in the Netherlands (Parsons, 1968) and the early hydraulic civilizations in Peru cannot be complete without the acknowledgment of coastal dunes (Ramesh et al., 2022). For also serving as an essential site for the cultivation of cereals and leguminous crops, botanical garden for the collection of medicinal and non-medicinal plants and a vital habitat for many invertebrates and vertebrates, credit have been given to coastal dunes (Bhagya and Sridhar, 2009; Ramesh et al., 2022). In view of the above, the economic worth of dune's provisioning, regulation, cultural and supporting services in addition to recreation and tourism have been estimated in Mexico and Colorado (Mendoza-González et al., 2012; Heberling and Templeton, 2009), in Spain (Brenner et al., 2010), India (Ramesh et al., 2022) and Nigeria (Ofre, 2024).

Despite being acknowledged as a blessing globally due to its enormous economic benefits, Nigerians still view their dunes with contempt because most indigenous literatures (Nichol, 1991; Musa and Shaib, 2010; Usman et al., 2014; Agbaje et al., 2020) considered it a threat to human existence, to agriculture, to infrastructure and societal welfare hence the need to document its ecotourism potentials and supportive activities to enhance valuation of its recreational and tourism potentials to facilitate a change of perception. The aim of this study is to assess ecotourism activities that can be supported and practiced in the Bulatura Oases Sector (BOS) of Chad Basin National Park (CBNP). The objectives of this study include (i) to assess the physical characteristics (shapes, sizes, height and colour) of dunes (ii) evaluate the supportability dune's characteristics for various sand-based ecotourism activities and (iii) determined if these activities can be patronized by tourist in the study area using geospatial techniques (Remote Sensing and GIS), laboratory analysis, field observation and structured interview.

## METHODOLOGY

### STUDY AREA

The Bulatura Oases Sector of Chad Basin National Park is a 92km$^2$ landmass located in Yusufari Local Government Area (LGA) of Yobe State -Nigeria toward the extreme Northeast and lies between Latitude 13°7'00"N - 13°21'30"N of the equator and Longitude 11°11'20"E - 11°13'50"E of the Green Wich Meridian (CBNP, 2011). Yusufari LGA shares borders to the North and North-east with the Republic of Niger and Yunusari LGA, to the South-west and South-east with Karasuwa and Borsari LGA and to the West with Machina LGA respectively as shown in Figure 1.

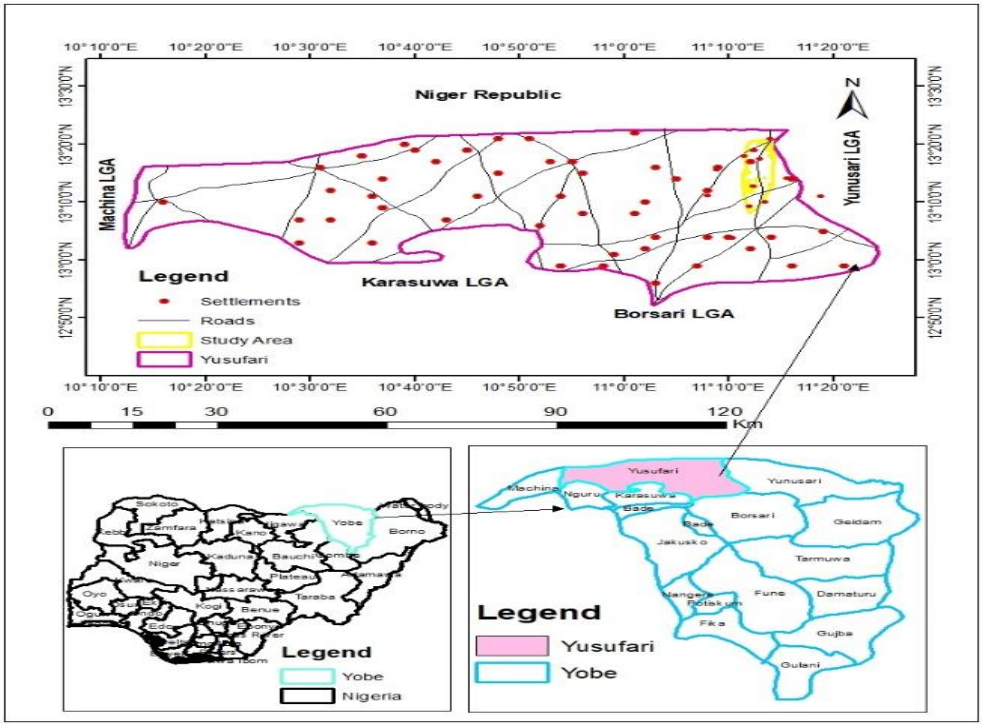


**Figure 1: Study Area**
**Source: Field Observation, 2023**

The study area is the only portion of Nigeria's National Park where sand dunes and Oases are exhibited for tourism (CBNP, 2011). It was established as Kilboa Forest Reserve in 1970 by the then Borno state government and later handed over to the Federal government in 1991 which led to a change of status (CBNP, 2011). Its status changed from Forest Reserve to a National Park (CBNP) when it was taken over by the Federal Government.

The study area is located in the tropics which has defined wet and dry seasons characterized by the dry continental Northeast trade wind (cT) which originates from the Sahara Desert, and the moist maritime South-westerly monsoon (mT) which originates from the Atlantic Ocean respectively. Dry season in the study area starts from October to May while the wet start from June to September (Elijah et al., 2017). Average annual scanty rainfall of 300mm with a minimum, mean and highest temperature of 19°C, 37°C and 44°C respectively have been recorded (Elijah et al., 2017; Gana, 2018). The soil comprises mostly of consolidated sands which makes it easily eroded by the dry wind since no surface drainage system abound in the study area. More so, the gently sloping plains with very few shrubs and scanty grasses encourage dunes transportation and eventual deposition mostly parallel to the wind direction (Gana, 2018).

According to the National Population Commission (NPC) in 2006, Yusufari Local Government area had a population of 125,821 that comprises of 64,349 males and 61,472 females (NPC, 2006). In 2023, the National Bureau of Statistics (NBS) asserted that the population of Yusufari grew by 60.5% from 125,821 in 2006 to 201,948 in 2023 based on the NPC 2006 projections (NBS, 2023). The inhabitants of this Local Government Area are largely members of the Hausa, Kanuries,

Tangali, and Fulani ethnic division whose main economic activities are crop farming, animal husbandry, pottery, potash mining, art and craft making, skill acquisition and commercial activities like tailoring/fashion designing, carpentry/furniture making, building construction, welding and fabrication, plumbing, vulcanizing, vehicle and motorcycle repairs and maintenance. Others include basic and secondary schools, grocery stores and supermarkets, patent medical stores and clinics, vehicle and motorcycle transport services, restaurants and fast food-joins, cafeteria, bakeries, local flour mills commercial fuel wood collection (Gana, 2018; Ofre, 2024).

## REMOTE SENSING AND GIS METHOD

The shapes, size and heights of sand dunes that can support ecotourism activities in the study area were obtained from google earth satellite with a spatial resolution of 1280 by 720 high definition (720HD) and analysed in ArcGIS. Googleearthprowin-7.3.6-x64 application was downloaded from the internet, installed on a Personal Computer (PC) and launched. The google-earth-pro-win satellite from the application was zoomed into the study area and historical time adjuster was adjusted until the image of 2023 was captured. Dunes in the 2023 imagery were identified using a point place marker. Accuracy assessment was done by visiting the study area and collecting the coordinates from 18 random dunes used as Ground Control Points (GCP) with the help of a Global Positioning System (GPS). These GCP were located about 100m away from each and were used for the purpose of ground truthing. After ground truthing, dune's outlines were traced in google earth imagery, digitized as polygons and saved in a KML file folder with each dune having a serial number. The shapes of digitized dunes were obtained in google earth imagery by comparing the shapes of their outlines with a standard dune's shape guideline. Dune's sizes (in square metre) were obtained in google earth imagery from the areal measurement of their polygonal outlines while their heights were obtained from google earth imagery using the differences between the peak and base elevations of each dune. ArcGIS 10.8 on the PC was launched and the KML file folder containing dunes in google earth imagery was then imported into ArcGIS on the PC and converted to shapefile to show the spatial distribution and shapes in the spatial distribution map shown in Figure 2 and 3 respectively.

## LABORATORY METHOD

In order to obtain the colours of sand dunes in the study area, sand samples were collected from the 18-Ground Control Point (GCP) used for accuracy assessment. Samples of coloured sand were collected randomly from dunes at about 100m away from each other using plastic bottles. Each coloured sand sample collected was labelled and taken to Ahmadu Bello University Soil Laboratory for visual examination using a Munsell colour chart. The colours of sand dunes in the study area were obtained using a Munsell colour chart.

## FIELD OBSERVATION AND PERSONAL INTERVIEW METHOD

Sand-base ecotourism activities were compiled from literature to form an interview guide and sand dunes characteristics (shapes, size, heights and colour) that can support each activity from the guide were first determined using dune's physical characteristics observed in the study area. A single session 3 hours structured interview (SI) was thereafter conducted on the 24$^{th}$ of August, 2023 with 10 staff of Chad Basin National Park (CBNP). Experienced staff of CBNP from Research (4) and Ecotourism (6) departments were interviewed based on the interview guide

computed to ascertain activities that can be supported by dunes in the study area. The supportable activities were further tested for compatibility with indigenous cultural, economic hardship and similarity with others to ascertain if they be patronizable using SI with the above stated respondents.

## FINDINGS

Figure 2 and 3 shows the locations and shapes of sand dunes in the study area that can support ecotourism obtained using geospatial analytical techniques.

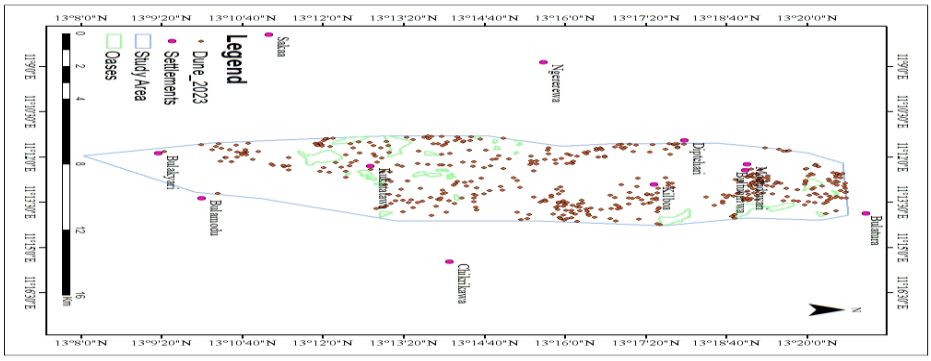


**Figure 1: Dune Distribution in the Study Area**
**Source: Google Earth Imagery Analysis**.

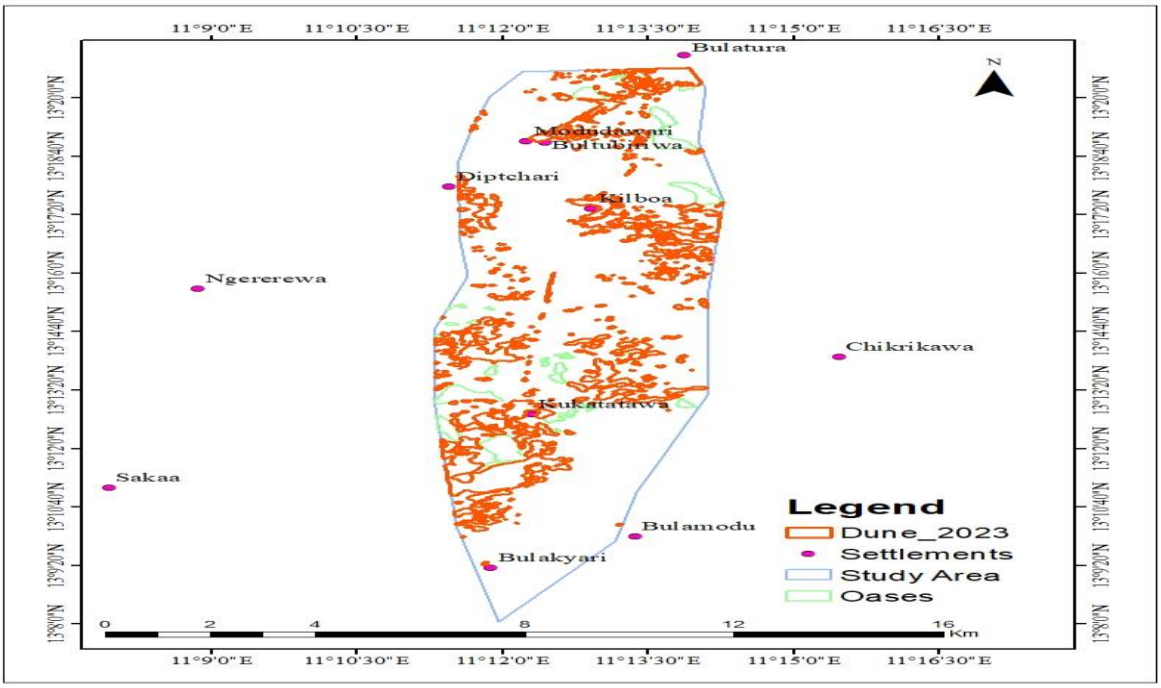


**Figure 3: Dune's Shapes in the Study Area.**
**Source: Google Earth Imagery Analysis**

Table 1 shows the characteristics of sand dunes obtained using geospatial analytical in the study area that can support ecotourism techniques.

**Table 1: Characteristics of Sand Dunes (Shapes, Sizes [smallest and largest], Height [shortest and tallest] and Colour) in the Study Area that can support Ecotourism.**

| S/n | Shape of Sand Dunes | Frequency | Dune Serial No. | Area ($M^2$) | Dune Serial No. | Height (M) | Dunes' colour |
|---|---|---|---|---|---|---|---|
| | **Simple** | | | | | | |
| **1** | Barchan | 62 | 188<br>438 | 187<br>84802 | 438 | 4.27 | Pinkish-white (2.5YR 8/2, 5YR 8/2 and 7.5YR 8/2); |
| **2** | Parabolic | 33 | 75<br>437 | 124<br>34899 | 437 | 7.02 | |
| **3** | Star | 61 | 41<br>430 | 316<br>95253 | 430 | 5.49 | Reddish-Yellow (7.5YR 6/6 and 7.5YR 7/6); |
| **4** | Dome | 111 | 9<br>427 | 296<br>47849 | 427 | 4.58 | |
| **5** | Transverse | 33 | 64<br>440 | 579<br>177476 | 440 | 6.41 | Very Pale-Brown (10YR 8/3, 8/4 and 7/4) |
| **6** | Linear | 78 | 96<br>439 | 161<br>58735 | 439 | 3.66 | Yellowish-Red (5YR 4/6 and 5/6) |
| | **Compound** | | | | | | Yellowish-Brown (10YR 5/4 and 5/6) |
| **1** | Barchan-Barchan | 5 | 6<br>386 | 1236<br>20456 | 386 | 4.27 | Strong-Brown (7.5YR 5/8) and Brown (7.5YR 5/4) |

| | | | | | | |
|---|---|---|---|---|---|---|
| **Complex** | | | | | | |
| **1** | Barchan-Parabolic | 8 | 15<br>387 | 26619<br>230760 | 387 | 9.15 |
| **2** | Star- Barchan | 4 | 3<br>350 | 17476<br>89267 | 350 | 3.05 |
| **3** | Star-Transverse | 3 | 193<br>329 | 6088<br>94769 | 329 | 6.1 |
| **4** | Star- Barchan-Parabolic | 3 | 1<br>214 | 164967<br>322452 | 19 & 214 | 5.49 |
| **5** | Star- Barchan-Transverse-Parabolic | 14 | 2<br>337 | 6888<br>2086350 | 337 | 12.81 |
| **6** | Transverse -Barchan | 2 | 178<br>228 | 11628<br>79721 | 228 | 0.61 |
| **7** | Transverse -Parabolic | 2 | 151<br>161 | 18156<br>173125 | 151 | 1.22 |
| **8** | Transverse -Barchan-Parabolic | 8 | 5<br>395 | 19068<br>408328 | 334 | 7.02 |
| **9** | Linear-Transverse | 1 | 414 | 96050 | 414 | 5.19 |
| **10** | Linear- Barchan | 11 | 16<br>434 | 565<br>162562 | 434 | 5.80 |
| **11** | Linear-Parabolic | 1 | 145 | 15597 | 145 | 3.36 |
| | **Total** | **440** | | **12,894,307** | | **7** |

**Source: Google Earth Imagery Analysis.**

It was observed from Table 1 that 18 different shapes of sand dunes were observed and they include 6 simple shapes, 1 compound shaped and 11 complex shapes - sand dunes. The average dune sizes observed in the study area ranges from 187m$^2$- 2,086,350m$^2$. Dune's heights in the study area were between 0.00m-12.81m tall and 7 different colours of dunes were confirmed using a Munsell colour chart. These colours include pinkish-white, reddish-yellow, very-pale-brown, strong brown, brown, yellowish-red and yellowish-brown. Apart from making the scenery colourful and attractive, the different shapes, sizes, heights and colours of dunes makes the sand dunes in the study area more captivating and suitable for different sand-base activities for different age-groups of tourists. These results agree with (McKee, 1979; Tsoar, 2001; Goudie et al., 2021; NASA, 2023) who documented different shapes, Solazzo et al. (2018), Amin and Abu-Seif (2019) who documented different sizes, (Stone, 2013; Amin and Abu-Seif, 2019) who recorded different dune's heights and (White and Bullard, 2009; Manare et al., 2016) who documents different sand colours in dune's fields. Whereas children prefer hiking lower dunes, youth prefer taller and tallest while aged people preferred medium height dunes. Dune's shapes, sizes and heights are somehow interrelated for instance, star-shaped dunes are usually the biggest and tallest simple dune while domed-shape dunes are the mostly the smallest and shortest simple dune record in most destination.

Table 2 shows ecotourism activities that can be supported by sand dunes in the study area based on dune's physical characteristics observed from geospatial analysis.

**Table 2 Activities that can be Supported by Dunes based Dune's Characteristics in the Study Area**

| Dune's characteristics | Activities that can be supported by the characteristics | Frequency |
|---|---|---|
| **Shapes** | Sand bathing/sand therapy, camping on sand dunes, sand dune dancing, sand dune photography, sand dune moulding/sculpturing, visiting sand dune Museum, sand dune watching/sightseeing, volunteer conservation project, guided nature tour and botanical tour. | 10 |
| **Sizes** | Jeep safari/sand dune driving (4x4 wheel), sledding, jumping off the dunes, zip lining, sleeping and rolling down the dune, sand bathing/sand therapy, jogging, parasailing, flying with gliders over sand dunes, paragliding, sand dune Camel/Horse riding, sand dune cycling, camping on sand dune, biking tour (normal bike), hot air balloon riding, sand dune dancing, sand dune wheelchair riding, quad/quad biking, yoga adventure, sand dune photography, **s**andboarding, **s**and dune mining, sand dune watching/sightseeing, volunteer conservation project, educational workshop, stargazing and Astronomic tour, guided nature tour, watching dawn and dusk on dunes and botanical tour. | 28 |
| **Heights** | Jeep safari/sand dune driving (4x4 wheel), sledding, jumping off the dunes, zip lining, sleeping and rolling down the dune, sand bathing/sand therapy, jogging, parasailing, flying with gliders over sand dunes, paragliding, sand dune Camel/Horse riding, sand dune cycling, camping on sand dune, biking tour (normal bike), hot air balloon riding, sand dune dancing, sand dune wheelchair riding, quad/ quad biking, yoga adventure, sand dune photography, **s**andboarding, **s**and dune mining, sand dune hiking/climbing, sand dune watching/sightseeing, sand dune skiing, volunteer conservation project, educational workshop, stargazing and Astronomic tour, guided nature tour, watching dawn and dusk on dunes and botanical Tour. | 31 |
| **Colours** | Jeep safari/ sand dune driving (4 x 4 wheel), sledding, jumping off the dunes, ziplining, sand dune photography, **s**and dune moulding/sculpturing, visiting sand dune sculpture/Museum, sand dune mining, sand dune watching/sightseeing, volunteer conservation project, educational workshop, guided nature tour and botanical tour. | 13 |

**Source: Field Survey, 2023.**

It was observed from Table 2 that out of the 33 ecotourism activities identified from literatures, 10 can be supported by the shapes of dunes while 28 can be supported by the dune's sizes in the study area. Also, 31 can be supported by the dune's height while 13 activities can be supported by the dune's colours in the study area. Variability in sand-based ecotourism options in the study area suggest that the BOS of CBNP deserved the status of a sand dune ecotourism hotspot since it is the only portion of Nigeria's National Park where sand dunes are exhibited for tourism. On like the single shape, single size, uniform

height characteristics of beach dunes, the various characteristic of in-land desert dunes enable them to support more sand-based activities than their beach counterparts. These Variabilities can help to sustain tourists' patronage by enhancing satisfaction. These results corroborate Rais (2013), Singh (2018), Eshraghi et al. (2010) who documented the practice of the above stated activities in Indian and Iranian deserts whose sand dunes are used extensively for ecotourism.

Table 3 shows ecotourism activities that can be supported by sand dunes characteristics in the study area based on structured interview conducted with staff of Chad Basin National Park.

**Table 3 Ecotourism Activities that can be Supported by Sand Dunes in Study Area based on Structured Interview**

| Dune's characteristics | Ecotourism activities | Frequency of Dune's characteristics |
|---|---|---|
| Sizes, height and colours. | Jeep safari/ Sand dune driving (4 x 4 wheel) | |
| Sizes, height and colours. | Sledding | |
| Sizes, height and colours. | Jumping off the dunes | |
| Sizes, height and colours. | Zip lining | 6 |
| Sizes, heights and colours. | Educational workshop | |
| Sizes, heights and colours. | Sand dune mining | |
| Shapes, sizes and heights | Sand bathing/ Sand therapy | |
| Shapes, sizes and heights | Camping on sand dune | 3 |
| Shapes, sizes and heights | Sand dune dancing | |
| Sizes and heights | Sleeping and rolling down the dune | |
| Sizes and heights | Jogging | |
| Sizes and heights | Parasailing | |
| Sizes and heights | Flying with gliders over sand dunes | |
| Sizes and heights | Paragliding | |
| Sizes and heights | Sand dune Camel/ Horse riding | 13 |
| Sizes and heights | Sand dune Cycling | |
| Sizes and heights | Biking tour | |
| Sizes and heights | Hot air balloon riding | |
| Sizes and heights | Sand dune wheelchair riding | |
| Sizes and heights | Quad/ quad biking | |
| Sizes and heights | Yoga adventure | |
| Size and heights | Sandboarding | |
| Shapes and colours. | Sand dune moulding/sculpturing | 2 |
| Shape and colours | Visiting sand dune sculpture/Museum | |
| Sizes and heights. | Sand dune hiking/climbing | 4 |
| Sizes and heights | Sand dune skiing | |
| Sizes and heights | Watching dawn and dusk on dunes | |
| Sizes and heights | Stargazing and Astronomy tour | |
| Shapes, sizes, heights and colours. | Guided nature Tour | |
| Shapes, sizes, heights and colours. | Botanical Tour | |
| Shapes, sizes, heights and colours. | Sand dune watching/sightseeing | 5 |
| Shapes, sizes, heights and colours. | Sand dune photography | |
| Shapes, sizes, heights and colours. | Volunteer conservation project | |
| **TOTAL** | | **33** |

**Source: Field Survey, 2023.**

It was observed from Table 3 that out of the 33 ecotourism activities identified from literatures, 6 can be supported by the Sizes, height and colours of sand dunes while 3 can be supported by the shapes, sizes and heights of dunes in the study area. Furthermore, 13 can be supported by the Sizes and heights of dunes in the study area while 2 can be supported by the Sizes and colour of dunes in the study area. Better still, 4 activities can be supported by the Sizes and heights of dunes in the study area while 5 activities can be supported by the Shapes, sizes, heights and colours of dunes in the study area. Dune's ability to support a plethora of ecotourism activities in the study area imply that maximum tourist satisfaction and sustainable patronage can easily to achieved. Patronage from the above state activities will strengthened ecotourism revenue generation in the study area. These results corroborate BharatGoGreen, (2023), Ruland (2020), Woyo and Amadhila, (2018) and Yabai, (2019) who documented the practice of the above stated activities in Indian deserts, the Great Sand Dunes National Park in Colorado, USA, the Namib Sand Sea (NSS) in Namibia and Tottori National Park (TNP) in Japan.

Table 4 shows ecotourism activities that can be supported and patronized by tourist in the study area based on cultural consideration economic hardship as obtained from structured interview.

**Table 4 Activities that can Patronized by Tourist in the Study Area based on Structured Interview**

| S/n | Dune's characteristics | Activities that can be supported | Intending patronage | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | Cultural compatibility | | Economic hardship | | Uniqueness/ Similarity with others | |
| | | | Yes | No | Yes | No | Yes | No |
| 1 | Sizes, height and colours. | Jeep safari/ Sand dune driving (4x4 wheel) | Yes | | Yes | | | No |
| 2 | Sizes, height and colours. | Sledding | Yes | | Yes | | | No |
| 3 | Sizes, height and colours. | Jumping off the dunes | Yes | | Yes | | | No |
| 4 | Sizes, height and colours. | Zip lining | Yes | | Yes | | | No |
| 5 | Sizes and heights | Sleeping and rolling down the dune | Yes | | Yes | | | No |
| 6 | Shapes, sizes and heights | Sand bathing/ Sand therapy | Yes | | Yes | | | No |
| 7 | Sizes and heights | Jogging | Yes | | Yes | | | No |
| 8 | Sizes and heights | Parasailing | Yes | | Yes | | | No |
| 9 | Sizes and heights | Flying with gliders over sand dunes | Yes | | Yes | | | No |
| 10 | Sizes and heights | Paragliding | Yes | | Yes | | | No |
| 11 | Sizes and heights | Sand dune Camel/ Horse riding | Yes | | Yes | | | No |
| 12 | Sizes and heights | Sand dune Cycling | Yes | | Yes | | | No |
| 13 | Shapes, sizes and heights | Camping on sand dune | Yes | | Yes | | | No |
| 14 | Sizes and heights | Biking tour | Yes | | Yes | | | No |
| 15 | Sizes and heights | Hot air balloon riding | Yes | | Yes | | | No |
| 16 | Shapes, sizes and heights | Sand dune dancing | Yes | | Yes | | | No |
| 17 | Sizes and heights | Sand dune wheelchair riding | Yes | | Yes | | | No |
| 18 | Sizes and heights | Quad/ quad biking | Yes | | Yes | | | No |
| 19 | Sizes and heights | Yoga adventure | Yes | | Yes | | | No |
| 20 | Shapes, sizes, heights and colours. | Sand dune photography | Yes | | Yes | | | No |

| | | | | | | |
|---|---|---|---|---|---|---|
| 21 | **Size and heights** | Sandboarding | **Yes** | **Yes** | | **No** |
| 22 | Shapes and colours. | Sand dune moulding/sculpturing | Yes | Yes | | No |
| 23 | Shape and colours | Visiting sand dune sculpture/Museum | Yes | Yes | | No |
| 24 | Sizes, heights and colours. | Sand dune mining | Yes | Yes | | No |
| 25 | Sizes and heights. | Sand dune hiking/climbing | Yes | Yes | | No |
| 26 | Shapes, sizes, heights and colours. | Sand dune watching/sightseeing | Yes | Yes | | No |
| 27 | Sizes and heights | Sand dune skiing | Yes | Yes | | No |
| 28 | Shapes, sizes, heights and colours. | Volunteer conservation project | Yes | No | Yes | |
| 29 | Sizes, heights and colours. | Educational workshop | Yes | No | Yes | |
| 30 | Sizes and heights | Stargazing and Astronomy tour | Yes | No | Yes | |
| 31 | Shapes, sizes, heights and colours. | Guided nature Tour | Yes | No | Yes | |
| 32 | Sizes and heights | Watching dawn and dusk on dunes | Yes | No | Yes | |
| 33 | Shapes, sizes, heights and colours. | Botanical Tour | Yes | No | Yes | |

**Source: Field Survey, 2023.**

It was observed from Table 4 that all the 33 ecotourism activities identified from literatures can be patronized by tourist in the study area based on culturally compatibility while only 27 ecotourism activities can be patronized based on both economic hardship and uniqueness to the study. The 6 ecotourism activities that cannot be patronized based on economic hardship were also the same activities that are similar to other previously accepted activities. In view of the above, respondents believed that volunteer conservation project and botanical tour were similar to camping on sand dunes while educational workshops, stargazing and astronomical tour as well as watching dawn and dusk were very similar to sand dune watching/sightseeing. More so, guided tour was also likened to jeep safari/sand dune driving on four wheels drive hence their rejection These results disagreed with Ruland (2020), Yabai, (2019) and Dell, (2016). who recorded the practice of these rejected activities in the Great Sand Dunes National Park in Colorado, USA, Tottori National Park (TNP) in Japan and in the Namib Sand Sea (NSS) of Namibia.

The results obtained imply that sand dunes in study area can support a pectora of practicable ecotourism activities. These activities if properly implemented and practiced can boast the revenue generation ability of Chad Basin National Park, Yobe State and the Yusufari Local government authority to ensure financial self-sufficiency and reduce their over-dependence on Federal government subvention. The attainment of self- sufficiency by these ecotourism key players in the study area as well as the satisfaction derived from visiting tourist will help to enhance the change of perception about sand dunes in the study area due to its enormous economic, aesthetics and recreational benefits enjoyed.

## CONCLUSION

The different shapes, sizes, heights and colours of dunes in the Bulatura Oases Sector of Chad Basin National Park makes them remarkably alluring to tourists. These shapes, sizes, heights and colours can support additional 29 sand-base ecotourism activities whose patronage will result to additional revenue apart from the one current generated from 4 activities (watching, photography, hiking and mining).

The additional revenue to be generated can make Chad Basin National Park, Yusufari Local Government Authority and the Yobe State Government to become financially independent thereby reducing their dependency on federal allocation.

## RECOMMENDATIONS

The study therefore recommends the following;

1. Constant monitoring of the shapes, sizes, heights and colours of sand dune's using remote sensing, GIS, personal observation and field survey is recommended to ascertain ecotourism potentials of sand dunes at any given time in the study area.
2. Constant monitoring of the above - mentioned sand dune characteristics using remote sensing, GIS and field survey is recommended to enhance the documentation of flexible ecotourism plans that can be implemented in the study area.
3. Future study adopting the same or similar methodology should expand the scope of respondents and the activities - selection criteria to tests if the rejected activities were mainly due to methodological bias.

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