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USE OF INFORMATION COMMUNICATION TECHNOLOGY IN BIODIVERSITY CONSERVATION: A CASE STUDY OF OLD OYO AND KAINJI LAKE NATIONAL PARKS, NIGERIA

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ABSTRACT

National parks were functionally mandated to preservation and conservation of both the flora and fauna. To fulfil its mandates, need for the deployment of current and updated resources become necessary. In the recent decades ICT around the globe at various sectors remains a keynote to any field seeking transformative impacts. The Old Oyo and the Kaniji Lake national parks were studied to determine its current state of ICT facilities deployment and engagement. Purposive technique was used to select the relevant departments in the two parks, random sampling was used for the data collection and descriptive statistics and chi-square to analyzed the data. The results reveal computers, Local Area Network (LAN), internet connectivity, Database, Global Positioning System (GPS), and trap camera ($\bar{x}$=3.0) were the most frequently used ICT facility by both Parks while the relevant contributions to biodiversity depends on both the available facilities along with manpower ICT proficiency. Poor funding was identified as the major challenges in the two parks. The study recommends that national parks authorities should invest more in ICT facilities to aid effective park management and to reduce Wildlife crimes.

Keywords: Biodiversity, Conservation, Information Communication Technology, Old Oyo National Park, Kainji Lake National Park

INTRODUCTION

The integration of new technologies for conservation can improve how the park authority monitor and measure changes to species and whole ecosystems (Pimm, 2015) which is critical to guide and evaluate management and policy decisions. Technology can provide novel data sources, expanded spatial and temporal coverage, access to real-time information and rapid processing and analysis for intervention (Pettorelli,Saf, and Turner, 2014)., The inclusion of real-time transmission and processing of data streams from acoustic devices has advanced remote detection and response to illegal logging (Marvin, 2016), the rapid growth and availability of technologies has been driven largely by adapting existing and consumer-oriented technologies to specific conservation needs (Snaddon, Petrokofsky, Jepson and Willis *et al*., 2013), including hobby drones for monitoring and response to threats (Pettorelli, *et al*., 2014), in situ molecular analyses in remote field settings 12, radar data to forecast bird migrations at continental scales (Horton, 2018) and the application of block chain protocols for fisheries supply chain management (Howson, 2020). While these options are widely available for commercial application, they may lack features required for ecological conservation purposes such as limited durability and power efficiency, constraints from proprietary silos, or high technical knowledge barriers (Howson, 2020). In other cases, adoption of data-rich and real-time sensors can lead to secondary problems with managing large datasets that often require their own custom approaches and pipelines (Norouzzadeh, 2018). Such constraints are thought to limit the uptake of new tools, but only recently have efforts been made to assess the degree to which they restrict the use of technologies in conservation settings and how to prioritize improvements for future development (Hill, 2018). Managing the environment in the modern world is becoming daunting and requires the application of modern technology. The rate at which the world is polluted recently with materials released into the environment; and degraded because of the materials withdrawn from the environment are causes for concern. Since Information and Communications Technology (ICT) have become a fundamental part of daily life (Volkodaeva, Balanovskaya and Rustenova, 2022) and its progressive impacts in any sector that has been fully adopted cannot be overemphasized. It is highly noted that developing nations of the world are gearing towards linking all economic activity to ICT based economy (Eleberi, 2021), in fact ICTs are transformative technologies that put intelligence at the edges of networks (Farounbi, 2013).

Though National parks are an important source of revenues, its main purpose of preserving the natural landscape and biodiversity should prevail (Abdou, Musabanganji, and Musahara, 2022). However there is need to arrest this loss of our biodiversity by adopting the use ICT hence, the monitoring and evaluation of the ecosystems using I and C T skills.

Several research works have been presented considering the role of ICT in biodiversity and its impacts on national park management. The role of ICT in biodiversity management in Nigeria was presented (Nwaizuzu-Daniel ,Nnadi and Opara, 2023), it enumerated the available ICT resources that are highly sophisticated, transformative technologies and useful to the management of Nigeria's biodiversity. The fact that ICT helps to assess the ecosystem better than the traditional methods of monitoring the environment and that it gives opportunity to prepare ahead of emergencies and facilitates quick response to environmental disasters. Effect of the usage of ICT in volcanoes national park Rwanda was carried out (Nyirigira, 2022), the services rendered by the park as it related to ICT and satisfying the tourist was discussed. Also the ICT resources available and in use in the park like GPS/GIS, VHF radio, radio tracking frequency devices and many more were highlighted. Conservation of biodiversity by making use of ICT was discussed (Yuka, Yoshihiko, Mutsumi and Fukutarol., 2014). It presented examples of utilizing ICT as Fujitsu's activities for biodiversity conservation. The work further considered information and its positive use to be essential keys for moving in the right

direction by understanding complicated natural environments globally and this is based on the positive use of ICT. Since using ICT in biodiversity conservation will be handled by the national park personnel, the knowledge and the use of ICT at Eco-destinations in Old Oyo National Park, Ikogosi Warm Spring Resort and Lacampagne Tropicana in Nigeria was considered (Oyebode, Adeyemo and Oladeji, 2021). The Staff were little competence in the ICT applications which was identified to poor ICT training received. The use of sophisticated software for forest fire detection system (Firehawk software) that differentiates between fire, smoke and glow and automatically raises the appropriate alarm was discussed (Oyinloye and Agbolade, 2019). The role of ICT on environmental protection was presented (Dastres and Mohsen, 2021), the use of ICT for system in the field of environment increased the efficiency of environmental pollution reduction, improve environmental protection and conservation. So the adaptability of ICTs to all aspects of human life has presented the opportunity to develop diverse tools and applications focused on the forest and environment (Gavilanes Montoya, Castillo Vizuete and Marcu, 2023), and Biodiversity Conservation in old Oyo and Kainji Lake National Park stands the benefits. The use of Internet Things (IoT) for wildlife conservation was presented (Ratnesh, 2020). Various challenges in the conservation of the wildlife which include deforestation, climate change, resource extraction, human-wildlife conflict, bush meat hunting and more were discussed. The work proposed a sensor based tracking system for detection of animal locations, animal heart rate and respiration information which provides a better platform in caring for the wild.

The study identify the types of I C T facilities, determine the contributions of I C T to biodiversity conservation and to assess the challenges encountered using I C T in biodiversity conservation in the study areas.

MATERIALS AND METHODS

Study Area

Old Oyo National Park covers a land area of approximately 2,512 km^2 making it the fourth largest national park in Nigeria. Politically, it lies in Oyo State in the Southwest of Nigeria and borders Kwara State in the Northeast.). While Kanji Lake National Park is a National Park in Niger State and Kwara State, Nigeria. Established in 1978, it covers an area of about 5,341 km^2 (2,062 sq mi).

Study Population and Sample Size

The two National Parks estimated staff strength was not revealed but it administrative department comprises of six (6) units, Ecology and Resource Management, Works and Maintenance Management, Ecotourism, Planning, Research and ICT, Human Resources Management and Finance and Accounts. The two parks were purposively selected based on their close proximity to the researchers. For the purpose of this research study, the target populations comprise the Staff of Planning, Research and ICT unit of the selected Parks, each of Head of different six (6) units and there staff, each Head of Park ranges whose daily operations involve the use of ICT. Hence, the sample size used for the study was put to one hundred and twenty (120) .

Method of Data Collection

Both primary and secondary sources of data were used for the srudy. The primary data was sourced through the use of structured questionnaire and face to face interview while the secondary data incorporates the use library research. One hundred and twenty questionnaires were administered during the study but eighty copies were collected from the respondents. The staff strength of Kainji Lake National Park were more than that of Old Oyo National Park so, seventy (70) copies were administered to staff of Kainji Lake National Park staff and fifty (50) copies to the staff of Old Oyo National Park. The six (6) units' heads of each of the parks were interviewed on their use of ICT in their various units.

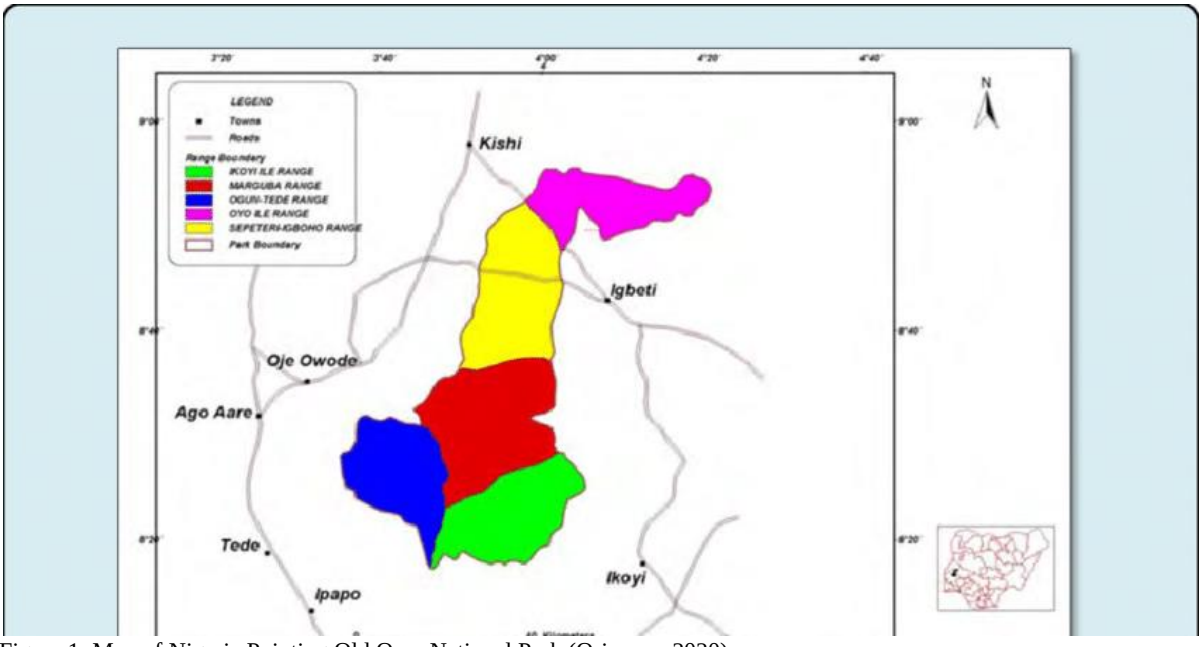

Figure 1: Map of Nigeria Pointing Old Oyo National Park (Orimaye, 2020)

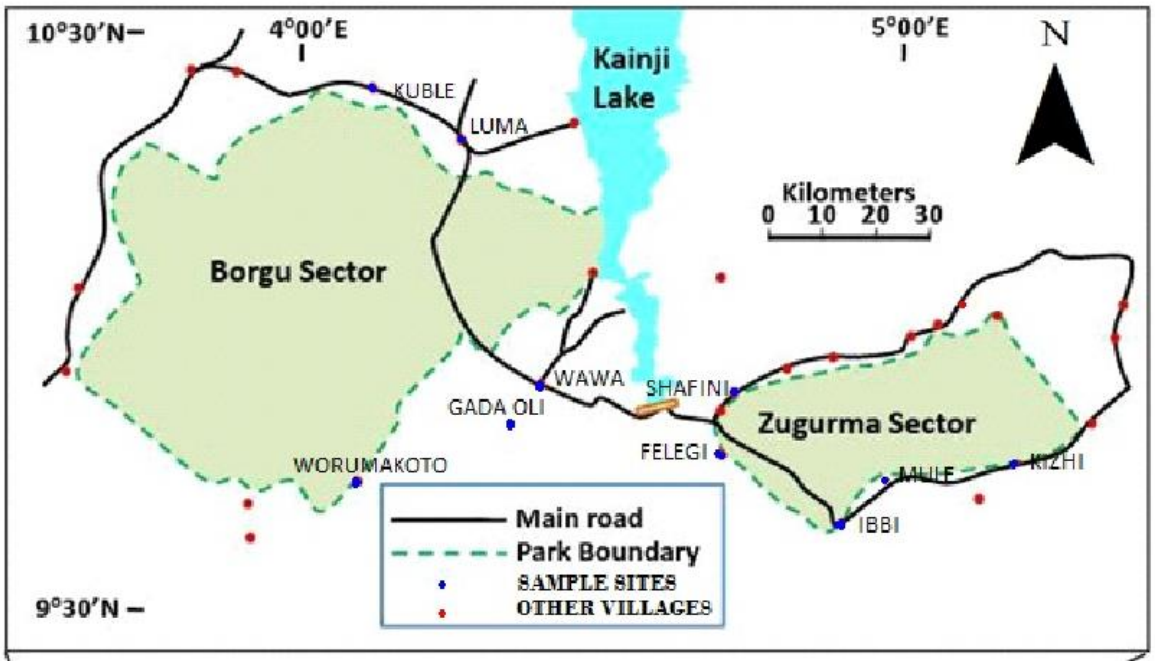

Figure 2: Map of Nigeria Pointing Kainji Lake National Park (Mmaduabuchi, Ogogo & Ogbara, 2012)

Sample Techniques

Sampling for quantitative data: This study focuses on Planning, Research and ICT units of the selected Parks (Old Oyo National Park and Kanji Lake National Park), Head of Ecology Resource Management units, Ecotourism units, Human resources unit, works and maintenance unit, Finance and Account units.

Method of Data Analysis

The collected data from the research subjects was coded and then analyzed by using Statistical Package of the Social Sciences (IBM SPSS 22). Descriptive statistics was used for the purpose of obtaining frequencies, percentages of demographic variables, means and standard deviations for the sample's responses on the questionnaire statements. The two data of both parks was compared using chi square.

RESULTS AND DISCUSSION

Table 1: Socio-Demographic Characteristics of the Respondents in the Study Areas

Options	Frequency	Percentage (%)	Mode
Gender			
Male	47	59	
Female	33	41	**Male (59%)**
Age			
20-29	19	24	
30-39	35	44	
40-49	10	13	**30-39 (44%)**
50-59	15	18	
60 above	1	1	
Marital status			
Married	60	75	
Single	14	18	**Married (75%)**
Divorcé/Separated	6	7	
Widow	-	-	
Educational Status			
No formal education	3	6	
Primary	6	12	
Secondary	833	16	**Tertiary (66%)**
Tertiary		66	
Religion			
Christianity	34	43	
Islam	35	44	
Traditional	11	13	
Total	**80**	**100**	

Source: Field Survey, 2022

The majority of the respondents (59%) were male. The greater proportions of the staff were in active age with (44%) within the age range of (30-39years) in wildlife conservation.

Table 2: Types of Information Communication Technology Used in the Study Areas

ICT Facilities/Skills	Yes		No		I don't know	
	Freq.	%	Freq.	%	Freq.	%
Computers	80	100	-	-	-	-
Local Area Network (LAN)	80	100	-	-	-	-
Internet Connectivity	80	100	-	-	-	-
Website	80	100	-	-	-	-
Database	80	100				
Electronic mail Service (Email)	39	49.0	41	51.0	-	-
QR codes for description podium	-	-	71	88.8	9	11.2
Analytical tools	-	-	80	100	-	-
Global Positioning System (GPS)	80	100	-	-	-	-
Drones	26	32.5	54	67.5	-	-
Closed-Circuit Television (CCTV)	12	15	61	76.0	7	9
Trap camera	80	100	-	-	-	-
Social media management	80	100	-	-	-	-
Desk Publishing	80	100				
Smart phones and Tablets	80	100	-	-	-	-
Online Collaboration	80	100	-	-	-	-

Source: Field Survey, 2022

Table 2 shows that Computers, Local Area Network (LAN), Internet Connectivity, Website, Database, Global positioning system (GPS), Trap camera, Social media management, Desk Publishing, Smart phones and Tablets and Online Collaboration are the major ICT facility used at the sampled parks.

Table 3: Frequent use of ICT Facilities at Different Unit of the Parks

ICT Facilities/Skills	Regularly	Occasionally	Not use	Mean	Std
Computers (Desktop, Laptop and Others)	80(100)	-	-	3.00	0.00
Local Area Network (LAN)	80(100)	-	-	3.00	0.00
Internet Connectivity	80(100)	-	-	3.00	0.00
Website	32(40)	48(60)	-	2.09	0.513
Database	80(100)	-	-	3.00	0.00
Electronic mail Service (Email)	--	80(100)	-	2.00	0.00
QR codes for description podium	--	--	80(100)	0.00	1.00
Analytical tools	--	--	80(100)	1.00	0.00
Global positioning system (GPS)	80(100)	-	-	3.00	0.00
Drones	17(21.2)	51(63.8)	12(15)	1.87	0.987
Closed-circuit Television (CCTV)	8(10)	72(90)	-	1.90	0.445
Trap camera	80(100)	-	-	3.00	0.00
Social Media Management					
Face book	16(20)	24(30)	40(50)	1.65	0.786
LinkedIn	--	--	80(100)	1.00	0.0
Pinterest	--	--	--	1.00	0.0
Instragram	--	--	80(100)	1.00	0.0
YouTube	--	80(100)	--	2.00	0.0
Twitter	--	80(100)	--	1.00	0.0
Reddit	--	--	80(100)	1.00	0.0
Social media group (WhatsApp)	12(15)	44(55)	24(30)	2.11	0.674
Desk Publishing					
MS Publisher	80(100)	-	-	3.00	0.00
MS Power Point	80(100)	-	-	3.00	0.00
MS Word	80(100)	-	-	3.00	0.00
Print Settings	80(100)	-	-	3.00	0.00
Adobe Creative Suite	2(2.5)	78(97.5)	--	1.36	0.612
Quark x Press	--	--	80(100)	1.00	0.0
Smart Phones and Tablets					
IPhone	--	--	80(100)	1.00	0.0
Android Devices	80(100)	-	-	3.00	0.00
Samsung Smartphone's or Tablets	--	--	80(100)	1.00	0.0

Blackberry devices	--	--	80(100)	1.00	0.0
IPad	--	80(100)	--	1.00	0.0
Camera Traps	80(100)	-	-	3.00	0.00
CAT S41	--	80(100)	--	1.00	0.0
Panasonic Tough Pad	--	--	80(100)	1.00	0.0
Online Collaboration					
Video Conferencing Software	--	--	80(100)	1.00	0.0
Skype	80(100)	-	-	3.00	0.00
Go to Meeting	--	--	80(100)	1.00	0.0
Slack	--	--	80(100)	1.00	0.0
Instant Messaging	10(13)	23(29)	47(58)	1.34	0.68
Google Docs	73(91)	5(6)	2(3)	2.92	032

Source: Field Survey, 2022

Results presented on Table 3 revealed that both Park uses ICT facilities skill at different levels. This indicates that ICT facilities and skill is important because biodiversity boosts ecosystem productivity where each species, no matter how small, all have an important role to play. The Table 3 also shows that computers, Local Area Network (LAN), internet connectivity, database, Global Positioning System (GPS) and Trap camera ($\bar{x}$=3.0) are the most frequently used ICT facility by both Park. While Go to meeting, slack, video conferencing software, Panasonic Tough pad, Samsung smartphone's or tablets, blackberry device and Reddit were the least used with mean value of ($\bar{x}$=1.0).

Table 4: Contributions of ICT to Biodiversity Conservation in the Study Areas

Relevance of the Information Communication Technology	HN	AN	SN	NN	REMARK
Use of computer in records keeping and official documentations	80 (100)	-	-	-	Highly needed
Carrying out field observations and data collection of the impacts of man or other ecological indicators on the ecosystem using technological devices	80(100)	-	-	-	Highly needed
Information management of organisms such as species, population, habitat etc. with the use of database.	80 (100)	-	-	-	Highly needed
Monitoring of the park resources with the use of CCTV and drones.	80 (100)	-	-	-	Highly needed
Using of Website of the Park to serve as a medium for enlightenment and awareness creation of their call mandate and activities	80 (100)	-	-	-	Highly needed
Use of computer as a measuring tools and remote sensor for information collection i.e. Identification of species by image, determination of temperature, humidity, weight using technology.	80 (100)	-	-	-	Highly needed
Use of GPS for marking of coordinates, determining positions in the park, moving from one location to another, monitoring object and creating maps.	80 (100)	-	-	-	Highly needed
Use of camera traps to provide data on species location, population sizes and how species interact in the park.	80 (100)	-	-	-	Highly needed
Use of social media platforms for official, personal or unit information dissemination, communication and interaction among staff of the park.	80 (100)	-	-	-	Highly needed
Use of Online collaboration such as Zoom, video conferencing software, Skype and others for meeting in the park and outside the park.	80 (100)	-	-	-	Highly needed
Use of Smartphone and tablets for education and research purposes.	80 (100)	-	-	-	Highly needed
Use of desk publishers' platform such as MS word and MS Power Point for research writing, reports presentation and other official usage.	80 (100)	-	-	-	Highly needed

Source: Field Survey, 2022
KEYS: HN: Highly needed,
AN: Averagely needed
SN: Slightly needed
NN: Not needed

Results presented on Table 4 out of the thirteen variables attached to relevance of ICT to conservation of biodiversity, the entire variables were highly needed ICT facilities and skill. ICT can be successfully used to organize and disseminate information regarding biodiversity, which can be used by governments and the private sector when planning and evaluating projects. This enables decision makers to obtain relevant information about endangered species, at risk areas, and other environmental concerns from a single, reputable source.

Table 5: Challenges Faced with the Used of ICT in Biodiversity Conservation in the Study Areas

Variable	Frequency	Percentage
Bad network	19	24
Poor funding	25	32
Poor space data center	9	11
Poor terrestrial data center	15	19
Technical know-how	1	1
Weather	10	13
Total	**80**	**100**

**multiple choice options

From the above Table 5, majority 25 (32%) of our respondents constituted those who perceived poor funding as major challenges encounter in the use of ICT. It is followed by bad network with 19(24%), poor terrestrial data centre had 15(19%) while poor space data centre and weather had 9(11%) and 10(13%) respectively. This typical revealed that poor funding is the major challenges faced with the use ICT in Biodiversity of the study area

Discussion of findings

The results presented in Table 1 characterized the respondents in the study areas with the highest respondents been male which correspond with (OnihunwaAkande, Irunokhai, Mohammed and Wealth, 2023) that reported more male respondents than the female counterparts. The t-Table 2 shows the list of ICT resources available at the two considered national parks which includes computers, LAN, GPS, internet services as major ICT facilities fully put to use in the park and this findings collaborates with (Nyirigira, 2022) which established a closed related ICT facilities which are also available and in use in volcanoes national in Rwanda. Also considering the Table 3 which shows the disposition and the extent of the usage of the listed ICT resources in the two considered parks, it further reveals that computers, LAN, internet connectivity, database, GPS and trap camera ($\bar{x}$=3.0) are the most frequently used ICT facility by both Parks. The findings also collaborates with (Nyirigira, 2022) which listed GPS/GIS, internet services and cellular phone as one of the major ICT resources frequently in use, just as (Koliouskaa and Andreopoulou, 2013) emphasized the use and adoption of websites in ten (10) national parks in Greece. Furthermore, (Read, Daniels and Harmon, 2021) fully implemented a technological based visitor counting in Korean war veterans memorial park which solidifies the contribution level of ICT resources into park management. Though (Nyirigira, 2022) listed Radio Frequency (RF) tracking devices as the topmost resource in use but the device was not considered or found in use in the two national parks under the study.

Table 4 vividly shows the contributions of ICT to Biodiversity Conservation in the study areas with deductions of the relevancy of the ICT resources in dissemination of vital information for prosper policy making, public education on the states of endanger species in the park, this collaborates the findings of (Gavilanes Montoya, Castillo Vizuete, and Marcu, 2023) which also highlighted ICTs role to educate the public about the importance of forests and the need for sustainable forest management. Likewise this findings agreed with (Nwaizuzu, Nnadi and Opara, 2023) which revealed that ICT helps to assess the ecosystem better than the traditional methods of monitoring the environment and gives opportunity to prepare ahead of emergencies and facilitates quick response to environmental disasters. Table 5 highlighted the challenges facing the use of ICT in biodiversity conservation in the two parks understudied. Several challenges were highlighted but the topmost challenge is based on the poor funding. The report agree with (Onihunwa *et al*.,2023) who also noted poor funding as a big challenge not just on ICT deployment in the Kainji Lake National Park but on other several aspects of the park.

CONCLUSION

The study revealed a majority male population of staff with 59%, with the dominant active age group between 30-39 of 44%. Most of the respondents are married (75%) with 66% with Tertiary education. The level of respondents' education reflected in their usage of ICT. ICT facilities and skills they were familiar with are computers, Local Area Network (LAN), Internet connectivity, website, Database, Global Positioning System (GPS), Trap Camera, Social Media Management, Desk Publishing, Smart phones, Tablets and Online Collaboration. ICT facilities were relevant and contribute significantly to biodiversity conservation. The greatest challenges to ICT usage are poor funding with 36% followed by poor space data center and the least is Technical Know-how with 7%. Further, study should be conducted in the remaining National Parks in the country to have a holistic and wider view of ICT usage in biodiversity conservation in Nigeria

RECOMMENDATION

The Parks authorities should invest more of their resources in ICT facilities, train more of their staff especially those in the Ecology and Resource Management, Planning, Research and ICT units on the up to dated knowledge, skills and relevant expertize in the handling of ICT facilities which is the most effective methods use by developed nations to curb wildlife crimes.

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