# FOREST MANAGEMENT STRATEGIES AND BIODIVERSITY CONSERVATION IN CALABAR EDUCATION ZONE OF CROSS RIVER STATE, NIGERIA.

## Mary Tom Ukpe
## Email; maryadaukpe@gmail.com
## Department of Environmental Education

## ABSTRACT

A cross-sectional survey was conducted to examine the contribution of forest regulation strategy and participatory forest management strategy to biodiversity conservation in the Calabar Education Zone of Cross River State, Nigeria. The study was guided by Skinnerian environmental reinforcement theory. A multistage sampling technique and a sample size of 1,230 household was adopted in the study. A structured questionnaire (FMSBCQ) was used to facilitate data collection. The instrument was analyzed with the use of descriptive statistics, and the hypotheses were tested with the use of Simple Linear Regression analysis with the help of SPSS version 27. Findings revealed that forest regulation strategy contributes significantly to biodiversity conservation (T-value = 28.229, P<0.05). Participatory forest management strategy contributed significantly to biodiversity conservation (T-value = 27.626, p< .05). It is recommended that adequate forest regulatory measures should be put in place and adequately enforced by forest agencies. This will help to promote sustainable forest behaviour in the communities, and thus enhance biodiversity conservation in the communities. Forest management agencies should ensure adequate involvement of community members in formulating and enforcing forest conservation policies in forest communities in the Zone, as this motivates community members to maintain the policies, which will lead to sustainable forest practices in the communities.

*Keywords*: Forest regulation strategy and Participatory forest management strategy

## Introduction

The disappearance of natural ecosystems has been a topical issue that is increasingly gaining prominence due to the quest for a healthy environment that can promote the physical, economic, social, emotional, and psychological well-being of people worldwide. This is because people's quality of life in any society bears direct relevance to the quality of the natural environment. Biodiversity conservation is a concept that denotes the preservation of animal and plant species and their natural environment. It is the continuous availability of living organisms within a single ecosystem or habitat, including numbers and diversity of species and all environmental aspects such as temperature, oxygen, carbon dioxide levels, and climate. It is the protection, upliftment, and management of biological diversity to ensure sustainable benefits for present and future generations (Anwadike, 2020).

Biodiversity conservation promotes nature's resilience to change as it enhances ecosystems' abilities to function effectively and efficiently and thus undermines nature's ability to support a healthy environment (Roe et al., 2019). This situation is also common in Cross River State. For instance, Ajake et al. (2012) noted that the rate of annual loss of forest cover in twelve sampled villages in Ikom, Akamkpa and Oban charge was alarming and that over 20 percent of the tropical high forest and their species was lost between 1972 and 1992 and over 76,000 hectares representing 19 percent of the forest is lost to agriculture and plantation development in recent times. This situation is not different in forest communities within the Calabar Education Zone of Cross River State, where this study is conducted. The researcher notes a high rate of indiscriminate bush burning and uncontrolled and continuous timber logging, which results in large-scale deforestation in almost all communities in the Zone (Baskent et al., 2020).

Today, the strategies for implementing forest management involve the forest regulation strategy and the participatory forest management strategy. The forest regulation involves a process where strict policies are put in place by the government or forest agencies to control forest practices in forest communities. Enforcement of forest laws can help in controlling unsustainable forest practices in forest communities (Poudel et al., 2025). Participatory forest management strategy involves a practice where community members are involved in managing forests in communities (Kotru, 2015). Hence, despite these measures, the level of biodiversity loss is still alarming in the State, including communities in the Southern Senatorial District of the State. This is shown in the level at which forest cover and patches are fast disappearing, the extent to which animal and plant species are becoming scarce in the State, and the extent to which aquatic species are gradually going extinct in the Zone. Given this situation, it becomes

necessary to study the relationship between forest management strategies and biodiversity conservation in the Calabar Education Zone of Cross River State.

## 1.2 Statement of the problem

The loss of biodiversity poses serious threats to environmental sustainability, socio-economic development, and the well-being of forest-dependent communities. Biodiversity conservation is essential for sustaining livelihoods, supporting food supply chains, promoting ecotourism, and mitigating environmental challenges such as erosion, climate change, and vegetation degradation. Despite its importance, biodiversity loss remains a global concern, with Nigeria experiencing significant declines in forest and wildlife resources. In Cross River State, particularly within the Calabar Education Zone, extensive deforestation, illegal hunting, uncontrolled bush burning, and unsustainable fishing practices have resulted in the depletion of forest cover and wildlife species. Even protected areas such as the Oban Forest Reserve, Afi Mountain Wildlife Sanctuary, Mbe Mountain, and Cross River National Park continue to experience illegal resource exploitation. Given that forest management strategies play a critical role in either promoting conservation or accelerating biodiversity decline, it becomes imperative to examine their effectiveness. Therefore, this study seeks to investigate the relationship between forest management strategies and biodiversity conservation in the Calabar Education Zone of Cross River State.

## Purpose of the study

The purpose of this study was to examine the relationship between forest management strategies and biodiversity conservation in the Calabar Education Zone of Cross River State, Nigeria. Specifically, the study sought to find whether:

1. Forest regulation strategy contributes to biodiversity conservation in Calabar Education Zone of Cross River State.

2. Participatory forest management strategy contributes to biodiversity conservation in Calabar Education Zone of Cross R

## Literature review

## Concept of forest management strategies

Forest management is a holistic and strategic approach to the planning and execution of activities within forest ecosystems, aimed at achieving a variety of specific goals that encompass ecological, economic, and social dimensions (Baskent, 2024; Baskent et al., 2020). It integrates a diverse array of practices designed to ensure the long-term health, resilience, productivity, and sustainability of forested areas, all while taking into account the complex

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*University of Calabar, Nigeria.*

needs of human populations and the broader societal benefits that healthy forests can provide (Fatima et al., 2024).

Forest management strategies are conceptualized as approaches adopted to ensure the sustainability of forest resources in forest communities. This is line with the views of Eludoyin and Iyanda (2018) who submitted that ensuring rational exploitation of our forest resources to satisfy local consumption, regulation of forestry activities to ensure conservation and environmentally sound management practices, creating awareness on the need for forest conservation in local communities, providing alternative livelihood projects for forest communities, strengthening of forest protection activities in marginal areas to prevent harmful changes in such areas, and encouraging afforestation and reforestation programmes to reverse the effects of deforestation, are available strategies for forest conservation and sustainability in Nigeria.

## Concept of biodiversity conservation

Biodiversity is a comprehensive umbrella term for the extent of nature's variety or variation within the natural system, both in number and frequency (Rawat & Agarwal, 2015). It is often understood in terms of the wide variety of plants, animals, microorganisms, the genes they contain, and the ecosystem they form. The concept refers to biological diversity and is used to describe the variety of life on earth, including the number, variety, and variability of living organisms like animals, plants, fungi, microbes, the genetic differences among them, and the ecosystems in which they occur (Adom et al., 2019). Yucel (2015) divides biodiversity into three main components, namely genetic diversity, species diversity, and ecosystem diversity. Zhang et al. (2024) stated that species diversity is also called species richness and denotes different kinds of species within a particular Region such as in a small river, where there can be plants, frogs, fish, snakes, and so forth, constituting diversity in species. Genetic diversity refers to the different types of genes in chromosomes of species and their variations (Scalabrin et al., 2024).

Biodiversity conservation is measured in terms of ecosystem biodiversity. Biodiversity is conceptualized as the preservation and protection of animal and plant species and their natural environment. Convention on Biological Diversity (CBD) (2017) states biodiversity conservation is the preservation of ecosystem diversity, which includes all the different habitats - or places - that exist, like tropical or temperate forests, hot and cold deserts, wetlands, rivers, mountains, coral reefs, etc. It stressed that each ecosystem corresponds to a series of complex relationships between biotic (living) components, such as plants and animals, and abiotic (non-living) components, which include sunlight, air, water, minerals, and nutrients.

**Theoretical background**

Skinnerian environmental reinforcement theory by Skinner (1948)

Burrhus Federick Skinner, an American Psychologist, based his argument on the idea that behaviour is a consequence of environmental factors. The author postulated that experience and learning are basic and very essential to understanding of human behavior, and that human behavior is something that is acquired through the process of interaction with the environment, rather than inherited. According to the theory, behavioral development is controlled by and is a function of the physical and psycho-social environment. Skinner believed that responses from the environment may either increase or decrease the probability of a behaviour being repeated based on whether the responses were negative or positive.

Skinner's environmental theory is based on the following implied assumptions. One, the best way to modify behaviour is to modify the environment. Two, reinforcement increases the propensity of a behaviour being repeated, while punishment weakens it. Three, environment shapes behaviour, and learning is manifested by a change in behaviour. Four, nthe ew learning occurs as a result of positive reinforcement, and undesirable behaviour is discarded through negative reinforcement.

The relevance of Skinner's environmental theory to this study is that biodiversity conservation is a resultant effect of the perception of human beings about their environment and their behaviour within the environment, which shapes the kind of activities they carry out in the environment and their reaction to environmental problems arising from those activities. The theory implies that people would not engage in destructive activities within the environment when the consequences of such behaviour are negatively reinforced. The application of this theory to biodiversity conservation is that when harmful activities that degrade the environment and cause hazards attract no punishments for culprits, there is a high propensity for such activities to be repeated and emulated by others around the environment, which will lead to biodiversity loss.

**Empirical review**

**Forest regulation strategy and biodiversity conservation**

Forest regulation involves a process where strict policies are put in place by the government or forest agencies to control forest practices in forest communities. McGinley et al. (2012) stated that governmental regulation of forest use is often instituted to protect the long-term external values that are not provided well by markets and may be required to prevent resource exhaustion or to prevent externalities and market failures from leading to damage to other resources. The researcher stresses further that though governmental forest regulation can

vary within and across countries, in the most general sense, it sets the minimum standard for forestry practices and/or defines permissible and prohibited forest practices. Saka-rasaq (2019) argued that the loss of forest coverage is characterized by illegal logging of forest wood and bad government policies, and that this requires adequate attention. The researcher reiterated that people do not regard natural forests as an adequate use of land, and that it is this feeling of waste, as well as economic necessity, that induces them to enter forest reserves for farming and other illegal activities. This implies that forest regulation strategy can be feasible in ensuring sustainable forest practices in forest communities.

Saka-rasaq (2019) examined forest loss in Nigeria and the impact on climate and people from the perspectives of illegal forest activities and government negligence. The researcher noted that forestry has attracted much attention in recent times, so it is considered vital to human life as it provides a wide range of resources and ecosystem services. According to this researcher, forests are important as a storage of carbon, for the production of oxygen vital for human existence on earth, and also help in the regulation of the hydrological cycle, purify water, provide wildlife habitats, and help in reducing global warming, as well as absorbing toxic gases, contain pollution, and, above all, conserve soil. The study aimed at analyzing the cause of forest decline in Nigeria, as well as the effects on climate, and to offer useful solutions to conserve and achieve sustainable forest management. The study focused mainly on the factors affecting forestry in Nigeria. These factors include illegal forest activities, deforestation, and government negligence. A qualitative method was employed where data and facts were assessed from secondary sources of information. From the results of the study, the researcher submitted that the preventive measures to curb forest illegalities must be implemented. Stakeholders' involvement in forest management should be encouraged. The researcher also recommended that for the local people to feel a sense of entitlement, they need to be educated on the ecological importance of forests and tree coverage. This finding is very clear. The researcher has established that forest regulation is a good measure to ensure the conservation of forest resources in communities.

In another study, McDermott et al. (2010) examined the content of forestry regulations in developed and developing countries, specifically determining if and how riparian zones, clearcuts, road construction, reforestation, and annual allowable cuts were addressed. The researcher found a wide range of variation in forestry regulations across and within the 20 countries examined. In particular, forest regulations in developing countries were significantly more "stringent" than those from developed countries (e.g., riparian buffer zone requirements, clear-cut size limits). Though policy implementation and enforcement were not systematically

examined, the researchers noted that the developing country case studies frequently exhibited perverse land-use policies, inadequately funded government institutions, and a severe lack of enforcement capacity. The researchers have established that forest regulation has implications for how forest activities are carried out across countries in the world. This implies that forest regulation as a strategy for sustainable forest practices in forest communities can enhance the way people conserve forest resources in society.

**Participatory forest management strategy and biodiversity conservation**

Participatory forest management strategy involves a practice where community members are involved in managing forests in communities. Kotru (2015) argued that, in combination with local institutional arrangements, technical considerations are indispensable for the success of livelihood-promoting, and that community mobilization and sustainable forest management cannot happen on their own if the capacity-building and empowerment of the communities in terms of local institutional strengthening and management of forest assets is not well conceived, effected, and technically backed up. Senganimalunje et al. (2015) added that the participatory forest management strategy has the potential to promote good governance, enhance sustainable forest management and livelihoods, and that there is a need to reconcile livelihood improvement and conservation through local enforcement and collective action to regulate the management and use of forests and forest products. Macharia (2015) stressed that local community participation is the key strategy to current forestry conservation and management, and that if wildlife and all the protected areas are to survive, conservation activities and communities must be in harmony so that it does not constrain community livelihoods.

Omari et al. (2019) conducted a study on the influence of community participatory mobilization on the attitude of farmers towards deforestation in the Cross River rainforest zone, Nigeria. The main purpose of this study was to examine community participation and the attitude of farmers towards deforestation in the rainforest zone of southern Cross River State, Nigeria. One hypothesis was formulated to guide the study. An ex-post facto research design was considered most suitable for the study. A sample of 568 respondents was randomly selected for the study through stratified and simple random sampling techniques. A structured questionnaire was the instrument used for data collection. The instrument was face validated by three experts in Test and Measurement and the research supervisor who vetted the items developed. The reliability estimate of the instrument was established through the Cronbach's alpha reliability method. A simple linear regression statistical tool was used for data analysis. The results of the analysis revealed that there was a significant influence of community

participatory mobilization on the attitude of farmers towards deforestation in the rainforest zone in the study area. Based on these finding it was recommended among others that environmental educators and advocates should ensure community participation to empower them to develop a more positive attitude towards the eradication of negative environmental practices and actions. This implies that there is a link between the application of a participatory forest management strategy and the sustainability of forest resources.

Kinyili (2014) examined the impacts of the participatory forest management approach in OlBolossat forest, Nyandarua County, Kenya. The main objective of this study was to assess the impacts of community participation on forest management and its effects on community livelihoods. Specifically, the study aimed at assessing the effectiveness of local structures and community participation in participatory forest management. Also, the study aimed at identifying forest-based enterprises in the study area and challenges and opportunities that stand out during participatory forest management. Both qualitative and quantitative methods were used in data collection, analysis, and presentation. Household questionnaires, semi-structured interviews with key informants, and Focus Group Discussions (FGD) were used in data collection. Data analysis was done with the Statistical Package for Social Sciences (SPSS). The findings showed that participatory forest management in OlBolossat forest had significant impacts on the livelihoods of adjacent communities. From the findings, it was found that there was a strong positive relationship between participatory forest management and community participation, community local structures, PFM enterprises, coordination of PFM activities, and forest management and conservation policies. This observation implied that there was significant integration of community participation in forest management and conservation. The Nature Based Enterprises (NBE) that the community was involved in included tree nursery seedlings production, bee-keeping, eco-tourism, and fish farming, among others. This study suggests that the involvement of community people in forest management would improve sustainable forest activities in the communities.

**Methodology**

A Correlational research design on forest management strategies and biodiversity conservation in Calabar education zone of Cross River State. This covered Akamkpa, Akpabuyo, Bakassi, Biase, Calabar Municipality, Calabar South, and Odukpani. With a population of 2,287,101, a multisatege sampling technique was adopted with a sample size of 1,230 household. A descriptive research design was used to explore the data. A Forest Management Strategies and Biodiversity Conservation Questionnaire (FMSBCQ) was adopted to elicit relevant information for the study. With the administered questionnaire, 1,200 copies were retrieved

with a response rate of 97 percent. The data collected were analyzed using descriptive statistics, while Simple Linear Regression analysis was used to test the hypotheses. The validity of the research instrument on forest management strategies and biodiversity conservation was obtained through the use of content and face validity, while the Cronbach Alpha Coefficient was used to ascertain the reliability. For instance, the instrument was found reliable and fit for the collection of data, as shown below:

Table 1

Cronbach's Alpha reliability coefficients for all sub-scales in the study instrument.

| S/N | Variables | No. of Items | X | SD | $\alpha$ |
|-----|-----------|--------------|-----|-----|-----|
| 1 | Forest regulation strategy | 6 | 13.42 | 2.01 | .79 |
| 2 | Participatory forest management strategy | 6 | 12.67 | 2.33 | .84 |

Source: Author's analysis 2026

**Result and discussion**

**Descriptive Statistics of Variables of the Study**

The descriptive statistics (mean and standard deviation) were generated automatically using Statistical Package for the Social Sciences (SPSS) version 27. The formulas for the sample mean and sample standard deviation are given as: Sample Mean ($\bar{x}$): $\bar{x} = \Sigma x / n$, where $\Sigma x$ is the sum of all values and n is the total number of values in the sample, and Sample Standard Deviation (s): $s = \sqrt{s^2}$, where $s^2$ is the sample variance.

The result in Table 2 below shows that the forest regulation strategy in forest communities in Calabar Education Zone of Cross River State had a mean rating and a standard deviation of $\bar{x}$ = 19.55± SD = 3.458, participatory forest management strategy had a mean rating and standard deviations, such as $\bar{x}$ = 18.55± SD = 3.638.

TABLE 2

Summary of mean and standard deviation of the research variables

| S/N | Variables | N | Mean ($\overline{X}$) | Std. Dev. |
|-----|-----------|-----|------|------|
| 1 | Forest regulation strategy | 1200 | 19.55 | 3.458 |
| 2 | Participatory forest management strategy | 1200 | 18.15 | 3.638 |

**Source:** Researcher field work 2026

**Test of hypotheses**

Hypothesis one

Forest regulation strategy does not significantly predict biodiversity conservation in Calabar Education Zone of Cross River State. The two variables in this hypothesis were forest regulation strategy and biodiversity conservation in Calabar Education Zone of Cross River State. Both the forest regulation strategy and biodiversity conservation in Calabar Education Zone of Cross River State were measured continuously in this study. To test this hypothesis, Simple Linear Regression analysis was used. The result of the analysis is presented in Table 3. Table 3 presents the summary of the Simple Linear Regression analysis of the relationship between forest regulation strategy and biodiversity conservation in Calabar Education Zone of Cross River State. The result in Table 3 shows that the analysis of variance in the regression output produced an F-ratio of 796.877 (p< .05), which is statistically significant at the .05 probability level with a critical F-ratio of 3.85 and 1:1198 degrees of freedom which means that the forest regulation strategy contributed significantly to the observed variance in biodiversity conservation in Calabar Education Zone of Cross River State.

The result in Table 3 also shows a regression coefficient (R) of .632 and a coefficient of determination ($R^2$) of .399. This implies that forest regulation strategy relates significantly to biodiversity conservation in Calabar Education Zone of Cross River State and that 39.9 % of the variation in biodiversity conservation in Calabar Education Zone of Cross River State is accounted for by the variation in forest regulation strategy in forest communities across Calabar Education Zone of the State. Thus, 60.1 % of the variance in biodiversity conservation in Calabar Education Zone of Cross River State is attributed to the effect of other variables considered in this study.

Similarly, the result of the regression weights of the predictor variable (forest regulation strategy) in Table 3 shows a positive unstandardized Beta of 1.217. This means that forest regulation strategy has a positive relationship with biodiversity conservation in Calabar Education Zone of Cross River State, and that a unit improvement in the application of forest regulation as a forest management strategy in forest communities in Calabar Education Zone of Cross River State would lead to more than one unit improvement in biodiversity conservation in the Zone. Accordingly, the result in Table 3 shows a t-value of 28.229 (p< .05). This implies that the forest regulation strategy contributed significantly to the variation in biodiversity conservation in Calabar Education Zone of Cross River State. With this result, therefore, hypothesis one is rejected. This means that the forest regulation strategy significantly predicts biodiversity conservation in the Calabar Education Zone of Cross River State.

TABLE 3

Summary of simple regression analysis for the relationship between forest regulation strategy and biodiversity conservation in Calabar Education Zone of Cross River State

| Source of variation | SS | df | MS | F-ratio | Sig. | β | SE | T | P |
|---|---|---|---|---|---|---|---|---|---|
| Regression | 21223.108 | 1 | 21223.108 | 796.877 | .000 | 1.217 | .043 | 28.229 | .000 |
| Residual | 31906.142 | 1198 | 26.633 | | | | | | |
| Total | 53129.250 | 1199 | | | | | | | |

$R = .632^a$
$R^2 = .399$
Adjusted $R^2 = .399$
Std. Error = 5.161
a. Criterion:  Biodiversity conservation in Calabar Education Zone of Cross River State
b. Predictors: (Constant), forest regulation strategy
Source: Researchers' Fieldwork, 2026

**Hypothesis two**

Participatory forest management strategy does not significantly contribute to biodiversity conservation in Calabar Education Zone of Cross River State. The two variables in this hypothesis were the participatory forest management strategy and biodiversity conservation in Calabar Education Zone of Cross River State. Both the participatory forest management strategy and biodiversity conservation in Calabar Education Zone of Cross River State were measured continuously in this study. To test this hypothesis, Simple Linear Regression analysis was used. The result of the analysis is presented in Table 4. Table 4 presents the summary of the Simple Linear Regression analysis of the relationship between participatory forest management strategy and biodiversity conservation in Calabar Education Zone of Cross River State. The result in Table 4 shows that the analysis of variance in the regression output produced an F-ratio of 763.175 (p< .05), which is statistically significant at the .05 probability level with a critical F-ratio of 3.85 and 1:1198 degrees of freedom. Which means that the participatory forest management strategy contributed significantly to the observed variance in biodiversity conservation in Calabar Education Zone of Cross River State. The result in Table 4 also shows a regression coefficient (R) of .624 and a coefficient of determination (R2) of .389. This implies that the participatory forest management strategy relates significantly to biodiversity conservation in Calabar Education Zone of Cross River

State and that 38.9 % of the variation in biodiversity conservation in Calabar Education Zone of Cross River State is accounted for by the variation in participatory forest management strategy in forest communities across Calabar Education Zone of the State. Thus, 61.1 % of the variance in biodiversity conservation in Calabar Education Zone of Cross River State is attributed to the effect of other variables considered in this study.

Similarly, the result of the regression weights of the predictor variable (participatory forest management strategy) in Table 4 shows a positive unstandardized Beta of 1.141. This means the participatory forest management strategy has a positive relationship with biodiversity conservation in Calabar Education Zone of Cross River State, and that a unit improvement in the application of participatory forest management as a forest management strategy in forest communities in Calabar Education Zone of Cross River State would lead to more than one unit improvement in biodiversity conservation in the Zone. Accordingly, the result in Table 4 shows a t-value of 27.626 ($p< .05$). This implies that the participatory forest management strategy contributed significantly to the variation in biodiversity conservation in Calabar Education Zone of Cross River State. With this result, therefore, hypothesis two is rejected. This means that the participatory forest management strategy significantly predicts biodiversity conservation in the Calabar Education Zone of Cross River State.

TABLE 4

Summary of simple regression analysis for the relationship between participatory forest management strategy and biodiversity conservation in Calabar Education Zone of Cross River State

| Source of variation | SS | df | MS | F-ratio | Sig. | B | SE | T | P |
|---|---|---|---|---|---|---|---|---|---|
| Regression | 20674.815 | 1 | 20674.815 | 763.175 | .000 | 1.141 | .041 | 27.626 | .001 |
| Residual | 32454.435 | 1198 | 27.091 | | | | | | |
| Total | 53129.250 | 1199 | | | | | | | |

R =.624[a]
$R^2$ =.389
Adjusted $R^2$ =.389
Std. Error = 5.205
a. Criterion:  Biodiversity conservation in Calabar Education Zone of Cross River State
b. Predictors: (Constant), participatory forest management strategy
Source: Researchers' Fieldwork, 2026

## 4.3    Discussion of findings

**Forest regulation strategy and biodiversity conservation**

The analysis of the first hypothesis, which stated that forest regulation strategy does not significantly predict biodiversity conservation, revealed that forest regulation strategy contributes significantly to biodiversity conservation. This implies that the extent to which forest regulation practices are used as strategies to manage forests in Calabar Education Zone of Cross River State determines the extent to which forest resources are sustained in Calabar Education Zone of Cross River State. This result suggests that the level of biodiversity conservation in Calabar Education Zone of Cross River State is directly related to the extent to which forest exploitation activities are being regulated in forest communities in the Zone.

This result agrees with Cubbage et al. (2007) who stated that governmental regulation of forest use is often instituted to protect the long-term external values that are not provided well by markets and may be required to prevent resource exhaustion or to prevent externalities and market failures from leading to damage to other resources, and thus sets the minimum standard for forestry practices and/or defines permissible and prohibited forest practices. In line with this result, Saka-rasaq (2019) argued that the loss of forest coverage is characterized by illegal logging of forests wood and bad government policies, and that because people do not regard natural forest as an adequate use of land, this feeling of waste, as well as economic necessity, that induces them to enter forest reserves for farm and other illegal activities.

Saka-rasaq (2019) further affirmed this result when noting that in Nigeria, inadequate regulations and sometimes uncontrollable exploitation or illegal logging pose a great danger to the forest industry and the forest resource base. This result also supports the opinion of Udeagha et al. (2016), who stressed that forest policy and administration reflect an ideal approach to fulfill the objectives of furthering rural development, arresting forest degradation, and ensuring sustainable forest development. These opinions and theoretical expressions affirm the positive correlation (R= .632) between forest regulation strategy and biodiversity conservation in Calabar Education Zone of Cross River State, realized in the Regression Model of this analysis.

The result of this analysis further revealed that forest regulation strategy significantly contributed to the variance in biodiversity conservation across communities in Calabar Education Zone of Cross River State, with a t-value of 28.229 (p< .05). The result also revealed an unstandardized Beta (B) of 1.217. This implies that there is a significant high direct relationship existing between forest regulation strategy and biodiversity conservation in Calabar Education Zone of Cross River State, and that the more forest regulation system is applied as forest management strategy to control the forest behaviour of people in the communities, the more community people will desist from carrying out exploitative practices in forest, and the more forest resources are sustained in the communities. This result is

supported by the findings of McDermott et al. (2010), who established that forest regulation has implications on how forest activities are carried out across countries in the world, and upheld that forest regulation as a strategy for sustainable forest practices in forest communities could enhance the way people conserve forest resources in society.

**Participatory forest management strategy and biodiversity conservation**

The analysis of the second hypothesis, which stated that the participatory forest management strategy does not significantly predict biodiversity conservation, revealed that the participatory forest management strategy contributed significantly to biodiversity conservation in Calabar Education Zone of Cross River State. This implies that the extent to which participatory forest management practices are used as strategies to manage forests in Calabar Education Zone of Cross River State determines the extent to which forest resources are sustained in Calabar Education Zone of Cross River State. This result suggests that the level of biodiversity conservation in Calabar Education Zone of Cross River State has a direct congruence with the extent to which members of the communities are involved in the forest management effort in the Zone.

The direction of this positive result is that people will naturally protect policies that they participated in formulating. For instance, when forest agencies partner with community chiefs and leaders to formulate forest policies in communities, the community leaders and chiefs tend to support the enforcement of environmental and forest laws in the communities. This result agrees with Kotru (2015) who argued that in combination with local institutional arrangements, technical considerations are indispensable for the success of livelihood-promoting, and that community mobilization and sustainable forest management cannot happen on their own if the capacity-building and empowerment of the communities in terms of local institutional strengthening and management of forest assets is not well conceived, effected and technically backed up. In line with this result, Senganimalunje et al. (2015) added that the participatory forest management strategy has the potential to promote good governance, enhance sustainable forest management and livelihoods, and that there is a need to reconcile livelihood improvement and conservation through local enforcement and collective action to regulate the management and use of forests and forest products. This result supports the opinion of Macharia (2015), who maintained that local community participation is the key strategy to current forestry conservation and management, and that if wildlife and all the protected areas are to survive, conservation activities and communities must be in harmony so that it does not constrain community livelihoods.   These opinions and theoretical expressions are not surprising given the positive correlation (R= .624) between participatory forest management

strategy and biodiversity conservation in Calabar Education Zone of Cross River State, realized in the Regression Model of this analysis.

The result of this analysis further revealed that the participatory forest management strategy significantly contributed to the variance in biodiversity conservation across communities in Calabar Education Zone of Cross River State, with a t-value of 27.626 (p< .05). The result also revealed an unstandardized Beta (B) of 1.141. This implies that there is a significant high direct relationship existing between participatory forest management strategy and biodiversity conservation in Calabar Education Zone of Cross River State, and that the more participatory forest management approach is applied as forest management strategy to control the forest behaviour of people in the communities, the more community people will desist from carrying out exploitative practices in forest, and the more forest resources are sustained in the communities. This result supports the empirical findings of Omari et al. (2019), who found that community participatory mobilization significantly influenced farmers' attitudes towards deforestation in the rainforest zone of the study area.

## Conclusion and recommendations

Based on the results of the study, it is concluded that the forest regulation strategy, participatory forest management strategy, forest protection strategy, community education strategy, and alternative livelihood strategy can determine the extent of biodiversity conservation in the Calabar Education Zone of Cross River State. It is also concluded that in order to maintain effective conservation of ecosystem diversity in Calabar Education Zone of Cross River State, pragmatic measures must be put in place to enhance the level of forest management in communities within the Zone. Based on the result of this study, the following recommendations are made;

1. Adequate forest regulatory measures should be put in place and adequately enforced by forest agencies. This will help to promote sustainable forest behaviour in the communities, and thus enhance biodiversity conservation in the communities.

2. Forest management agencies should ensure adequate involvement of community members in formulating and enforcing forest conservation policies in forest communities in the Zone, as this will motivate community members to maintain the policies, which will lead to sustainable forest practices in the communities.

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